Capital Goods Import and Manufacturing Sector's Output in Nigeria: Evidence from ARDL Bounds Testing Procedure

The study examined the impact of capital goods import on manufacturing sector output in Nigeria using annual time series data for the period 1981–2017. The Autoregressive Distributed Lag (ARDL) modelling procedure and the bounds testing approach to co-integration were adopted to examine the short run and the long run relationship between the manufacturing sector output and its selected determinants. The empirical results revealed that importation of capital goods has a positive impact on the manufacturing sector output in Nigeria. However, the impact was statistically significant only in the long run. In the short run, though the impact of importation of capital goods was positive, it was not statistically different from zero. Also, devaluation / depreciation of the naira was found to have a significant but negative impact on manufacturing sector output in Nigeria, both in the short run and long run. It was therefore recommended that the Nigerian authorities should relax import restrictions on capital goods imported into the country to enable the manufacturing sector have easy access to the needed capital inputs for their operations. The paper also called on the monetary authorities in Nigeria to initiate deliberate policies to stabilize the exchange rate of the naira.

Keywords: *Bounds Test, Capital Imports, Co-Integration, Manufacturing Sector*
JEL Classification: F43

Introduction

Nigeria is a country well-endowed with natural and human resources. It is one of the leading exporter of crude oil in Africa. However, over 80% of the country's population currently live on less than US$2 a day (Schiere, Ndikumana & Walkenhorst, 2018).

The country which is among the lower middle income country rely heavily on oil export for government revenue. In 2017, oil revenue accounted for N4,109.8 billion or 56.2% of total government revenue (CBN, 2017). With the heavy dependence on crude oil export as the chief source of foreign exchange, shocks in the international oil price greatly affect economic activities in Nigeria. It is a common saying that when the international oil price sneezes the Nigeria nation catches cold. One way to insulate the Nigerian economy from the effect of the continuous fluctuations in the international oil price is to diversify the export base of the country away from oil. Hence, the economic recovery and growth plan of Nigeria (2017–20) identified six priority sectors which are Agriculture, Manufacturing, Solid minerals, Services, Construction and Real Estate, and Oil and gas (CBN, 2017).

Expansions in the manufacturing sector is a serious source of economic growth in any economy. One of the main driver of the Asia miracle is the rise in the share of the manufacturing sector in the Gross Domestic Product (GDP). Wahab, Sultana and Hoque (2016) noted that Bangladesh economy started growing rapidly since the mid 90's and the growth was propelled by the

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dominance of large manufacturing industries in the economy. According to them, the share of manufacturing sector in GDP increased from 11.6% in the1980's to about 15% in the 1990's. In 2014, the share of manufacturing sector in GDP in Bangladesh hit 19%. During the period, the economy grow about 9% annually.

The performance of the manufacturing sector in any economy depends greatly on the amount of capital accumulated. The manufacturing sector in the industrialized countries is expanding rapidly because they have high accumulation of capital resulting from their huge investment in research and development (R & D), (DeLong & Summers, 1991). But the less developed countries with comparative disadvantage in the production of capital goods have to depend on import to acquire the needed inputs in the manufacturing sector.

Generally, there is a robust literature on the role of international trade on economic growth in develop and less developed countries. studies such as Agbo, Ebere and Oluchukwu (2018), Lawal and Ezeuchenne (2017), Abiodun (2017), Afolabi, Danladi and Azeez (2017), Afaf and Hussain (2015), Adeley, Adeteye and Adewuyi (2015), Oluwatoyin and Folasade (2014), Daumal and Ozyurt (2011) and Sun and Heshmati (2010) examined the impact of international trade on economic growth in different countries and came up with mixed findings on the impact of international trade on economic growth. Other studies on international trade focused on the impact of capital goods import on economic growth. Cavallo and Landry (2018) found out in their study that capital goods import contributed about 14% to the growth of the United States output per hour since 1975. This findings were in line with Arawomo (2014[b]) and Lee (1994). Arawomo (2014[b]) based his study on WAMZ (West Africa Monetary Zone) countries, while Lee (1994) employed a panel of 89 less developed countries. In their various studies, they found that capital goods import significantly and positively influence economic growth. But the findings of Mazol (2016) from his study on Belarious economy shows that import of intermediate and capital goods have negative impact on economic growth. These studies examined the impact of the import of capital goods on the growth of the entire economy.

