

Nexus Of Capital Goods Import and Economic Growth: Evidence from Panel ARDL Model for WAMZ

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Abstract Low and unstable economic growth characterized WAMZ countries between 1970 and 2012. Although some of the countries improved in in the last decade, the average growth rate in the sub-region remained unimpressive till 2012. Capital goods import in the sub-region increased from \$1.24 billion in 1970 to \$49.77 billion in 2012. The contradiction presented by increased capital but unstable growth necessitated this study. The panel ARDL that allow for rich dynamics in a way that the dependent variable adjusts to changes in the independent variables was used. The Mean Group (MG), Pooled Mean Group (PMG), and Dynamic Fixed-Effect (DFE) were estimated. The Hausman test informed the choice of PMG. The results indicated that capital import has positive significant impact on economic growth in both short-run and long-run, although the magnitude of coefficient is higher in the long-run. Crude products have negative insignificant impact on economic growth in the short-run, although it was insignificant in the long-run. The impact of domestic investment on economic growth is negative but insignificant although it was significant in the long-run. Same in the long-run, budget deficit, political instability and inflation have negative significant impact on economic growth.

Keywords: Capital Goods import, Economic Growth and ARDL Panel

JEL Classification: F10, F43, O40, O4

1. Introduction

Economic growth and stability remained prominent and consistent in the macroeconomic goals of developing countries, WAMZ¹ countries inclusive. This is centered on the numerous benefits of economic growth to individual country and region. Economic growth has been an important avenue through which per capita can rise and absolute poverty can be reduced in developing nations. Moreover, economic growth enhances job creation and also capable of changing the pattern of employment. A growing economy equally has the capacity to boost tax revenues and generate the money to finance spending on public goods and services, without necessarily increasing tax (Riley, 2012).

Available data from the World Bank showed that the pattern of economic growth in WAMZ countries has been very unstable since 1970. All the countries in the sub region recorded negative growth rate in most periods of 1970 to 2012, although, Nigeria, Ghana and Sierra Leone showed some improvement in the last one decade. The improvement notwithstanding, average growth rate in the sub region remained unimpressive till 2012. It is pertinent therefore, to re-assess the factors responsible for the poor economic growth in the sub-region. Previous studies

¹WAMZ is West Africa Monetary Zone that comprises Nigeria, Ghana, Gambia, Guinea, Liberia and Sierra Leone

have identified factors such as poor quality of labour (Romer, 1990; Barro, 1991), health of the population (Gallup et al. 1998; Barro and Lee 1993), and overdependence on crude product (Gallup et al., 1998). Other notable causes of economic stagnation in developing countries are budget deficits (Fischer, 1993, Easterly and Rebelo, 1992), political instability (Brunetti and Weder, 1995), poor financial system (Levine and Zervos, 1993) high inflation rate (Clark, 1993). Finally, low technological progress and capital goods are other factors fingered when accounting for the low economic growth in developing countries.

Most of the factors restraining economic growth in developing countries could be addressed domestically except technology and capital goods. The capacity of WAMZ countries to produce capital goods required to grow the countries' economies have been very limited hence the need to rely on import. Most of the world capital goods are produced in a small number of research and development (R&D)-intensive countries, while the rest of the world generally imports capital equipment (De Long and Summers, 1991). The importance of capital import by developing countries cannot be over stressed, basically for the international spillovers from developed countries. Moreover, capital import can also drive structural changes and increase competitiveness in the world market. The quality of imported capital stocks differs with its composition, and thus the overall contribution to growth is different across countries (Caselli and Wilson, 2004).

Import of goods and services in WAMZ countries have increased considerably in the last four decades, it increased from \$1.24 billion in 1970 to \$49.77 billion. The share of capital goods in the total import of the WAMZ countries ranged between 22.4% and 41.2% within the period. Despite the increasing import of capital goods, economic growth in WAMZ countries remained unimpressive. It is important therefore to empirically examine the relationship that exists between them. Aside the fact that none of such study existed for either aggregate WAMZ or its individual countries, the present examined the relationship between capital import and economic growth. The ARDL-ECM model, also known as "bounds testing for cointegration", proposed by Pesaran et al (2001) was used instead of granger causality and VECM commonly utilized previously.

