EXPORT-LED GROWTH HYPOTHESIS: EMPIRICAL EVIDENCE FROM SELECTED SUB-SAHARAN AFRICAN COUNTRIES



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ABSTRACT

Export-Led Growth Hypothesis: Empirical evidence from selected Sub-Saharan African countries

The objective of this study is to examine the validity of Export-Led Growth (ELG) hypothesis in selected Sub-Saharan African (SSA) countries for the period from 1985 to 2014. A new generation panel data approach is applied such as panel unit root, panel cointegration, Fully Modified OLS (FMOLS) and Dynamic Ordinary Least Square (DOLS). The empirical findings revealed that the panel unit root is stationary after the first difference and presents a cointegration. After the confirmation of panel cointegration, there exists a long-run relationship between exports and growth based on FMOLS and DOLS results. FMOLS and DOLS estimation showed a positive impact of investment, government expenditure and exports on the economic growth. Hence, the findings proved that export-oriented growth strategy is valid in the SSA countries.

Keywords: Export; economic growth; panel data; Sub-Saharan Africa



ABSTRAK

Objektif kajian ini adalah untuk mengkaji kesahihan eksport dan pertumbuhan ekonomi (ELG) hipotesis di negara-negara terpilih Sub-Sahara Afrika (SSA) bagi tempoh dari tahun 1985 hingga 2014. Generasi baru pendekatan panel data digunakan seperti unit panel akar, panel cointegrasi, OLS diubahsuai sepenuhnya (FMOLS) dan Dinamik Biasa Kurang Persegi (DOLS). Hasil kajian empirikal menunjukkan bahawa punca unit panel adalah pegun selepas perbezaan pertama dan menunjukkan cointegrasi. Selepas pengesahan panel cointegrasi, hubungan jangka panjang antara eksport dan pertumbuhan ekonomi berdasarkan FMOLS dan keputusan DOLS adalah wujud. FMOLS dan DOLS menunjukkan kesan positif daripada pelaburan, perbelanjaan kerajaan dan eksport kepada pertumbuhan ekonomi. Oleh itu, hasil kajian membuktikan bahawa strategi pertumbuhan ekonomi berorientasikan eksport adalah sah di negara-negara SSA.

Kata kunci: Eksport; pertumbuhan ekonomi; data panel; Sub-Sahara Afrika



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1.0 Introduction

Africa is one of the world's poorest continents (Basu et al., 2005). Over the last 20 years, Sub-Saharan African (SSA) countries started enjoying robust and sustained economic growth. After the growth expanded by 4.9% in 2013, the economic performance is expected to continue increasing about 5.5% in 2015.¹ The strong economic performance is mainly driven by investments in the mining activities, infrastructure for transport and communication, and energy production. In the early of 1960s, policy makers and scholars showed an interest in the relationship between exports and economic growth. However, there is still an ongoing debate among scholars. Numerous studies, both theoretical and empirical have been undertaken to validate the ELG hypothesis and SSA countries are getting less attention in academic discussions.

Cross-country studies such as Abu-Quarn and Abu-Bader (2004) supported a positive relationship between export and growth in the developing countries, while few groups of studies investigated the causal relationship between export and output growth for individual countries using Granger's (1969) or Sims' (1972) causality test. Among these studies are Dodaro (1993), Sharma and Dhakal (1994), and Riezman et al. (1996). In fact, another group of studies used cointegration techniques to examine the long-run relationship between exports and output of individual countries such as Bahmani-Oskooee and Alse (1994) and Bahmani-Oskooee and Economidou (2009). Overall of these studies suggested that there is a positive long-run relationship between exports and output, and causality is running from exports to output or in both directions in the most of the developing countries.

Giles and Williams (2000) reviewed more than 150 export-growth papers which fell into three groups of studies. The first group of studies was based on cross-country rank correlation coefficients, second group applies cross-sectional regression analysis and third group employs time series techniques on a countryby-country basis. Two thirds of this paper is owned by the third group and more than 70 are papers based on Granger causality tests.