It is important to note that the link through which international trade affect economic growth is through technological transfer resulting from knowledge spillover from the advanced countries. These technologies are embedded in capital and intermediate goods imported and used heavily in the manufacturing sector. The ability of productivity in the manufacturing sector to react positively to these new technologies is what trigger off economic growth. From empirical literature, fewer studies have been conducted on the reactions of manufacturing sub-sector to importation of capital goods. The result from the study of Wahab, Sultana and Hoque (2016) on Bangladesh economy from 1981 to 2014 reveled that capital goods import significantly promote output growth in the manufacturing sector in the long run. From that study, the impact of capital goods import on manufacturing output was not statistically significant in the short run. Jiranyakul (2012) using monthly data from Thailand for the period 2000 – 2011, found that capital goods import

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significantly encourage manufacturing export. However, the findings of Arawomo (2014[a]) using annual time series data from Nigeria for the period 1970 – 2012 revealed that capital goods import impede manufacturing sector export in Nigeria both in the short run and in the long run.

The above review shows that much attention in international trade studies is placed on economic growth in aggregative terms. Less attention has been placed on the reactions of the various sub-sectors of the economy to international trade particularly imports. Empirical studies on the reaction of the manufacturing sector to import of capital good are rather scarce. Even the study of Arawomo (2014b) only focused on manufacturing sector export and not the total manufacturing sub-sector output. Lessons from the Asia growth miracle suggest that performance of the manufacturing sector is a key to rapid and sustainable economic growth. Economic theory postulates that capital goods importation will stimulate economic growth in developing countries, since they have comparative cost disadvantage in the production of capital goods compared to the industrialized countries. However, empirical findings in this direction from different developing economies are mixed. Hence, it become pertinent to ask the question: "how is output in the manufacturing sector reacting to imports of capital goods in developing country like Nigeria?" There seems to be a drought of studies in this direction and this is the area this study seek to address. Therefore, this study is aimed at verifying the impact of capital goods import on output growth in the manufacturing sector using annual time series data from Nigeria for the period 1981 – 2017. The broad hypothesis tested in this study is:

H_0: Import of capital goods does not significantly affect manufacturing sector output in Nigeria.

This study is divided into five sections. Apart from section one which is the introduction, section two deals with the presentation of the methodology applied in the study. Section three covers the presentation of empirical results. Discussion of empirical findings are contained in section four, while the study is rounded off in section five with some concluding remarks.

Methodology

The study relied on the endogenous growth model to establish the link between capital goods import and output of the manufacturing sector. Technological progress has been identified as a key source of economic growth. However, in the classical growth model, technological progress was treated as exogenous. Romer (1990) in his endogenous growth model introduced research and development (R&D) into the growth model to make technological progress endogenous. From Romer (1990), innovation which is a bye product of research is the prime mover of economic growth. Innovation resulting from investment into the R&D sector causes productivity growth by creating new varieties of products. This shows that the growth in the final goods sector depends on innovations and discoveries in the R&D sector.

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However, Grossman and Helpman (1991) noted that research activities in the developing countries are scanty due to poor investment in the research and development sector. The poor funding of research in these countries has resulted in low research output creating scarcity of discoveries needed to propel development in the industrial sector. Poor development of the R&D sector in developing countries constrain them to a position of comparative disadvantage in the production of capital goods compared to the industrialized countries. Hence, Grossman and Helpman (1991) noted that development in the manufacturing sector is only possible if the less developed countries import capital goods form the industrialized countries as input for manufacturing output.