2. Trends of Economic Growth and the Performance of Capital Goods in WAMZ

The pattern of economic growth of WAMZ countries has been very unstable in the last couple of decades. Consistent economic contraction characterized most of the countries in WAMZ in 1970 to 2012 period; this is evidenced by negative growth rate. This is an indication of economic recession or depression in these countries. Depicted in Figure 1, based on available data from World Development Indicators is the annual growth rate of GDP per capital between the period 1970 and 2012. It shows that between the period, Gambia recorded negative growth rate in about 22 years. And as at 2012, the country's economy still stinks by 6.9%. The same scenario is the case in Liberia, as the country's economy declined in most of the period she had civil war. For Ghana, Nigeria and Sierra Leone similar economic growth pattern was observed between 1970 and 2000, the negative economic growth witnessed by these countries in the period changed around 2000, and they have been having consistent growth rate in the last decade.

In measuring the welfare implication of the growth in the countries, recourse is made to GDP per capita. Among the WAMZ countries, Ghana has the highest GDP per capita of \$255.1 in 1970. The country's GDP per capita increased to \$407.0 in 1980, although it was not sustained as it declined to \$260. Appreciable increase was recorded in the last decade in Ghana as her GDP increase to \$1570. The per capital GDP in Nigeria fluctuated between \$218.7 and \$1501.7 between 1970 and 2011. Gambia per capita GDP increased from \$114 in 1970 to \$709.3 in 1993 although it declined to \$505 in 2011.

Available data indicated low level of capital goods imports among WAMZ countries, especially, between 1970 and 1996. Expectedly, Nigeria, being an oil rich country, stands out among them, as the import of capital goods in the country increased from \$309 million in 1970 to \$14.6 billion in 2012. Same could not be said about other counties, because as at 2012, Ghana's capital import remained as low as \$3.25 billion. Sierra Leone and Gambia that have the least, reported \$299.1 million and \$908.0 million respectively in 2012.

3. Literature Review

Mini (1968) examined the contribution of foreign investment to economic growth in Italy in the decade after 1955 in the light of classical theories. Their result showed that foreign investment made a contribution to Italy's postwar economic growth. Zhuang and Juliana (2010) explored the determinants of economic growth in American countries using variables from traditional Solow model. Their estimates show that per capita GDP growth is positively related to capital expenditure, primary completion rate and trade openness moreover the relationship is statistically significant. However, the effects of population growth rate and investment in research and development on economic growth are not significant.

Veeramani (2008) showed the type of intermediate goods and capital equipments a country imports and from where it imports indeed matters for its long-run growth. The result further indicated that higher initial value of the productivity level associated with a country's imports leads to a faster growth rate of income per capita in the subsequent years. Cavallo and Landry (2009) examined the impact of capital goods imports and investment specific productivity on the growth of United States. The result indicated that capital goods imports have become an increasing source of growth for the U.S. economy. The result further showed that the U.S. could have lost more than 20 percent of its growth in output per hour without capital-goods imports technology over the past 20 years.

Lagares (2013) examined the growth effects of imported and domestic capital in thirty two Latin America economies from 1960 to 2010. The result showed that countries which experienced a slowdown in economic growth were relatively richer in 1970, and acquired relatively less capital imports and domestic capital. Dulleck and Foster (2008) studied the effect of equipment investment on the growth of developing countries and the interrelationship between such investment and human capital. They found a complex interrelationship between equipment investment and human capital. Generally, the relationship between equipment investment and growth is lowest, and often negative, for countries with low levels of human capital, highest for countries within an intermediate range and somewhat in between for countries with the highest level of human capital.

