

Balance of Payment Constrained Growth: Johansen versus Autoregressive Distributed Lag Model (ARDL) Test for Co-integration

**Rexford Abaidoo
Jackson State University**

This study empirically examines the long-run relationship between growth in GDP and growth in export in an attempt to verify the balance of payment constrained growth model or the Thirlwall's law in the case of an emerging economy in Sub-Sahara Africa; Ghana¹. This study for the first time employs both the Johansen test for co-integration as well as the Autoregressive distributed lag model (ARDL) (the Bounds test), in its attempt at verifying this long run relationship. Existing studies show that these two statistical methods provide an ideal platform in testing for the presence of Thirlwall's law, and have been used independently. However, whether the two methods could arrive at similar conclusion in a single test is yet to be explored. This study explores this likelihood in addition to verifying the presence of Thirlwall's law in the sub-region. Data used in this study span the period 1965 to 2004. Result from the Johansen's approach to co-integration shows that Ghana's GDP growth and growth in exports are cointegrated; which supports Thirlwall's law or a balance of payment constrained growth economy. The outcome in the case of the autoregressive distributed lag model test for co-integration was however inconclusive.

INTRODUCTION

Early economic literature focusing on the myriad of factors responsible for growth in gross domestic product (GDP) among economies, and the critical factors which tend to constrain this growth drew heavily from the Solow (1956) growth model which highlights the critical role of exogenous growth factor –technology. Recent studies however, have witnessed developments and adaptation of varied frameworks and models all geared towards explaining the various mechanisms influencing growth dynamics (growth in GDP) characterizing both developed and developing economies. This evolving trend according to existing research thrives on the increasing perception that an economy's growth constitutes a pivotal macroeconomic element around which other integral macroeconomic conditions of interest such unemployment etc, revolves. This pivotal role played by growth dynamics of an economy continues to attract growing research interest in the ever-expanding macroeconomic literature. Some of these studies seeking to account for the ongoing variability in growth among economies in recent years have tended to draw from the predictions of the Balance of Payment Constrained Growth Model; originally propounded by Thirlwall (1979) and modified subsequently in Thirlwall and Hussain (1982).

The Balance of Payment Constrained Growth (BPCG) framework suggests that, the rate of growth characterizing most economies (growth in GDP or national income) is often constrained by the structure of their balance of payments mix. The framework argues that the constraining condition occurs because all things being equal, economic growth cannot be higher than a country's consistent balance of payment

equilibrium at any point in time. The BPCG framework or model (to be derived shortly) which has come to be known as the Thirlwall's law formally states that, the growth of an economy (relative to that of the rest of the world) is a function of the ratio of that economy's income elasticity of demand for export to that of its imports. In other words, the extent of an economy's growth potential at any point in time depends on the ratio of its income elasticity of demand for exports to that of its imports. Recent related empirical work on this stated relationship have further shown that the fortunes of a country's national income or growth in GDP tend to be predominantly dependent on its exports growth because of relative stability of income elasticity of demand for imports in the long run. In other words, in the long run (with income elasticity of demand for imports held constant) an economy's GDP growth becomes mainly dependent on its relative export performance or growth in exports. Consequently, a test for the presence of balance of payment constrained growth in our analysis is based on a test for long run relationship between an economy's GDP growth and growth in exports.