Given the link between capital goods import and manufacturing sector output described above, the study modify the model of Jiranyakul (2012) to estimate the manufacturing output model for Nigeria. For this study, manufacturing sector output is model as a function of capital goods import, domestic capital stock, exchange rate and economic growth rate. This can be expressed as:

$$MANY_t = \alpha_0 + \alpha_1 CAPG_t + \alpha_2 K_t + \alpha_3 EXG_t + \alpha_4 GR_t + u \quad - \quad - \quad - \quad (1)$$

Where:

MANY = value of manufacturing sector output
CAPG = value of total capital goods imported
K = Domestic capital stock
EXG = exchange rate of the naira
GR = Economic growth rate

The corresponding autoregressive distributed lag (ARDL) model specification of the above is given as:

$$\Delta MANY_t = \beta 0 + \beta_1 MANY_{t-i} + \beta_2 CAPG_{t-i} + \beta_3 K_{t-i} + \beta_4 EXG_{t-I} + \beta_5 GR_{t-i} + \sum_{i=1}^{n} \beta 6i \Delta MANYt - i + \sum_{i=1}^{n} \beta 7i \Delta CAPGt - i + \sum_{i=1}^{n} \beta 8i \Delta Kt - i + \sum_{i=1}^{n} \beta 9i \Delta EXGt - i + \sum_{i=1}^{n} \beta 10i \Delta GRt - i + \varepsilon_t \quad (2)$$

Where: Δ is the first difference operator and ε is white noise error term. Other variables are as defined previously and are expressed in their log form.

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The study employed the bounds test approach to co-integration to examine the nature of long run relationship between manufacturing sector output and its selected determinants. This approach which is based on wald test (F statistics) is conducted by imposing restrictions on the long run estimated coefficient of one period lagged level of the selected variables to be equal to zero. This means that:

$$H_0: \beta_1 = \beta_2 = \beta_3 = \beta 4 = \beta 5 = 0 \quad - \quad - \quad - \quad (3)$$

The tabulated critical value of Narayan (2005) is employed to ascertain the lower and upper bounds asymptotic critical values at 5% significant level since the observation is less than 100 (Seng & Hook, 2018). The short run determinants of manufacturing sector output and the speed of adjustment were captured using the error correction model expressed as:

$$\Delta MANY_t = \beta 0 + \sum_{i=1}^{n} \beta 1i\Delta MANYt - i + \sum_{i=1}^{n} \beta 2i\Delta CAPGt - i + \sum_{i=1}^{n} \beta 3i\Delta Kt - i + \sum_{i=1}^{n} \beta 4i\Delta EXGt - i + \sum_{i=1}^{n} \beta 5i\Delta GRt - i + \beta 6\, ect_{t-1} + \pi_t \quad (4)$$

Where: ect_{t-1} is the error correction term and β_6 is the coefficient for measuring speed of adjustment. The coefficient β_6 is expected to be negative for the model to be dynamically stable.

The study adopted the autoregressive distributed lag (ARDL) modelling procedure and the bounds testing approach to co-integration to examine the short run and long run relationship between manufacturing sector output and its selected determinants. This method is widely used in the analysis of long run relationship among variables when the data generating process underlying the time series are integrated of different order (Pasaran & Shin, 1999). The bounds testing procedure to co-integration is preferred to other methods such as Johansen co-integration test and Engle and Granger test due to its relative better performance even in cases of small sample size. Also, it yield consistent result when applied to model with a mixture of stationary and non-stationary time series.

The lag structure of the ARDL model is selected based on Akaike information criterion (AIC). The data are soured from the annual report of National Bureau of Statistics (NBS) and the statistical bulletin of the Central Bank of Nigeria (CBN).

Empirical Results

Unit Root Test of Variables

The Augmented Dickey Fuller (ADF) statistics was adopted in testing for stationarity of the variables. The result is presented in table 1 below

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Table 1. *Unit Root Test for Variables*

Variables	Level		First difference		Order of integration
	ADF statistics	Critical value @ 5% level	ADF statistics	Critical value @ 5% level	
MANY	0.6628	2.9484	3.2881	2.9484	I(1)
CAPG	0.1135	2.9571	5.6556	2.9571	I(1)
K	4.7640	2.9458	-	-	I(0)
EXG	1.2973	2.9458	5.0416	2.6128	I(1)
GR	5.0217	2.9458	-	-	I(0)

Source:

From the table, domestic capital stock and economic growth rate were stationary in level, hence they are said to be integrated of order zero {I (0)}. Manufacturing sector output, capital goods import and exchange rate of the naira were stationary in first order difference, hence they are said to be integrated of order one {I(1)}. Since some of the variable contains unit root, it is necessary to ascertain the nature of long run relationship among the variables, hence, the co-integration test is conducted.