Lee (1994) confirmed empirically that the ratio of imported to domestically produced capital goods in the composition of investment has a significant positive effect on per capita income

growth rates across countries, in particular, in developing countries. Hence, the composition of investment in addition to the volume of total capital accumulation is highlighted as an important determinant of economic growth.

4. Theoretical Framework and Methodology

4.1 Theoretical Framework

Two major strands of theories have been prominent in establishing the impact of capital on long run productivity. They are neoclassical growth and endogenous growth models. The Solow growth, the most adopted neoclassical growth model, has a number of limitations in analysing the impact of imported capital on growth. The theory is based on the assumption that every firm or economy can take and adopt a new technology without bearing any cost. Another is the unrealistic perfect competition assumption. Therefore the neoclassical growth model cannot capture the spillover effects of technology via international flows of capital goods and knowledge. The endogenous model based on imperfect competition asserts the new products raise productivity once they are embodied in non-labor inputs such as higher quality or more specialized capital and intermediate goods. This paper adopts the endogenous model to examine the impact of capital goods on economic growth. Following ERK (2000), the physical capital flows is splitted into domestic and imported components.

Giving a general production function, that gave the technical relationship between inputs and outputs.

$$Y = F(L, K, M) \quad (1)$$

Where Y , L , K , M are represents output, labor input, physical capital stock generated only by domestic endowments and imported capital goods stock respectively.

Rewriting the production function in per capita form,

$$\frac{Y}{L} = F\left[\frac{L}{L}, \frac{K}{L}, \frac{M}{L}\right] \quad (2)$$

By denoting per-capita variables, $y = Y/L$; $k = K/L$ and $m = M/L$, where y , k and m denote per capita values for Y , K and M . While unlike M , m denotes a flow concept that is, imports of capital goods. The function then can be written as follows:

$$y = f(k, m) \quad (3)$$

By totally differentiating with respect to time and rearranging, we obtained:

$$\frac{dy/dt}{y} = \alpha_K \frac{dk/dt}{y} + \alpha_M \frac{dm/dt}{y} \quad (4)$$

Finally the equation can be expressed as:

$$g_y = \alpha_K i_K + \alpha_M i \quad (5)$$

Where g_y , i_K and i_M denote per capita GDP growth rate, per capita investment generated only by domestic endowments and imported capital goods flow, respectively.

4.2 Methodology

4.2.1 Model Specification

Arising from equation (5) that presents the theoretical underpinning of this paper, economic growth is determined by capital import and domestic investment.

$$egr = f(imcg, dinv) \quad (6)$$

However, previous empirical studies mentioned in the introductory paragraph suggested other factors that affect economic growth problem in developing countries. The factors include quality of labour, health of the population, crude product, budget deficits, political instability, poor financial system, and inflation rate. These other factors were accounted for in this paper, and hence, equation 7.

$$egr = f(imcg, dinv, lab, het, cru, bd, pins, fs, in) \quad (7)$$

Equation (7) can be transformed to (8) an econometrics form expression

$$\begin{aligned} egr_{it} = & \beta_i + \zeta_1 imcg_{it} + \zeta_2 dinv_{it} + \zeta_3 lab_{it} + \zeta_4 het_{it} + \zeta_5 cru_{it} \\ & + \zeta_6 bd_{it} + \zeta_7 pins_{it} + \zeta_8 fs_{it} + \zeta_9 in_{it} + \delta_{it} \end{aligned} \quad (8)$$

Where *egr* is economic growth rate, *imcg* is import of capital goods, *dinv* is domestic investment, *lab* is quality of labour, *het* is health of the labour, *cru* is crude products, *bd* is budget deficit, *pins* is political instability, *fs* is financial system and *inf* is inflation. β is the constant, δ is the error term and $\zeta_1 \dots \zeta_9$ are the coefficients.