The objective of this study is to test empirically for the presence of Thirlwall's law (The Balance of Payment Constrained Growth) in Ghana's economic (GDP) growth trajectory over a forty year period (1965-2004). This timeframe captures periods of various macroeconomic recovery programs initiated after the country's independence as well as recent years of appreciable economic growth. This study utilizes two empirical models; the Johansen co-integration test and the Autoregressive distributed lag (ARDL) model test for co-integration. The concurrent utilization of these two tests procedures is meant to verify if the two procedures (which are often used independently in existing studies) will arrive at similar conclusions. The ultimate goal however, is to establish or otherwise, a condition of long-run relationship between Ghana's GDP growth and growth in exports. The two frameworks are also being used because existing literature suggest that they are robust in testing for condition of long-run relationship between any critical variables of interest such as those used in this study. Our test for the presence of Thirlwall's law as encapsulated in the Balance of Payment Constrained Growth Model (BPCGM) would thus revolve around these two empirical procedures after other critical initial test requirements are met. The rest of this study is organized as follows: the second section is devoted to given a succinct account of GDP growth dynamics in the Ghanaian economy (driven by implementation of various economic programs) over the past forty years since independence. The third section reviews relevant empirical literature on how to test for the presence of Thirlwall's law and its validity in both developed and under-developed economies around the world. Empirical framework in section four systematically derives the Thirlwall's law or balance of payment constrained growth model coupled with explanation of its projections. Section five conducts the various empirical estimations crucial in testing for the presence of Thirlwall's law utilizing relevant data on the Ghanaian economy. This section as indicated earlier conducts two different tests aimed at verifying the presence of Thirlwall's law with respect to trends in GDP growth in the Ghanaian economy. The final section outlines empirical results and interpretations as well as potential policy implications for decision making in the Ghanaian economy and other economies in the sub-region.

Ghana's GDP Growth Trend

Available GDP growth data since the 1960s shows that growth dynamics characterizing the economy to some degree correlates with the type of political system (military or democratically elected governments) prevailing at a particular point time. The data shows that the period between 1960 and 1970 which has often been termed the Era of Manufacturing Growth, ironically witnessed a downward fluctuation in GDP growth. This study's enquiry suggests that the quest to hurriedly transform the agrarian economy into a competitive exporter of finished and semi-finished goods without the necessary structures and the technological know-how were responsible. According to Ewusi (1987), economic growth deteriorated significantly over this period; and the adverse effect of the policy continued until the implementation of the Structural Adjustment Program in 1983. The second face in Ghana's GDP growth trajectory towards economic prosperity was ushered in by the implementation of the Structural Adjustment Program. The Structural Adjustment program was developed by the World Bank in collaboration with the IMF. The program involved the implementation of specific economic policies which in theory, was meant to improve resource allocation, increase economic efficiency and increase the

economy's ability to attained appreciable growth. Creating this growth enabling economic environment was considered crucial in improving the living standard of the general populace; Kwadwo Konadu-Agyemang (2001).

Although the apparent effectiveness of the Structural Adjustment Program in meeting its ultimate objectives after its implementation in 1983 continue to be a subject of debate in the various echelons of academia, the period after its implementation marked a critical timeframe in the economy's quest towards attaining sustainable growth in its gross domestic product. GDP growth data over the period of the Structural Adjustment Program till the emergence of multi-party democracy in 1992 shows the Ghanaian economy experienced significant measure of growth in GDP after the program's implementation. This is evident from the fact that the period between 1984 and 1992, exhibits significantly different (positive) GDP growth trend compared to periods prior to the program's implementation; which were often characterized by negative GDP growth. Thus, notwithstanding the ongoing debate on the effectiveness of the Structural Adjustment Program in improving standard of living, its impact on GDP growth was mainly positive.

The third face in the economy's growth spectrum which spans the period of multi-party democracy in 1992 to date, exhibits GDP growth features reflective of the structural and economic gains witnessed after the implementation of the Structural Adjustment Program. Although lower than that of comparable developing economies around the world, GDP growth over this period has been significant and complementary to the economy's efforts towards achieving its vision 2020 objectives. A key feature of these objectives is to maintain appreciable economic growth to promote standard of living among the general populace. These three stages in the country's drive towards attaining a sustainable economic growth necessary to improve the general welfare of its citizenry, constitutes the critical timeframe within which this study test for the presence of Thirlwall's law or the condition of balance of payment constrained growth.