Co-integration Test

The co-integration test based on bounds test procedure is presented in the table 2 below

Table 2. *ARDL Bounds Test Result*

Model	F-Statistics	
Model: MANY = f(CAPG, K, EXG, GR)	18.3041(0.000)	
Narayan (2005) k = 4	n = 37	
Critical value	Lower bound	Upper bound
1%	4.590	6.368
5%	3.276	4.630
10%	2.696	3.898

Source:

From the result above, the computed F- statistics is greater than critical upper bound value at even 1% level. This clearly shows that there exist a long run co-integration relationship among the manufacturing sector output and its selected determinants

Manufacturing sector output short run equation estimate

The short run estimates of the manufacturing sector output model based on ARDL modeling is presented in the table below:

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Table 3. *Short Run Estimates of Manufacturing Sector Output Model*

Variable	Coefficient	t-statistics [p-value]
Constant	13.561	0.117 [0.907]
MANY(-1)	-0.439**	-2.285 [0.033]
MANY(-2)	-0.201	-0.990 [0.333]
MANY(-3)	0.668*	4.088 [0.000]
MANY(-4)	-0.276***	-2.020 [0.057]
CAPG(-1)	0.027	0.386 [0.703]
CAPG(-2)	0.027	0.229 [0.821]
CAPG(-3)	0.263**	2.158 [0.043]
CAPG(-4)	0.164	1.393 [0.178]
K	30.667*	2.934 [0.008]
EXG(-1)	-0.136	-0.110 [0.912]
EXG(-2)	-3.020***	-2.051 [0.053]
GR	0.621	0.166 [0.869]
ECT_{t-1}	-1.249*	-20.536 [0.000]
R^2 = 0.916 Adjustment R^2 = 0.866 F – Statistics = 18.304 [0.000] Dependent Variable = MANY Estimation period : 1981 – 2017		

Source:

The lag structure of (4, 4, 0, 2, 0) was selected based on Akaike information criterion (AIC). The above result revealed that capital good import has a positive impact on manufacturing sector output in the short run, however, the impact was not statistically significant even at 10% in the first and second lag period. It was only significant in the third lag period at 5% level. Domestic capital stock has a positive sign and also statistically significant at 1% level. Exchange rate has a negative sign in the current period and in the lag period value. The impact of exchange rate on manufacturing sector output was not statistically significant in the current period but significant at 10% in the one lag period. Economic growth rate though has a positive sign was not statistically significant even at 10% level.

The error correction term has the appropriate negative sign with a coefficient of -1.249 and a t ratio of -20.536. This shows that about 124.9% of the short run disequilibrium is adjusted for every period. The negative sign of the error correction term is an indication that the model is dynamically stable. Also, it is a further confirmation that the manufacturing sector output and it selected determinants are indeed co-integrated.

i. Long run coefficient of variable.

The long run impact of the explanatory variables are shown by the long run coefficient of the variable in table 4 below:

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Table 4. *Long Run Coefficient*

Variable	Coefficient	t-statistics [p-value]
CAPG	0.387*	6.182 [0.000]
K	24.550*	3.115 [0.005]
EXG	-2.309*	-3.646 [0.001]
GR	0.497	0.166 [0.869]
Constant	10.856	0.117 [0.907]

*=significant at 1% level

From the result, capital goods import and domestic capital stock have positive and significant impact on manufacturing sector output in Nigeria, while the impact of exchange rate is negative. Economic growth rate was not statistically significant.

ii. Diagnostic test

In order to test for the robustness of the estimates, some diagnostic tests were conducted. These include the serial correlation test, heteroscedasticity test, normality test of residual and the cusum stability test.