4.2.2 Estimation Techniques

The data of the six WAMZ member countries covering the period of 1970 to 2012 were obtained from World Development Indicator (WDI) and World Integrated Trade Solution (WITS). Being a regional study a panel data specification was required. Before proceeding to the estimation, first of all it is necessary to determine the existence of unit roots. The study used Im *et al.* (2003), to test the unit root. The method combines information from the time series dimension as well as from the cross section dimension. The test has been found to have superior test power to analyze long-run relationships in panel data. Additionally the study has performed other unit root test used for both common & individual unit root process as suggested by Levin *et al.* (2002), and Breitung and Meyer (1991).

This paper used the panel ARDL (autoregressive distributed lag) that allow for rich dynamics in a way that the dependent variable adjusts to changes in the independent variables. The ARDL is such that the dependent and independent variables enter the right hand side with lags. Moreover, the (Pesaran and Smith, 1995; Pesaran *et al.*, 1999) Mean Group (MG), Pooled Mean Group (PMG), and Dynamic Fixed-Effect (DFE) were used to estimate the WAMZ data.

$$\begin{aligned}
\Delta egr_{it} = & -\mu_i + \phi_i (egr_{i,t-1} - \varphi_i mcg_{i,t-1} - \varphi_i inv_{i,t-1} - \varphi_i lab_{i,t-1} - \varphi_i het_{i,t-1} \\
& - \varphi_i cru_{i,t-1} - \varphi_i bd_{i,t-1} - \varphi_i pins_{i,t-1} - \varphi_i fs_{i,t-1} - \varphi_i in_{i,t-1}) \\
& + \sum_{j=1}^{p-1} \delta_{0j}^i \Delta(egr_i)_{t-j} + \sum_{j=0}^{q-1} \delta_{1j}^i \Delta inv_{it-j} + \sum_{j=0}^{q-1} \delta_{2j}^i \Delta lab_{it-j} + \sum_{j=0}^{q-1} \delta_{3j}^i \Delta het_{it-j} \\
& + \sum_{j=0}^{q-1} \delta_{4j}^i \Delta cru_{it-j} + \sum_{j=0}^{q-1} \delta_{5j}^i \Delta bd_{it-j} + \sum_{j=0}^{q-1} \delta_{6j}^i \Delta pins_{it-j} + \sum_{j=0}^{q-1} \delta_{6j}^i \Delta fs_{it-j} + \sum_{j=0}^{q-1} \delta_{7j}^i \Delta in_{it-j} + \varepsilon_{i,t} \quad (9)
\end{aligned}$$

Where, $i = 1, 2, \dots, 6$ represents the countries, $t = 1, 2 \dots 42$ represents time period (annual), j is the time lag, p and q are lag orders, μ_i is the fixed effect, ϕ_i is the error-correction coefficient, that measures the speed of adjustment, Δ is first differencing operator, the coefficients of φ_i s denote corresponding long run elasticity and are constraint to be the same across countries.

MG estimates separate ARDL regressions for each group and obtains θ and as simple averages of individual group coefficients. In particular, Pesaran and Smith (1995) showed that the MG estimator will provide consistent estimates of the average of parameters interested. DFE allows the intercepts to differ across groups, but imposes homogeneity of all slope coefficients and error variances. PMG restricts the long-run parameters to be identical over the cross section, but allows the intercepts, short-run coefficients (including the speed of adjustment), and error variances to differ across groups on the cross section. Thus Hausman (1978) was used to identify the relative choice among the MG, PMG and DFE methods.

5. Empirical Analysis

Before proceeding with the result of the ARDL model, that of the stationary status of the variables first reported in order to determine the respective order of integration of the variables under consideration. This becomes expedient since variables $I(2)$ will generate spurious result, despite the fact that ARDL can combine variables of $I(0)$ and $I(1)$ (Pesaran and Pesaran (1997)).