¹ IMF, World Economic Outlook database, April 2015

In addition, this study does not belong to any of these groups. Additionally, voluminous literature focused on developing countries that utilized cross-sectional data, production function, and time series data. On the other hand, far too little attention has been paid to the panel data technique in the Sub-Saharan African countries that this paper seeks to investigate. One of the primary reasons to utilize the panel unit root tests for cross-sectional data is because this test can increase the statistical power of univariate counterparts as compared to the traditional Augmented Dickey-Fuller test (ADF) (Dickey-Fuller, 1979) characterized to have a low power in rejecting the null of non-stationary of the series, especially for short-spanned data. Recent literature suggests that a new generation of panel unit root tests has a higher power that is able to capture the country-specific effects, heterogeneity in the direction and magnitude of the parameters across the panel, and weak restrictions.

Against this background, presently scholars and policy makers have raised issues on the relevancy of export-led growth hypothesis strategy as an appropriate development tactic to achieve the MDGs (Millennium Development Goals) 2015 in the SSA countries. The importance of economic transformation in the SSA countries is a key to achieve the Millennium Development Goals 2015 to improve their standard of living and reduce poverty, hunger, maternal and child deaths, disease and gender inequality. Hence, this study intends to re-examine the ELG hypothesis with a new panel data approach in selected Sub-Saharan African countries, namely; Botswana, Equatorial Guinea and Mauritius.

This paper is organized into six sections. The second section discusses an economic performance of Botswana, Equatorial Guinea, and Mauritius. The third section reviews the literature review. The forth section describes data, whereas the empirical evidence is presented in section five. The final section concludes the paper with important findings and policy implications.

2.0 Economic Performance of Botswana, Equatorial Guinea and Mauritius

During 1980-2011, economic growth performance among Sub-Saharan Africa countries recorded an average growth rate of 4%. The faster grows of GDP per



capita are attributed from mining sector. Botswana ELG strategy started during the colonial era (1885 to 1966) when the country was a British protectorate and become independence in 1966. Since Botswana independence, it has enjoyed one of the fastest growth rates in per capita income in the world. It moved from third poorest nation in the world to become upper middle-income country with GDP per capita of US\$16,800 in 2012 as compare to US\$236 in 1967. During that period, Botswana trade was dominated by meat, skins and beef exports. According to Sentso (2003), exports of beef continued to be the main exports that contribute to growth until the early 1970s when Botswana discovered minerals (diamond, coal, copper, nickel). Since then Botswana starts to rely on diamond exports. This is a big challenge for the country to sustain economic growth just by depending on diamond export. This trends support the ELG hypothesis that export is a key to economic growth in Botswana. Currently, Botswana is the world's leading diamond producer in terms of quality and grade of its diamonds. Diamonds is the main components of exports which constitute 90% compared to other products like meat product, copper nickel, machinery and electric equipment and other goods which is 1%, 3%, 1% and 5% respectively (Refer to Figure 1.0).

Meanwhile, Botswana also has significant copper, nickel, and cobalt which are currently being exploited and developed. Besides that, mining sector contributes in a greater proportion to GDP in 2014 (63%) followed by manufacturing sector (28%) and agriculture (9%) (Refer to Figure 2.0). The expansion in mining sector was mainly due to recovery of diamond sub-sector with Debswana producing 22.7 million carats during 2013, up to 12.4% from previous year. The increment of diamond production was improved demand from United States of America (USA), China and other markets. This shows that Botswana economy is not quite diversified and relies more on mineral products as it main sources of exports. The trend analysis of Botswana's economic growth is presented in Figure 3.0. Economic growth rate has recorded an average of 9% per year from 1970-2006, but its growth slowdown after 2006 due to the economic downturn. During the global financial crisis in 2008-2009, economic growth rate was only 3.9% before dropping to minus 7.8% in 2009. A drastic drop in 2009 is due to the substantial fail in diamond demand which eventually caused the export decrease subsequently, but the growth bounced back to 8.6% in 2010.