The serial correlation test was based on Breusch-Godfrey LM test, while the heteroscedasticity test was based on Breusch-Pagan-Godfrey test. The results are shown in table 5 and table 6 for serial correlation and heteroscedasticity respectively. From the results there is no indication of serial correlation in the model. Also from the Breusch-Pagan-Godfrey test result, the residual is homoscedastic.

Table 5. *Breusch-Godfrey Serial Correlation LM Test*

F-statistic	0.085615	Prob. F(2,18)	0.9183
Obs*R-squared	0.310965	Prob. Chi-Square(2)	0.8560

Table 6. *Heteroskedasticity Test: Breusch-Pagan-Godfrey*

F-statistic	0.304578	Prob. F(12,20)	0.9807
Obs*R-squared	5.098841	Prob. Chi-Square(12)	0.9546
Scaled explained SS	1.418455	Prob. Chi-Square(12)	0.9999

The normality test is based on Jarque-Bera statistics. The result is shown in figure 1 below.

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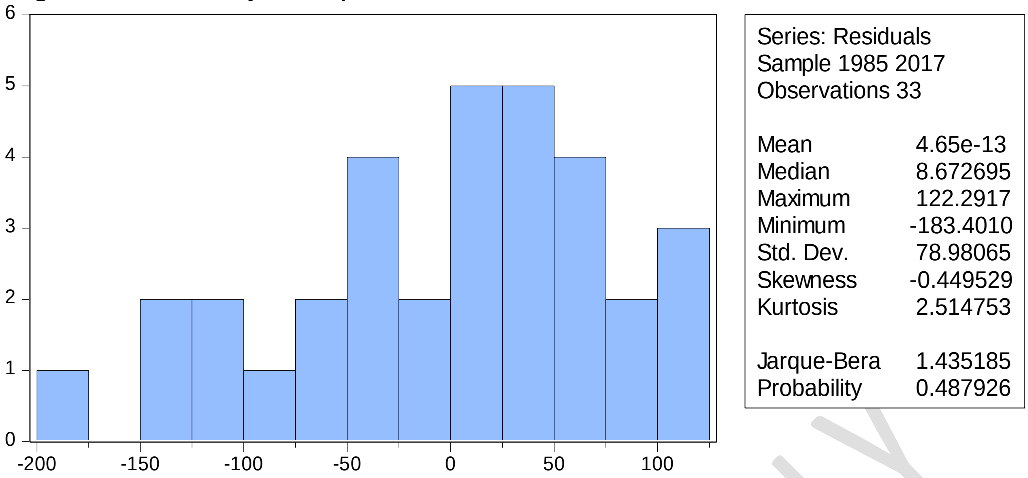
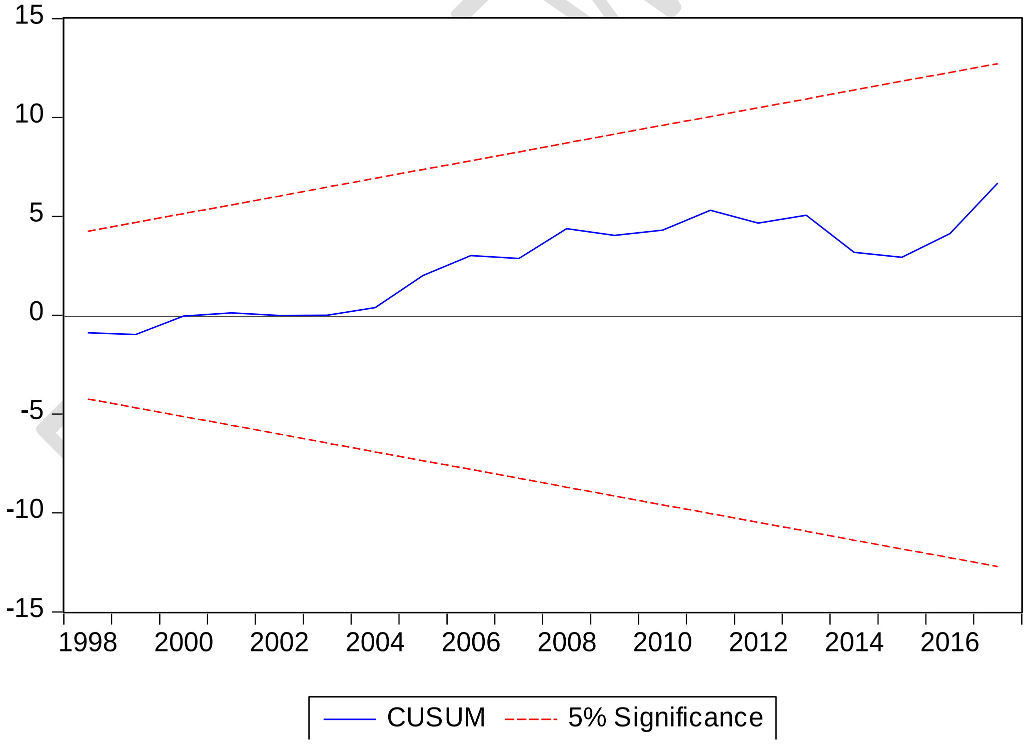
Figure 1. *Normality test of Residual*