As indicated in Table 1, the unit root test showed that all the variables are stationary at both level and first difference. Resulting from the mixed levels of integration among the series, the Panel ARDL approach rather than the traditional static or panel cointegration test is applied. Another major advantage of the approach is possibility of estimating both short run and long run relationship along with the error correction coefficient.

Based on the result of Hausman test presented in Table 2, the PMG regression is preferred to MG and DFE. Moreover, the preference of the PMG regression result is also premised on the fact that it has higher number of significant variables. It must be remarked however, that the error-correction coefficients of the three models are negative and significant. This indicates that there exists a long-run relationship between economic growth and its determinants (especially capital goods import). This gives evidence of mean reversion to non-spurious and therefore stationary residuals, and further implies that economic growth and its determinants are cointegrated. Moreover, if there are shocks on the determinants, they can cause bias on equilibrium growth rate such that it will tend to equilibrium at the level of 78% in a year.

Regarding the long-run coefficients, capital goods import has positive and statistically significant impact on economic growth. This is consistent with the theoretical expectation and previous studies, although they have been predominantly done in developed countries. Specifically, 1% change in capital goods import causes economic growth to increase by 12%. Domestic investment has been found to produce negative significant effect on economic growth. Budget deficit, political instability and inflation caused the economic growth of the WAMZ countries to significantly decline. The impacts of labour, quality of labour, crude product and financial system have positive insignificant impact on economic growth. The short-run analysis of the PMG on the other hand revealed a better outcome in comparison with the long-run evidence. For the main variable of interest, the impact of capital goods import on economic growth is also significant and positive like in the long-run.

However, based on the magnitude of the coefficients, the coefficient of capital good import indicates a very smaller impact of capital goods import on growth in the short-run compared to long-run. Crude products have negative insignificant impact on economic growth in the short-run, although it was not significant in the long-run. The impact of domestic investment on economic growth is negative but insignificant although it was significant in the long-run. As it is in the long-run, budget deficit, political instability and inflation have negative significant impact on economic growth.

6. Conclusion and Remarks

Low and unstable economic growth characterized WAMZ countries between 1970 and 2012. Although the economic growth of some of the countries improved in the last decade, notwithstanding, the average growth rate in the sub region remained unimpressive till 2012. The place of capital goods import in salvaging economic growth in the sub-region is emphasized in this study more importantly that capital goods import increased from \$1.24 billion in 1970 to \$49.77 billion in 2012. This paper used the panel ARDL (autoregressive distributed lag) that allow for rich dynamics in a way that the dependent variable adjusts to changes in the independent variables. The Hausman test informed the choice of Pooled Mean Group (PMG). The results indicated that capital goods import has positive significant impact on economic growth in both short-run and long-run, although the magnitude of coefficient is higher in the long run. Crude products have negative insignificant impact on economic growth in the short-run, although it was not significant in the long-run. The impact of domestic investment on economic growth is negative but insignificant although it was significant in the long-run. As it is in the long-run, budget deficit, political instability and inflation have negative significant impact on economic growth.