Figure 1.0: Exports Composition 2014

Sources: International Trade Statistics, 2014



Figure 2.0: Contribution of GDP in Economic Activity 2014

Source: Bank of Botswana Annual Report 2014





Figure 3.0: GDP Growth (annual %)

Equatorial Guinea was independence since 1968. Equatorial Guinea has experienced rapid economic growth due to the discovery of large offshore oil reserves. At the same time, oil is the primary engine of Equatorial Guinea's economy. In the last decade, the country becomes Sub-Saharan Africa's third largest oil exporter and the oil production represents their country's income. The country has recorded the most impressive economic growth in Africa with an average annual GDP growth of 15.6% between 1986 until 2012 while real GDP drop from 5.5% in 2012 to 4.9% in 2013. Initially, the discovery of oil in the 1990s transformed Equatorial Guinea into one of the Africa fastest growing economic and the main destination for foreign investment. As shown in figure 4.0, oil exports grew steadily from year 1992 until 2008 in which the value increased from US\$0.018 billion to US\$14.366 billion. The boost to the country economy is mainly due to improve in oil production. But there is slowdown for oil exporting after 2008. Based on figure 5.0, oil production was 4500 barrels per day in 1993, and steadily increased to 375,477 barrels per day in 2005. But oil production started to decline in 2007 because of sluggish oil sector. Concurrently, oil exporting also decreased in downward trend from US\$14.366 billion (2008) to US\$8.366 billion (2009) because of the oil production declined.



Source: World Bank, World Development Indicators, 2014



Figure 4.0: Exporting oil in Equatorial Guinea, US\$

Source: IMF, World Economic Outlook Database, December 2014



Figure 5.0: Total Oil Production in Equatorial Guinea ('000, bbl/day)

Source: EIA (Energy Information Administration) - Country Information on Equatorial Guinea

Mauritius has been one of the most successful and competitive economies in Africa. Figure 6.0 shows GDP per capita where Mauritius has enjoyed an upward trend growth from 1985 until 2008, dropping down to US\$6,914 in 2009 and bounced back in 2010 with US\$7,562. In fact, economic growth started to decline in 2008 and 2009 due to the some problems such as labor shortages and rising inflation. By the 1960s, Mauritius was a monoculture economy which highly dependent on a single crop, which is sugar. Before the 1960s, the manufacturing sector was small, and "King Sugar" reigned.



The development strategy in the 1960s changed to one based on import substitution. In the mid-1960s, the Mauritius government began to follow two strategy of import substitution and export-oriented strategy. Import substitution was promoted through the use of high tariff barriers to protect local industry from overseas competition. Meanwhile, in order to encourage the production of goods for export, Export Processing Zones (EPZ) was established in 1970s. Clothing and textiles were the main manufactures produced by the EPZ sector. Manufactures in textiles and apparel recorded highest exporting compare to commodities in sugar sector. As refer to table 1.0, Mauritius's exports are dominated by clothing and textiles which accounted 27.34% of total merchandise product exports in 2014, followed by fish products (10.44%), sugar (9.22%) and metals or coins (4.78%). Mauritius enjoyed rapid economic growth due to high sugar prices on the world market (1973-75). According to the World Bank, the economy of Mauritius has sustained a growth rate of about 5.5 percent since independence in 1968 and the country is currently classified as middle income earners.



Figure 6.0: Gross Domestic Product Per Capita in US\$

Source: World Bank, World Development Indicators 2015

Main Exports: % share of total 2014				
Clothing, textiles 27.34				
Fish	10.44			
Sugar	9.22			
Metals, coins	4.78			

Table 1: Main Exports - % share of total 2014





3.0 Review of Literature

ELG hypothesis has been done by many researchers using different econometric techniques. In general, recent empirical literature has shown that causality relations vary with the period of study, the use of econometric methods, treatment of variables (nominal or real) whether one-way or two-way linkages, and the presence of other related variables or inclusion of interaction variables in the estimated equation.

Exports-growth nexus which has still been a subject of extensive debate since the 1960s was also studied by Giles and Williams (2000). It was surprising that there is no clear consensus between the export-led-growth and growth-ledexports even though early cross-section studies favored the past. Wernerheim (2000) found bidirectional causality between exports and growth by using cointegration and causality test. However, only few papers applied the panel data causality analysis.