From the result, Jarque – Bera statistics has a coefficient of 1.435 with a probability value of 0.487. Based on 5% significant level, the residual can be said to be normally distributed. On this basis it can be stated that $\varepsilon_t \sim N(0, \sigma^2)$.

The stability of the coefficients of the model were examined using cumulative sum (CUSUM) plot. The result is shown in figure 2 below:

Figure 2. *Cusum Stability Test*



From the above result, the recursive estimation of the model clearly indicates stability of the coefficient over the sample period.

Discussion of Findings

The empirical result of this study revealed that import of capital goods significantly affect manufacturing sector output in Nigeria only in the long run. This shows that the null hypothesis which state that the capital goods import does not significantly affect manufacturing sector output in Nigeria is rejected against the alternative hypothesis.

An increase in importation of capital goods will boost the performance of the manufacturing sector in Nigeria in the long run. This implies that the performance of the manufacturing sector in Nigeria depends significantly on importation of capital goods. This finding validate the theoretical postulation of Grossman and Helpman (1991) that developing countries due to their poor funding of research and development (R&D) sector are constraint to continuously depend on importation of capital goods from the industrialized countries to propel development in their industrial sector. This result is also in line with the empirical findings of Wahab, Sultana and Hoque (2016).

The result also revealed that exchange rate has a significant but negative impact on manufacturing sector output in Nigeria. This shows that an increase in exchange rate (devaluation of the naira against the US$) will lead to a fall in the output of manufacturing sector output in Nigeria. This is explainable, as devaluation of the naira will mean an increase in the price of imported manufacturing inputs. This is so as more naira would the needed to pay for the same quantity of imported inputs of the manufacturing firms. This implies that devaluation of the naira will constrain the capacity of the manufacturing firms to import needed inputs for their operations.

Conclusion

The study examined the impact of import of capital goods on manufacturing sector output in Nigeria. The empirical result revealed that manufacturing sector depends significantly on the importation of capital goods. Also, devaluation of the naira leads to a fall in the manufacturing sector output both in the short run and long run.

On the basis of these findings, it is recommended that:

a. The authorities should as a matter of deliberate policy relax the import restriction on capital goods in Nigeria. This will help manufacturing firms to be able to acquire the needed capital inputs for their operations.

b. Depreciation / devaluation of the naira has detrimental effect on the manufacturing sector output in Nigeria. Therefore, the Central Bank of Nigeria (CBN) should initiate policies to stabilize the exchange rate of the naira.