References

- Arawomo F. D.** 2014. "Manufacturing Exports and Imports of Capital Goods: the Nigeria's Case" *Economics Bulletin*, 2014, Vol. 34 No. 3 pp. 1522-1529
- Barre, R. J.** 1991. "Economic Growth in a Cross Section of Countries," *Quarterly Journal of Economics*, 106, 2 (May), 407-433.
- Barre, R. J. and J. Lee.** 1993. "International Comparisons of Educational Attainment," *Journal of Monetary Economics*, 32 (December), 363-394.
- Breitung, J., Meyer, W.** 1991. Testing for unit roots in panel data: are wages on different bargaining levels cointegrated? *Institut fur Quantitative Wirtschaftsforschung*, Working paper.
- Brunetti A. and B. Weder.** 1995. "Political Sources of Growth: A Critical Note on Measurement", *Public Choice* 82, pp. 125-134.
- Cavallo M. and A. Landry.** 2009. Capital-Goods Imports, Investment-Specific Productivity, and U.S. Growth *Working Paper of Federal Reserve Bank of Dallas*.
- DeLong, J. B. and L. H. Summers.** 1991. "Equipment Investment and Economic Growth," *Quarterly Journal of Economics*, 106, 2 (May), 445-502.
- Dulleck U. and N. Foster.** 2008. Imported Equipment, Human Capital and Economic Growth in Developing Countries *Economic Analysis & Policy*, Vol. 38 NO. 2, September 2008
- Easterly W. and S. Rebelo.** 1993. "Fiscal policy and economic growth: An empirical investigation" *Journal of Monetary Economics* 32 (1993) 417-458. North-Holland
- Fischer, S.** 1993. "The Role of Macroeconomic Factors in Growth," *Journal of Monetary Economics*, 32, 3 (December), 485-512
- Lagares O.** 2013. Domestic and Imported Capital, Economic Growth and Relative Income Differences in Latin America *Working Paper of University of York*
- Lee, Jong-Wha.** 1994. Capital Goods Imports and Long-Run Growth NBER Working Paper No. 4725.
- Levine, R. & Zervos, S.** 1996. Stock Market Development and Long-Run Growth. *The World Bank Economic Review*, 10, 323-339
- Mini P. V.** 1968. Capital Imports and Economic Growth: The Italian Experience, 1955-64. *Economic Development and Cultural Change*, Vol. 16, No. 2, Part 1 (Jan., 1968), pp.261-273
- Romer P.M.** 1990. "Capital, Labor, and Productivity." *Brookings Papers Econ. Activity* (1990), in press.

Safdari, Mehrizi and Elahi. 2012. Effects of imported technology on economic growth in Iran *African Journal of Business Management* Vol.6 (24), pp. 7120-7125, 20 June, 2012

Veeramani C. 2008. Impact of Imported Intermediate and Capital Goods on Economic Growth: A Cross Country Analysis. The Working Paper of Indira Gandhi Institute of Development Research (IGIDR)

Zhuang and Juliana. 2010. Determinants Of Economic Growth: Evidence From American Countries *International Business & Economics Research Journal* Volume 9, Number 5