In addition, there are voluminous literature studied in empirical relationship between exports and growth in different countries testing for export-led arowth or growth-led hypothesis, or both (Giles and Williams, 2000; Singh, 2010). In the literature, previous studies have employed cross-sectional data to study the relation between exports and economic growth is generally supportive of export-led growth hypothesis. However, several earlier works do not take account into countryspecific factors and the estimation results are biased. Recently, existing researcher employed time-series data for single country cases fail to provide whether exportled growth or growth-led exports hypotheses (Singh, 2010). The findings are misleading as the results suffer from spurious regression problem because regressions were based on the use of non-stationary data. In contrast, Kónya and Singh (2006) reviewed 30 export-growth time-series studies from the period 1978 until 2005 in India. This study used time-series techniques based on unit root and cointegration tests, single equation, vector autoregressive (VAR) and vector error correction models (VECM). The results showed a positive and significant correlation between exports and economic growth.



Altaf et al. (2012) determined the significance of macroeconomic variables on Pakistan's economic growth with the application of VAR modeling using annual time series data. The quantitative evidence can be explained by the fact that real GDP per capita is caused by money-supply. The author speculated that exchange rate policies, government spending and money supply are significant in the regression of investment. Similarly, this result provides further support that exports and exchange rate policies affect the growth of real per capita money supply. In the case of the Middle East and North African countries, Abu-Qarn and Abu-Bader (2004) used cointegration and error correction models to test the validity of the export-led growth hypothesis. The result does not hold ELG hypothesis when only manufactured exports are considered. This study concluded that exports may contribute to economic growth only after a certain threshold of manufactured exports has been reached.

Several literatures argued that positive productivity effects estimated by export-led growth hypothesis do not necessarily occur in developing countries. This is because most of the developing countries are heavily dependent on primary commodity exports. At the same time, exports can lead economies to shift away from the competitive manufacturing sectors which have many externality factors required for sustainable growth. This is compared to the primary export sector which does not have many linkages and spillover into the economy (Sachs & Warner 1995; Herzer 2007). In addition, increased exports of primary goods are subjected to large price and volume fluctuations. Simultaneously, increased exports may increase macroeconomic uncertainty that can impede efforts for economic planning and reduce the quantity as well as the efficiency of domestic investment (Dawe, 1996).

In fact, there are four groups of studies which employed panel cointegration in which the tests have higher power due to the exploitation of both time-series and cross-sectional dimensions of the data. By examining export-led growth hypothesis, these groups of studies show that the results are mixed. Bahmani-Oskooee et al. (2005) and Reppas and Christopoulos (2005) concluded that longrun causality is a unidirectional running from GDP to exports, whereas the results of Parida and Sahoo (2007) revealed that the increased exports are the cause of



increased GDP. On the other hand, Jun (2007) found positive long-run effects running from exports to GDP. Moreover, Reppas and Christopoulos (2005) analyzed 22 samples from the African and Asian countries, while Parida and Sahoo (2007) included only four South Asian countries. These studies did not engage with the validity of the export-led growth hypothesis or long-run effects of exports. This is because Parida and Sahoo (2007) and Jun (2007) used the within-dimension panel cointegration estimators, which were unable to capture the heterogeneity of the long-run coefficients across the countries.

Furthermore, the methods presented in these studies did not take into account the potential cross-sectional dependence which could generate biased results.² Numerous researchers like Bahmani-Oskooee et al. (2005), Reppas and Christopoulos (2005), and Jun (2007) did not control the simultaneity bias associated with exports through national income as a component of GDP. Specifically, the finding showed a positive correlation between exports and growth because export is a part of GDP. Simultaneously, exports and output growth may lead to the misleading inferences on causality. In overall, these groups of studies only examined the long-run relationship between exports and output and did not account for possible differences between long-run and short-run effects of exports.

Another study by Li Yuhong et al. (2010) explored cointegration analysis with the data of import, export and economic growth. The results suggest that the growth of import promotes economic growth in China while export executes opposite one. The findings are also consistent with the study of Agasha (2009) whereby the determinant of export growth rate was significant in Uganda. However, not many studies were carried out in the case of Sub-Saharan African countries. Pazim (2009) worked on exports and growth in the panel data analysis, which includes the variables of government expenditure, gross domestic investment, labor force and inflation. The finding supports the ELG hypothesis for the African countries and this result is consistent with a number of studies that have been done in the African context such as Fosu (1990) and Ukpolo (1994).

² Cross sectional dependence can arise due to several factors, such as omitted observed or unobserved common factors, or spatial spillover effects. For example, the data may be in part driven by common global business cycles.