OVERVIEW OF THE LITERATURE

Existing empirical studies testing for the presence of balance of payments constrained growth (BPCG) among various economies around the world have found significant evidence in support of the BPCG model. Elitok and Campbell (2008) studied the long-run economic growth trends in the Turkish economy in an attempt to ascertain the extent to which apparent constraints in growth could be explained by the BPCG model. Result of the study supported operation of Thirlwall's Law in Turkey's economic growth over the period 1960-2004, the focus timeframe of the study. The study found significant evidence to the effect that economic growth over the period in question had been constrained by imbalances in the country's balance of payments equilibrium structure. In this study, not only was the presence of Thirlwall's law verified in the case of Turkey, but a critical factor constraining appreciable GDP growth in the economy (that is its export structure) was also identified. In an investigation into the extent to which balance of payments structure has been a key determinant of Cuba's long-term economic growth during the various commercial policy regimes spanning the period 1960 to 2004, Álvarez-Ude et al (2008) synthesized impact of terms of trade movements into the specification of Thirlwall's hypothesis using co-integration techniques. The study found evidence of long run relationship among Cuba's economic growth, growth in exports of goods and terms of trade; which to a larger extent suggest the presence of Thirlwall's law.

An Sy Pham (2007) focused on ascertaining the extent to which economic growth has been constrained by Vietnam's balance of payments structure between the period 1990-2004 using the Thirlwall model. Utilizing both quarterly and annual data within the focus period, the study confirmed the validity of Thirlwall's law in the case of Vietnam. Arevilca Vasquez and Risso Charquero (2007), in another South American study analyzed demand factors as determinants of Bolivia's economic growth between 1953-2002 using Thirlwall's framework. Co-integration analysis conducted showed that Bolivian exports were significant determinants in the economy's growth over the period studied, which confirmed the presence of Thirlwall's law. The study further showed that there is an inverse relationship

between real exchange rate and Bolivia's long run growth. Fida, Zakaria and Hashmi (2009), examined the balance of payment constrained model in the case of Pakistan utilizing both co-integration and vector error correction techniques. The outcome of this study showed that Pakistan's exports growth and economic growth are cointegrated as predicted by Thirlwall's law. Furthermore Arslan Razmi (2004), verified the validity of the balance of payment constrained growth model by focusing on how long-run constraint imposed by foreign exchange requirements impact growth in the Indian economy. The study explored both the 'weak and strong form' of the BPCG model and found support for the model in the long run using the Johansen co-integration procedure.

Jani Beko (2003) tested the balance-of-payments-constrained growth model with data on the Slovenian economy using co-integration methodology. Beko's empirical work found a long-run relationship between real gross domestic product growth and growth in real export; a condition which suggests the presence of a balance of payment constrained growth. Using data sets between the periods 1955 and 1998 on the Brazilian economy, Gonzaga Jayme (2001) further demonstrated that there exist a positive co-integration between growth in exports and long-term economic growth in Brazil; an outcome which further conclusively provide evidence in support of Thirlwall's law. Yongbok (2006) empirically tested the validity of Thirlwall's law in the case of China between the period 1979 and 2002. The study estimated the income elasticity of imports demand utilizing ARDL-VEC model or the bounds test. Results showed that China's economic growth dynamics reflects predictions of Thirlwall's law; because the economy's growth in GDP and exports were cointegrated over the period studied. The result further provided evidence indicating that China's rapid economic growth over the period could also be explained by Thirlwall's law.

However, notwithstanding these empirical studies which provide evidence in support of Thirlwall's law among economies, there are others that question some of the procedural techniques employed in testing for the presence of Thirlwall's law. Alexander and King (1998), for instance argued that some methods employed in the process of testing for the evidence of Thirlwall's law are flawed due to heavy reliance on least-squares estimates of income elasticities. Their empirical work on G7 nations utilizing Johansen co-integration procedure in a test for long-run relationship between domestic and world incomes consequently failed to tentatively support Thirlwall's law among the G7 nations. Adding to the growing support for the Thirlwall's law, Moreno-Brid (1999), applied the basic balance-of-payments constraint model to analyze trends in Mexico's economic growth between the periods 1950 and 1996. Unit-root tests and co-integration procedures employed in assessing the long-run association between Mexico's real exports growth and real output or GDP over the period showed a significant positive co-integration between the two variables; a condition which supports the presence of Balance of Payment Constrained Growth. The BPCG model was thus found to be a relevant framework in explaining Mexico's long-term economic growth dynamics.