Figure 1: GDP per capita growth (annual %) in WAMZ Countries

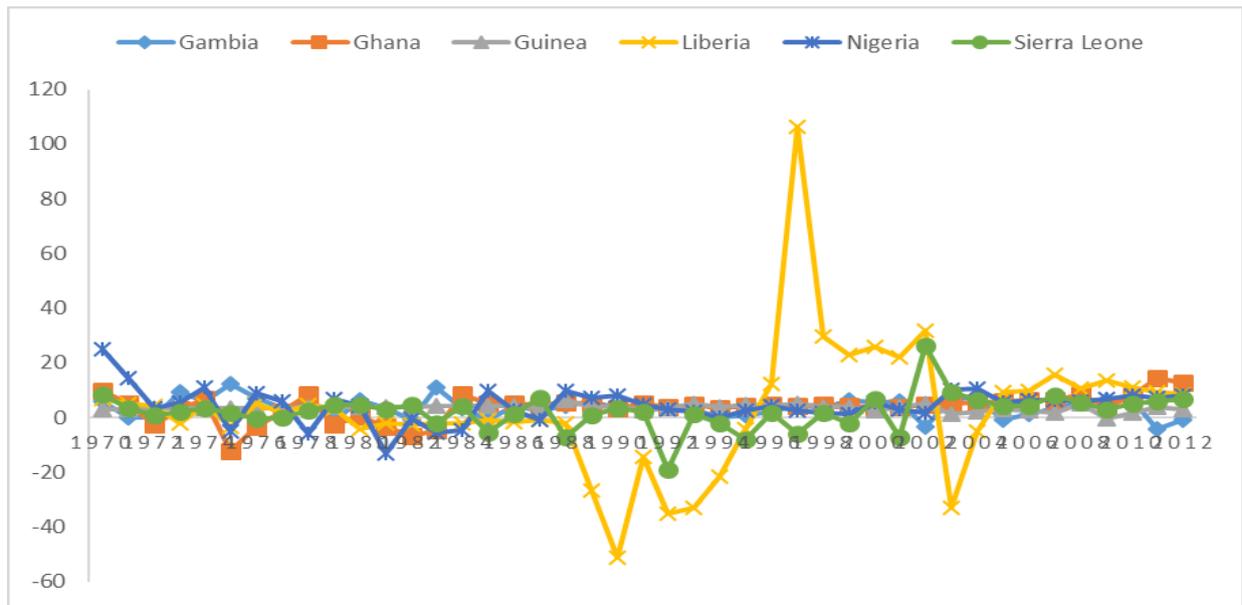


Figure 2: GDP per capita for WAMZ Countries

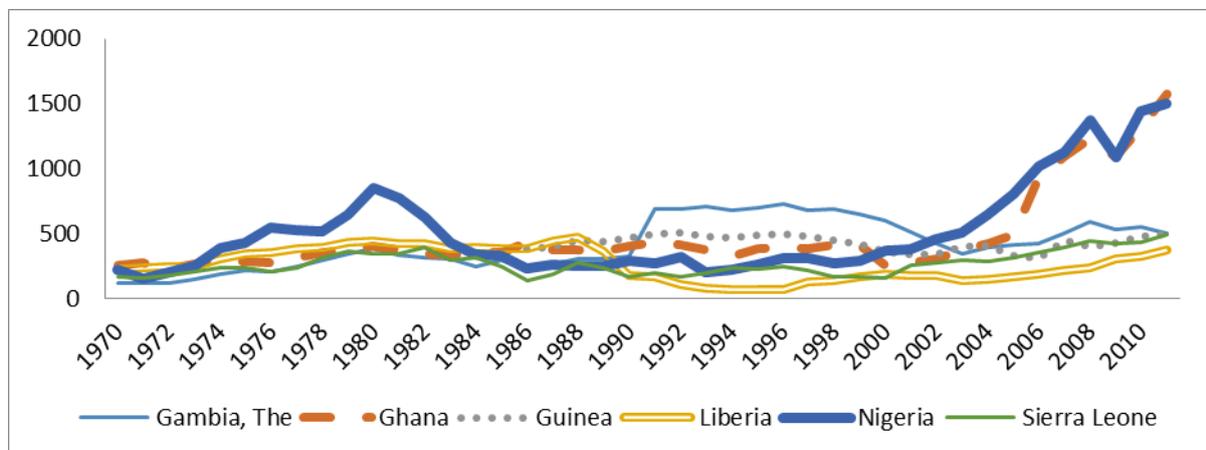


Figure 3: Capital Goods Import (\$ million)