In the recent years, a number of studies have been undertaken based on panel data that examined both inter and intra country frameworks to figure out the export-led growth hypothesis. The empirical analysis showed that the relationship between export, investment, growth and import based on panel granger causality holds the existing export-led growth (Ahumada & Sanguinetti, 1995). Konya (2006) employed seemingly unrelated regression (SUR) method to test the causality between export and GDP in the OECD countries and the test indicated a mixed result. In addition, following the same procedure for 18 least developed countries have supported the export-led growth (Tekin, 2012). However, based on the threshold regression technique between export and growth, the empirical outcome supports the export-led growth for a group of African countries (Foster, 2006). These findings are also similar with some studies such as Galimberti (2009), Seabra and Galimberti (2012). However, Mehrara and Firouzjaee (2011) found the existence of bidirectional causality between the non-oil export and economic growth for a group of countries.

Ahmed et al. (2007) studied causal links between export, FDI and output for a set of Sub-Saharan African Countries in a panel cointegration setting. Their findings support the export-led growth hypothesis for the five Sub-Saharan African countries studied. Ahmed et al. (2007) further found that there exist bidirectional Granger causality between FDI and exports in Ghana, Kenya and Nigeria, while the Granger causality runs from FDI to exports in South Africa and from exports to FDI in Zambia. The authors further provided evidence in favor of a positive causal relation from exports and FDI to income for all five Sub-Saharan African countries studied.

Moreover, Bbaale and Mutenyo (2011) demonstrated that a sample of 35 Sub-Saharan African countries was included in the capital goods imports into the Cobb-Douglas production function with exports, GDP per capita, labor force, credits to the private sector, government consumption, and gross capital formation. Capital goods imports, which embody knowledge and technology can enhance productivity, Bbaale and Mutenyo (2011) found that one unit percentage increase in the capital goods imports will increase 0.03% GDP per capita at 1% significance level. The literature strongly supported the theoretical view that capital goods imports,



especially from the technologically advanced countries contain the most current technological knowledge. Therefore, it also enhances economic growth via the knowledge and technology effects.

Apart from that, some studies utilizing the panel econometric methods are also conflicting. Fowowe (2011) investigated 17 African countries with panel data analysis existence of a homogenous bi-directional causality between financial development and economic growth. Compared to Demetriades and James (2011) who were using 18 SSA countries for the period from 1975 to 2006 observed that while bank liabilities in Sub-Saharan Africa were found, the causality link between bank credit and growth were invalid. Meanwhile, Ahmed and Wahid (2010) who were using data from 15 SSA countries found a long-run equilibrium relationship between the financial development and economic growth, where financial development can act as an engine of growth and play an important role in the process of economic development.

Many developing countries are too heavily depending on the primary products as their main source of export income. Some studies argued that countries which concentrate on manufacturing exports will grow faster than those primary product exporters (Hausmann et al., 2007; Jarreau Poncet, 2012; Crespo-Cuaresma & Worz, 2005; Berg et al., 2012). This idea emphasized that export products with a high relatively technology will benefit from positive externalities in boosting the economic growth. Furthermore, Rao and Hassan (2011), Cooray (2012), Azam et al. (2013) and Imai et al. (2014) reviewed that technological transfer effect can stimulate economic growth through a work force.

According to IMF estimation, more open banking sectors have a higher annual growth rate than the less open banking sectors about 1% Ostry et al. (2008). Beck et al. (2011) and Murinde (2012) reviewed that Africa's financial development and payment systems still a long way to go compare to the other successful regions of the world. Nevertheless, with a sustainable financial development and international trade would accelerate the economic growth. On the other hand, one country can be transmitted to other countries through international trade and economic and financial integration with a Cross-sectional dependency.



Beck et al. (2011) applied cross-sectional approach because there is evidence showed a growing trend toward regional integration within Africa. This method enables to avoid any misleading inferences regarding the causality direction which could arise with an individual country study that does not account for such crosssection dependency. While the panel causality test is valid irrespective of unit root and cointegration properties of the variables.

Based on several reviews, there exists a wide empirical literature on causality relations between exports and economic growth, but panel data empirical estimation is still unresolved which this study seeks to investigate.