THEORETICAL FRAMEWORK

Using Thirlwall and Hussain (1982) framework which adjusted the original Thirlwall (1979) model to assess the impact of capital flows (exchange rate) among developing economies, we express the balance of payments equilibrium equation as follows:

$$P^d X + E F = E P^f M \quad (1)$$

where P^d denote domestic price level in local currency, X captures quantity demand for home exports, $E(e)$ represents the nominal exchange rate (ie domestic currency per unit of foreign currency) and F is the value of net capital inflows. P^f denotes foreign price levels in foreign currency and finally, M represents the quantity demanded of imports in the home country. Given equation 1, the proportion of export out of total foreign exchange receipts, designated as θ could be expressed as follows:

$$\theta = \frac{P^d X}{P^d X + E F} \quad (2)$$

Furthermore, in terms of standard demand theory, the Export Function is expressed as:

$$X = \left(\frac{P^d}{E P^f} \right)^\theta Z^\mu \quad (3)$$

where θ , Z and μ are price elasticity of demand for exports, foreign or world income and the income elasticity of demand for exports respectively. ($\theta < 0$, $\mu > 0$).

Given the above equations, the rate of growth of exports using normal log-differential manipulation of equation 1 and 3 can then be expressed as follows:

$$x = \partial(P^d - P^f - e) + \mu z \quad (4)$$

Equation 4 states that all things being equal, growth in export depends on the difference between domestic and foreign prices less variations in exchange rate (e), all multiply by the price elasticity of demand for export (θ); plus the product of the rate of change in world income and the value of the income elasticity of the demand for exports (μz).

Additionally, import Function following the standard demand theory procedure in equation 3 is also expressed as:

$$M = \left(\frac{E P^f}{P^d} \right)^\phi Y^\pi \quad (5)$$

where ϕ , Y and π are the price elasticity of demand for imports, the domestic income and the income elasticity of demand for imports respectively; ($\phi < 0$, $\pi > 0$). Consequently, growth rate of imports following the procedure used in equation 4 could also be expressed as:

$$m = \phi(P^f + e - P^d) + \pi y \quad (6)$$

Equation 6 states that growth in imports is a function of the product between price elasticity of demand for imports and the relationship between foreign prices adjusted for variations in exchange rate and domestic prices; plus the product of domestic income and the income elasticity of the demand for imports. Stating the basic current account equation as: (all the variables previously defined)

$$x + P^d = m + P^f + e \quad (7)$$

We substitute equation 4 and equation 6 into this basic current account equation in 7 and solve for growth rate in domestic income (y) or *GDP*, as follows:

$$\partial(P^d - P^f - e) + \mu z + P^d = \phi(P^f + e - P^d) + \pi y + P^f + e \quad (8)$$

$$\partial(P^d - P^f - e) + \mu z + P^d - [\phi(P^f + e - P^d)] - P^f - e = \pi y \quad (9)$$

$$y = \frac{\partial(P^d - P^f - e) + \mu z + P^d - [\phi(P^f + e - P^d)] - P^f - e}{\pi} \quad (10)$$

$$y = \frac{\partial(P^d - P^f - e) + P^d - P^f - e - [\partial(P^f + e - P^d)] + \mu z}{\pi} \quad (11)$$

$$y = \frac{(\partial + 1 + \partial)(P^d - P^f - e) + \mu z}{\pi} \quad (12)$$

Subscribing to the assumption that relative prices measured in common currencies are neutral or constant in the long-run, that is $P^d = P^f + e$, or, $(P^d - P^f - e = 0)$; equation 12 could be reduced to:

$$y = \frac{\mu z}{\pi} \quad (13)$$

Applying the same assumption to equation 4, that is $P^d = P^f + e$, it could be shown that $x = \mu z$. In this case equation 13 could further be simplified as follows:

$$y = \frac{x}{\pi} \quad (14)$$

Equation 14 captures the essence of Thirlwall's law which governs the balance of payment constraint growth model. Equation 14, states that an increase in the income elasticity of demand for imports (π) reduces equilibrium income (y) growth with respect to balance of payments. That is, the higher the income elasticity of demand for imports characterizing an economy, the lower its balance of payment equilibrium growth rate.