References

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Abiodun, K., (2017). Contribution of international trade to economic growth in Nigeria. 2017 *Award for excellence in students research and creative activity-documents.1* retrieved from http://thekeep.eiu.edu/lib_awards_2017_docs/1

Adeleye, J. O., Adeteye, O. S., & Adewuyi, M. O (2015). Impact of international trade on economic growth in Nigeria. *International Journal of Financial Research 6(3):163 – 172.*

Afolabi, B., Danladi, J. D., & Azeez, M. I., (2017). International trade and economic growth in Nigeria. *Global journal of human-social sciences. 17(5): 29 – 39.*

Afaf, A. J. S., & Hussain, M. A., (2015). Impact of export and import on economic growth: Evidence from Tunisia. *Journal of Emerging Trend in Economics and Social Sciences 6(1): 13 – 21.*

Agbo, E. I., Ebere, A. R., & Oluchukwu, E. L., (2018). Impact of international trade on economic Growth in Nigeria. *European Journal of Business and Management 10(18): 22 – 30.*

Arawomo, D. F., (2014). Manufacturing exports and imports of capital goods nexus: the Nigeria's Case. *Economic bulletin 34(3):1522 – 1529*

Arawomo, D.F. (2014). Nexus of capital goods import and economic growth: evidence from panel ARDL model for WAMZ. *Journal of international and global economic studies 7(2):32-44.*

Cavallo, M & Landry, A,. (2018). Capital – goods imports and US growth. *Bank of Canada staff working paper. No 2018-1*

CBN (2017). Central Bank of Nigeria of Nigeria annual report, 2017.

Daumal, M.J & Ozyurt, S., (2011). The impact of international trade flows on economic growth in Brazilian states. *Review of economics and institution 2(1): 1 – 25*

DeLong, J. B & Summers (1991) Equipment investment and economic growth. *Quarterly journal of economics 106(2): 445 – 502*

Grossman, G.M., & Helpman, E. (1991). Trade, knowledge spillovers and growth. *European economic review 35(2): 517 – 526*

Jiranyakul, K. (2012) Are Thai manufacturing exports and imports of capital goods related? *Modern economics 106(3):237 – 244*

Lawal, E.O. & Ezeuchenne, K (2017) International trade and economic growth in Nigeria. *Journal of humanities and social sciences 22(4): 35 – 43*

Mazol, A., (2016) Intermediate and capital goods import and economic growth in Belarus. *Belarious research and outreach center policy brief 2016*

Narayan, P. K. (2005). The savings and investment nexus in China: Evidence from co-integration test. *Applied econometrics 37:1979 – 1990.*

Oluwatoyin, M. A., & Folasade, A. B., (2014). Trade openness, institutions and economic growth In Sub-Sharan Africa. *Developing Country Studies 4(8): 18 – 30.*

Pesaran, M.H. & Shin, Y. (1999). An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis. *Econometrics and Economic Theory in the 20th Century*: The Ragnar Frisch Centennial Symposium, Strom, S. (ed.) Cambridge University Press.

Schiere, R., Ndikumana, L., & Walkenhorst, P. (2018) China and Africa: an emerging partnership for development? *African Development Bank group 2018.*

Seng, K. W. K & Hook, L. S (2018). Notes on bounds test and ARDL co-integration testing Procedure. *ResearchGate.* *https://www.researchgate.net/publication/322208483*.

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APPENDIX

Long Run OLS Output

Dependent Variable: D(MANY)				
Method: Least Squares				
Date: 01/11/19 Time: 00:19				
Sample (adjusted): 1985 2017				
Included observations: 33 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.56126	115.1914	0.117728	0.9075
MANY(-1)	-0.439029	0.192079	-2.285668	0.0333
MANY(-2)	-0.201765	0.203667	-0.990664	0.3337
MANY(-3)	0.668561	0.163518	4.088618	0.0006
MANY(-4)	-0.276952	0.137096	-2.020135	0.0570
CAPG(-1)	0.027973	0.072369	0.386527	0.7032
CAPG(-2)	0.027607	0.120519	0.229071	0.8211
CAPG(-3)	0.263967	0.122305	2.158276	0.0432
CAPG(-4)	0.164025	0.117692	1.393678	0.1787
K	30.66771	10.44980	2.934766	0.0082
EXG(-1)	-0.136188	1.230122	-0.110711	0.9129
EXG(-2)	-3.020978	1.472721	-2.051290	0.0536
GR	0.621631	3.724439	0.166906	0.8691
R-squared	0.916545	Mean dependent var		168.9424
Adjusted R-squared	0.866472	S.D. dependent var		273.3973
S.E. of regression	99.90350	Akaike info criterion		12.33339
Sum squared resid	199614.2	Schwarz criterion		12.92292
Log likelihood	-190.5009	Hannan-Quinn criter.		12.53175
F-statistic	18.30415	Durbin-Watson stat		1.904920
Prob(F-statistic)	0.000000			