4.0 Data sources

This paper carried out a panel data analysis of export-led growth hypothesis for selected Sub-Saharan African countries, namely; Botswana, Equatorial Guinea and Mauritius over the period of 1985 to 2014. The data were taken from World Development Indicator (WDI) 2014 and International Financial Statistics (IFS) of the International Monetary Fund (IMF).

4.1 Variables descriptions

4.1.1 Real Gross Domestic Product

GDP define as the total market value of all final goods and services produced in a country in a given year, equal to total consumption, investment and government spending, plus the value of exports minus the value of imports. In this study, real GDP is used. Real GDP is measure the actual increase in goods and services and excludes the impact of rising prices. In other words, real GDP is taken into account of inflation. GDP can bring larger impact to economy within the country. For instance, when the economy is stable, it will create low unemployment and wages increase as business demand labor to meet in growing economy. Fosu (2010) explained that some SSA countries considered growth is lack behind in 1960s but grow faster after the several years. According to International Monetary Fund, Botswana economic growth average over 9% per year from 1966 to 1999. It has a high level of economic freedom compare to other African countries. While annual



growth for Mauritius is 5% to 6% for most of the period due to sustainable progress in economic condition. So, the variable is used in this study to see the significant results for selected SSA countries.

4.1.2 Investment

Investment is a component of aggregate expenditure where increase in investment will lead to an increase in economic growth. Investment plays a vital role in pushing up economic growth in both developed and developing countries especially in SSA countries. It contributes by transferring advanced technology to host countries and stimulating local market competition. Neoclassical researchers regard foreign direct investment (FDI) and international capital flows as closing the saving gap in developing countries (Chenery and Bruno, 1962). The researchers expect capital will flow from rich to poor countries as suggested by developments in Hechscher-Ohlin approach to trade by Mundell (1957). It is because capital is scarce in developing countries which lead to profitable investment opportunities in developing countries. On this view, there should be no outflows from Africa. In Mauritius case study, Goldstein (2003) proposed Mauritius has grown rich on building up a large textile and clothing sector using Export Processing Zones (EPZ). On that time, Mauritius relied on EU and US markets. Mauritius tried to compete on costs by investing in lower costs locations such as Madagascar and Mozambique, although the quality of infrastructure and productivity was lower than expected, While receiving FDI in clothing sector, Senegal has also boosted Mauritius FDI to their countries.

4.1.3 Government

The role of good governance and economic is a key determinant of long term economic growth (Easterly, 2000; Hall and Jones, 1999). Olson (2000) illustrated with bad policies, instability and poor governance are considered to bring bad performance in African countries growth. Park (2009) has included government expenditure in the model and the finding support ELG hypothesis for African countries. It is also consistent with a number of studies that has been done in African context such as Fosu (1990) and Ukpolo (1994). Some studies pointed that



there is a negative relationship between government and growth because government is detrimental of economic growth. A negative relationship between the variables provided the fact that high levels of government expenditure tend to crowd out investment which in turn reduces growth. However, a study by Ram (1986), analyzed a panel data of 115 countries concluded that growth and government is positively related. Indeed, historical evidence showed that some of SSA countries have been successfully transformed from agrarian economies to modern advanced economies. In this situation, government played a proactive role in assisting individual firms in overcoming externality problem in the process of their structural transformation.

4.1.4 Export

Exports of goods and services represent the value of all goods and other market services to the rest of the world. Exports of goods and services include the value of merchandise, transport, and other services such as communication, financial, and government services. Richards (2001) supported Adam Smith and David Ricardo theory for the export-led growth (ELG) hypothesis. Among the economists, Beckerman (1965) attributed exports is mainly due to the production efficiency gains stemming from improved resources allocation. While Haberlar (1959) stressed the relevance of dynamic benefits, such as improved availability of foreign capital and technology through release the balance of payments constraint. Moreover, endogenous growth model which has discussed in theoretical framework emphasize the benefits stemming from export sector, characterize by increasing returns to scale, technological and managerial spill-over effects toward other sectors (Fedor, 1992; Helpman and Krugmen, 1985) has developed Beckerman's idea, argued that export expansion through efficiency and resources allocation will enhance international competitiveness for SSA countries. So, the higher level of export, the higher level of economic growth.