However, Bairam (1997) showed that equation (14), which is sometimes regarded as a weak form of Thirlwall's Law by researchers such as Arslan Razmi (2004) and Yongbok (2006), might be superior to equation (13) (normally regarded as the strong version) in empirical analysis. According to Bairam's empirical observations, the ratio of income elasticity of export to that of import strongly correlates with the level of output or GDP as described in Thirlwall's analysis. However, in a defining finding which has provided empirical basis for most studies verifying the BPCG model among economies around the world, Bairam showed that income elasticity of export demand (x) tend to vary over time as economies progress, while income elasticity of demand for imports (π) tend to be relatively constant in the long run. This fluctuating nature of income elasticity of demand for exports, coupled with relatively constant income elasticity of demand for imports in the long run provides a succinct procedure in testing for the presence of Thirlwall's Law among economies. In other words, since income elasticity of demand for imports (π) tend to be relatively stable in the long run, variability in growth in output (y) or GDP in the long run given equation 14 could be attributed mainly to fluctuations in income elasticity of demand for exports or growth in exports. Thus in the long run, a country's income (y) growth or GDP growth basically depends on its rate of growth in exports. With this background, this study test for the long run relationship between growth in income (y) or GDP and growth in exports (x) with the view of verifying the presence of Thirlwall's law in Ghana, an emerging economy in Sub-Sahara Africa.

Empirical Estimation

This section presents an auxiliary framework employed in our empirical analysis, and the results of the test for the presence of the balance of payment constraint growth in Ghana's economy. The process involves initial testing of individual variables used in this study. This process finally culminates in conducting Johansen co-integration test as well as autoregressive distributed lag model test for co-integration to verify if Ghana's GDP growth and growth in exports over the period under consideration are cointegrated. Given that one of the major problems associated with using time series data is the possible occurrence of spurious regression results due to non-stationary data variables, this section

conducts the critical statistical test to ascertain the stationarity of the various time series variables use in this study. The goal is to ensure that the various variables are integrated in the order I(0). To meet this criterion, we evaluate the properties of the variables using the Augmented Dickey-Fuller Unit root test to establish the nature of the variables to be used in our test. The following test assesses the stationary properties of the two key variables in this study:

Unit Root Test

$$X_t = \beta_1 + \beta_2 t + \delta X_{t-1} + \sum_{i=1}^m \alpha_i \Delta X_{t-i} + \varepsilon \tag{15}$$

$$Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^m \alpha_i \Delta Y_{t-i} + \varepsilon \tag{16}$$

Where, β_1 represent the constant term, t denotes the trend variable, X and Y in this case are the variables (growth in GDP or income and growth in exports) being tested for unit root, and ε is the error term. (δX_{t-1}) and (δY_{t-1}) are the lagged values of X and Y variables respectively. In this test the null hypothesis of unit roots (non stationary of the variable), is analyzed against the alternative hypothesis of no unit root. A rejection of the null hypothesis all things being equal, suggests the variables are stationary.

Table 1 and 2 presents the results of unit root test for the growth in exports and growth in income (GDP) variables used in our empirical analysis. Initial test for unit root on the growth in export variable found the presence of unit root; results in table 1 showing lack of unit root were subsequently obtained after differencing procedures were conducted.

**TABLE 1
UNIT ROOT TEST FOR GROWTH IN EXPORTS**

	Augmented Dickey-Fuller test for unit root Number of obs = 39			
Exports	Test	1% Critical	5% Critical	10% Critical
	Statistic	Value	Value	value
Z(t)	-7.005	-3.662	-2.964	-2.614
	MacKinnon	approximate p-value	for Z(t) = 0.0000	

**TABLE 2
UNIT ROOT TEST FOR GROWTH IN GDP (INCOME (y))**

	Augmented Dickey-Fuller test for unit root Number of obs = 39			
Income(y)	Test	1% Critical	5% Critical	10% Critical
	Statistic	Value	Value	value
Z(t)	-4.594	-3.662	-2.961	-2.613
	MacKinnon	approximate p-value	for Z(t) = 0.0000	

Table 1 test for the stationarity of the growth in exports variable; the null hypothesis is the presence of unit root. The augmented Dickey-Fuller statistic of -7.005 lies outside the acceptance critical value region at 1%, 5%, and 10% respectively; consequently, we reject the null hypothesis of unit root in this variable.