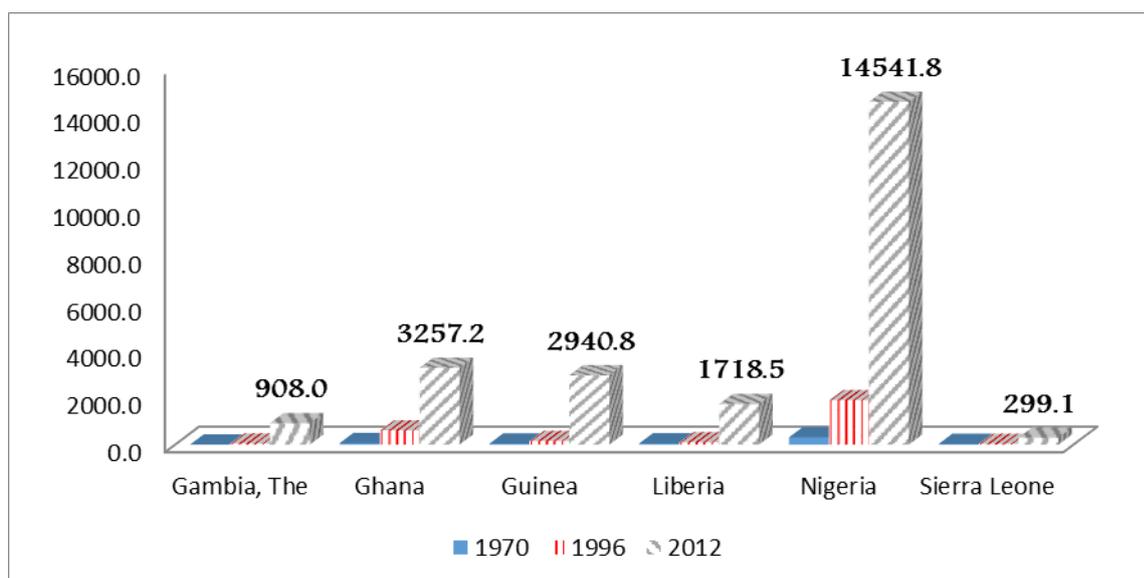


Table 1: Panel Unit Root Test

Variables	Level		Ist Difference	
	Levin, Lin & Chu t*	Im, Pesaran and Shin W-stat	Levin, Lin & Chu t*	Im, Pesaran and Shin W-stat
<i>Egr</i>	3.01	0.61	17.97***	15.31***
<i>Imcg</i>	4.49***	3.21	32.12***	17.61***
<i>Dinv</i>	2.36	2.07	24.11***	8.71***
<i>Lab</i>	4.02***	3.91	25.15***	18.32***
<i>Het</i>	1.99	2.21	14.52***	15.62***
<i>Cru</i>	1.02	0.29	21.23*	23.11***
<i>Bd</i>	2.10	1.65	17.19**	17.12***
<i>Pins</i>	2.11	1.71	16.43***	12.14***
<i>Fs</i>	0.71	0.21	10.43	11.17***
<i>Inf</i>	1.23	0.13	17.32***	5.29***

*, **, *** represent 10%, 5% and 1% significant level respectively

Table 2: The Effects of Capital Goods Import on Economic Growth in WAMZ

Variables	Mean Group (MG)	Pooled Mean Group (PMG)	Dynamic Fixed Effect (DFE)
<i>Long Run</i>			
<i>Imcg</i>	0.022**	0.120**	0.029**
<i>Dinv</i>	-3.836***	-1.881**	-6.618**
<i>Lab</i>	2.510	2.653	1.559
<i>Het</i>	9.251	3.868	8.396
<i>Cru</i>	3.269	0.175	1.128
<i>Bd</i>	-1.345	-0.356**	-2.752
<i>Pins</i>	-4.023**	-5.235*	-2.255**
<i>Fs</i>	1.788	2.779	7.220
<i>Inf</i>	-1.249*	-0.073***	-3.549**
<i>Short Run</i>			
<i>Ec</i>	-1.015***	-0.788***	-0.769***
$\Delta imcg$	1.729**	0.018**	0.135**
$\Delta dinv$	-6.225	-4.642	-0.420
Δlab	3.692	4.173	-1.810
Δhet	-7.685	4.296	-2.768
Δcru	-3.523	-0.053***	-0.821*
Δbd	2.067***	-5.359*	1.649
$\Delta pins$	-1.008**	-6.429**	-1.259***
Δfs	2.587	3.466	3.089
Δinf	-1.062	-0.687***	-0.420
<i>Cons_</i>	73.135***	32.324**	13.854**
<i>Hausman Test</i> ²	7.27 (0.0687)		
<i>Hausman Test</i> ³	7.09 (0.0291)		

***, **, and * indicate significant at 1%, 5% and 10% levels, respectively.

² MG is not a more efficient estimation compared to PMG under null Hypothesis

³ DFE is not a more efficient estimation compared to PMG under null Hypothesis