5.0 Empirical results

5.1 Panel unit root

In this study, the precondition of panel unit root tests were carried out before being proceeded to panel cointegration test. According to Im et al. (2003), all variables were tested both in level and first difference with constant and without constant. Panel unit root tests are reported in Table 1. The results have shown that unit root in level cannot be rejected while after the first difference, unit root is stationary. These tests are less restrictive and more powerful compared to the first generation tests developed by Levin and Lin (1993).³ The shortcoming of the first generation tests is not to allow for heterogeneity in the autoregressive coefficient. While the tests proposed by IPS allowed the solving of Levin and Lin's serial autocorrelation problem by assuming heterogeneity between units in a dynamic panel framework. The equation for panel unit root tests for IPS is as stated below:

$$\Delta Y_{i,i} = \alpha_i + \rho_i y_{i,j-1} + \sum_{j=1}^{p} \phi_{ij} \Delta y_{i,j-j} + \varepsilon_{i,j} \quad i = 1, 2, 3, ..., N; t = 1, 2, 3, ..., T$$
(1)

where $y_{i,t}$ stands for each variable of the model, a_i is the individual fixed effect and ρ is selected to make the residuals uncorrelated over time. The null hypothesis is ρ_i = 0 for all i while the alternative hypothesis is $\rho_i < 0$ for some $i = 1, ..., N_1$ and $\rho_i = 0$ for $i = N_1 + 1, ..., N$.

Series	RGDP		INV		GOV		EXPORT	
	No Trend	Trend	No Trend	Trend	No Trend	Trend	No Trend	Trend
Level								
Levin, Lin	2.1602	0.2198	0.2779	-1.1149	1.0233	0.6412	0.6633	1.7410
IPS	0.5646	-1.4321	-1.6215	-2.5488	0.2251	-1. 9693	-0.2386	-1.7 4 72
ADF-Fisher	0.6020	1.7478	6.9200	8.0998	0.2427	3.4663	1.0425	1.4208
First Difference	1							
Levin, Lin	-3.5491***	-3.6141***	-4.4637***	-3.3127***	-4.2377***	-3.9916***	-2.0729**	-1.9911**
IPS	-3.5124***	-3.9427***	-4.3536***	-4.5006***	-3.3827***	-3.4519***	-2.9747***	-3.0107**
ADF-Fisher	24.6051***	22.358***	35.5072***	28.5366***	22.8203***	16.3739**	17.8889***	11.6538*

Table	2:	Panel	unit	root
	-			

Notes: *, **, and *** denote rejection of the null of non-stationary at 10%, 5% and 1% levels of significance. SBC is used to select the lag length.

³ See Hurlin and Mignon (2005) and Banerjee (1999) for a useful survey on panel unit root tests.



5.2 Panel cointegration tests

After all the variables are stationary in the first difference, Pedroni's cointegration test is applied in this study. Panel cointegration tests proposed by Pedroni (2000, 2004) also take heterogeneity into account the using of specific parameters that were allowed to vary across individual members of the sample. In the Pedroni's tests, seven different cointegration statistics were proposed to capture the within (pooled) and between (group mean) effects which are classified into two categories. For the tests based on "Within", the alternative hypothesis is $\rho_i = \rho < 1$ for all i, while the tests based on "Between" dimension, the alternative hypothesis is $\rho_i < 1$, for all i. Table 2 shows the results of Pedroni's (2004) cointegration tests with four within-group tests and three between-group tests which indicate the presence of cointegration relationship among the variables.

	Without Trend	With Trend
Within	- <u> </u>	
Dimension		
Panel v-stat	-0.1736	1.2015
Panel rho-stat	-0.4539	-0.4193
Panel pp-stat	-2.0257**	-2.71 62** *
Panel adf-stat	-2.1920**	-2.7162***
Between		
Dimension		
Group rho-stat	0.773 4	0.4821
Group pp-stat	-1. 4929 *	-1.8691**
Group adf-stat	-7.2666**	-1.8691**

Table 3: Pedroni panel cointegration test results (Dependent variable: Real GDP)

Notes: *, **, *** denote significance level at 10%, 5%, and 1% levels, respectively. Maximum lags on Schwartz information criterion (SEC) is 2.