Table 2 test the growth in GDP variable for unit root. The null hypothesis is the presence of unit root. The augmented Dickey-Fuller statistic of -4.594 also lies outside the acceptance critical value region at 1%, 5%, and 10% respectively; we therefore reject the presence of unit root in this variable as well.

Test for Co-integration: Johansen versus Autoregressive Distributed Lag Model (ARDL)

The test for co-integration verifies whether Ghana's GDP growth could be considered to be BOP-constrained during the period 1965–2004. As evidenced in the literature review, a number of studies have tested and verified the model in various economies around the world since its promulgation by Thirlwall in 1979. Results from these existing studies to a greater extent have provided compelling evidence in support of the model for a number of both developed and under-developed economies. The objective in this section is to expand this trend by ascertaining the extent to which growth dynamics in an emerging Sub-Saharan African economy reflects projections of the balance of payment constrained growth model. We verify this by ascertaining whether the two core variables (growth in GDP and growth in Exports) in our final balance of payment constrained growth function in equation 14 are cointegrated. The first of these two tests involves the Johansen test for co-integration procedure using the maximum likelihood approach. Table 3, shows the results of the Johansen co-integration test verifying balance of payment constrained growth in the Ghanaian economy.

The null and alternative hypotheses in this test are stated as follows:

$$H_0: r = 0, H_1: r \geq 1$$

$$H_0: r = 1, H_1: r \geq 2$$

TABLE 3
JOHANSEN TEST FOR CO-INTEGRATION BETWEEN GROWTH IN GDP
AND GROWTH IN EXPORTS

					5%
Maximum				trace	critical
rank	parms	LL	eigenvalue	statistic	value
0	6	-58.51037		41.8056	15.41
1	9	-42.77632	0.57279	10.3375	3.76
2	10	-37.60756	0.24376		

The 5% critical values for the hypothesis $H_0: r = 0, H_1: r \geq 1$ and $H_0: r = 1, H_1: r \geq 2$ are 15.41 and 3.76, respectively. Trace statistic of 41.8056 is greater than critical value 15.41 indicating condition of co-integration.

Results presented in table 3 shows that the reported trace statistic is greater than the critical value at 5% percent level when the null hypothesis is $r = 0$. This suggests that the null hypothesis of no co-integration can be rejected in support of a condition of co-integration between the two variables (growth in gdp and growth in exports). Thus Thirlwall's law or the balance of payment constrained growth model predicting a long run relationship between growth in income or GDP and growth in export is verified in Ghana or supported utilizing Johansen test for co-integration procedure. This outcome suggests that Ghana's GDP (y) growth between the period 1965 and 2004 was constrained by its balance of payment structure.

The second test for co-integration between growth in GDP and growth in exports as predicted by the balance of payment constraint growth model is conducted using the autoregressive distributed lag model (ARDL model) or bounds test approach by Pesaran et al. (2001). Just like the Johansen approach, co-integration test in ARDL framework or the bound test approach also tests for long-run relationship between any two key variables of interest; in this case, the relationship between growth rate in GDP and growth rate in exports. This approach has been adopted as an auxiliary framework because compared to the Johansen cointegration procedure; this approach is much more suited for relatively small sample data.

The bound test procedure is based on F-test manipulation. F-test in this case test the null hypothesis of no co-integration between the two variables in question (growth in GDP and growth in exports) against an alternative hypothesis of co-integration between the variables being tested. In this approach, two critical value bounds or parameters provides the thresholds to test for co-integration between the two variables in this study when the independent variable is $I(\alpha)$ where $0 \leq \alpha \leq 1$. The lower bound of the two critical value bounds assumes that the regressor is $I(0)$, with the upper bound value assuming $I(1)$ regressor. Under this condition, if the computed F-statistic lies above the upper level of the band (bounds parameters are adapted from Pesaran et al 2001), the null hypothesis is rejected in favor of condition of co-integration. However, if the computed F-statistic lies below the lower level band, the null cannot be rejected, thus supporting the condition of no co-integration all things being equal. If the F-statistic falls between the lower and upper bounds, then the outcome is inconclusive.

The ARDL framework is stated as follows:

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \delta_1 X_{t-1} + u_t \quad (17)$$

where Y_t , Y_{t-1} , X_{t-1} , u_t are growth in GDP, lagged variables of growth in GDP, lagged variables of growth in export and the error term respectively.

The null and alternative hypotheses are defined as follows:

$$H_0: \beta = 0$$

$$H_1: \beta \neq 0$$

where the null hypothesis suggest the presence of no co-integration against the alternative hypothesis of the presence of co-integration. Table (4) presents the results of the bounds test with normalized dependent variable (s) in ARDL least square regression.

TABLE 4
ARDL BOUNDS TEST FOR CO-INTEGRATION BETWEEN GROWTH IN GDP AND GROWTH IN EXPORTS

Results from Bounds Test				
Dep Var	AIC	F-Statistic	Bounds Interval(I(0)-I(1))	Outcome
GDP	1	2.79	6.34 -7.52	No Co-integration
EXP	1	106.48	6.34 -7.52	Co-integration

The bound intervals are based on table CI(v): Unrestricted intercept and Unrestricted Trend (Pesaran et al 2001)

Table 4 presents the outcome of co-integration test using bound test approach for long run relationship between growth in GDP and growth in export. Regressing the two main variables with growth in GDP as dependent variable, the ensuing calculated F statistic of 2.79 falls below the bounds interval (i.e. outside bound interval 6.34 -7.52); consequently, we fail to reject the null hypothesis of no co-integration between the variables. Utilizing export growth variable as the dependent variable however shows a strong condition of co-integration between the variables (F-statistic above the higher level bound interval). Given the two divergent outcomes, the bounds test for co-integration between growth in GDP and growth in exports is deemed inconclusive. Thus unlike the Johansen approach, Thirlwall's law in this framework could not be verified with absolute certainty.

CONCLUSION

This study verified Thirlwall's law or the balance of payment constrained growth model in an emerging economy in Sub-Sahara Africa. The choice of the Ghanaian economy for this study was informed by the country's position as economic success story among economies in the sub-region. Two separate tests are conducted. Results from the first test using the Johansen approach to co-integration supports the presence of balance of payment constrained growth or the Thirlwall's law in the Ghanaian economy between the period 1965 and 2004. The outcome of ARDL or bounds test (the second test) verifying similar condition or relationship between the two key variables in our study was however inconclusive.

Our results further show that the two co-integration empirical tests conducted in this study (Two main empirical tests prevalent in the BPCG literature) might not necessarily arrive at similar outcome in verifying the condition of a balance of payment constrained growth economy. Consequently, there is the likelihood that a single test using either of the methods might present a misleading conclusion on the nature of an economy's growth. The tests further suggest that classifying an economy's growth as being constrained by its balance of payment structure might be subjective; and dependent on the robustness and type of empirical framework adopted in a specific study.

Policy Implications

A verified long-run relationship between an economy's GDP growth and growth in exports as suggested by the Johansen co-integration procedure in the first test of this study could be essential for stakeholders and policy makers in Ghana as well as the sub-region. It could serve as a guide on how best to allocate available resources to maximize growth in export in order to enhance the probability of achieving the desired growth in GDP; a critical economic variable on which most key variables such as employment/unemployment depend. The knowledge base could also provide policy makers with a much narrower scope of reference by helping to cut through the clutter of trying to promote growth in GDP using various stimuli options. A verified long-run relationship between GDP and export growth for instance could help channel resources directly towards strengthening core export oriented firms and other allied institutions. This narrower focus could enhance efforts at promoting and sustaining desired economic growth necessary for improving living standards and employment prospects.

NOTES

1. Ghana's economy was chosen for this test because of its relatively stable political climate and vibrant economy within the West African Sub-region. Cases of balance of payment constrained growth in northern and southern American economies as well as Asian economies are well documented in the literature; this paper test for the presence of the law within an emerging economy in Sub-Sahara Africa.

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