Breusch-Godfrey Serial Correlation LM Test:				
F-statistic	0.085615	Prob. F(2,18)		0.9183
Obs*R-squared	0.310965	Prob. Chi-Square(2)		0.8560
Test Equation:				
Dependent Variable: RESID				
Method: Least Squares				
Date: 01/11/19 Time: 00:25				
Sample: 1985 2017				
Included observations: 33				
Presample missing value lagged residuals set to zero.				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-25.70161	136.7846	-0.187898	0.8531
MANY(-1)	-0.000601	0.252402	-0.002381	0.9981
MANY(-2)	0.009328	0.256422	0.036377	0.9714
MANY(-3)	-0.006636	0.197139	-0.033663	0.9735
MANY(-4)	0.004577	0.180886	0.025304	0.9801
CAPG(-1)	0.006157	0.078210	0.078729	0.9381
CAPG(-2)	-0.023312	0.138883	-0.167855	0.8686
CAPG(-3)	0.021936	0.139400	0.157362	0.8767
CAPG(-4)	-0.018080	0.142974	-0.126456	0.9008
K	1.615017	11.88616	0.135874	0.8934
EXG(-1)	-0.277144	1.459379	-0.189905	0.8515
EXG(-2)	-0.292228	1.699535	-0.171946	0.8654

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GR	0.144210	4.036308	0.035728	0.9719
RESID(-1)	0.016489	0.382667	0.043090	0.9661
RESID(-2)	-0.150867	0.376497	-0.400712	0.6933
R-squared	0.009423	Mean dependent var		4.65E-13
Adjusted R-squared	-0.761025	S.D. dependent var		78.98065
S.E. of regression	104.8102	Akaike info criterion		12.44513
Sum squared resid	197733.2	Schwarz criterion		13.12536
Log likelihood	-190.3447	Hannan-Quinn criter.		12.67401
F-statistic	0.012231	Durbin-Watson stat		1.984644
Prob(F-statistic)	1.000000			

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Heteroskedasticity Test: Breusch-Pagan-Godfrey				
F-statistic	0.304578	Prob. F(12,20)		0.9807
Obs*R-squared	5.098841	Prob. Chi-Square(12)		0.9546
Scaled explained SS	1.418455	Prob. Chi-Square(12)		0.9999
Test Equation:				
Dependent Variable: RESID^2				
Method: Least Squares				
Date: 01/11/19 Time: 00:26				
Sample: 1985 2017				
Included observations: 33				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3773.180	10138.74	0.372155	0.7137
MANY(-1)	14.21072	16.90613	0.840567	0.4105
MANY(-2)	-6.087659	17.92600	-0.339599	0.7377
MANY(-3)	-1.709169	14.39224	-0.118756	0.9067
MANY(-4)	-3.554091	12.06668	-0.294538	0.7714
CAPG(-1)	3.835895	6.369689	0.602211	0.5538
CAPG(-2)	-6.481673	10.60765	-0.611038	0.5481
CAPG(-3)	8.815816	10.76482	0.818947	0.4225
CAPG(-4)	-11.76593	10.35887	-1.135831	0.2695
K	-128.2554	919.7540	-0.139445	0.8905
EXG(-1)	-37.76839	108.2709	-0.348832	0.7309
EXG(-2)	82.51143	129.6236	0.636546	0.5316
GR	-137.5139	327.8118	-0.419490	0.6793
R-squared	0.154510	Mean dependent var		6048.915
Adjusted R-squared	-0.352783	S.D. dependent var		7560.149
S.E. of regression	8793.150	Akaike info criterion		21.28844
Sum squared resid	1.55E+09	Schwarz criterion		21.87797
Log likelihood	-338.2592	Hannan-Quinn criter.		21.48680
F-statistic	0.304578	Durbin-Watson stat		2.564201
Prob(F-statistic)	0.980683			

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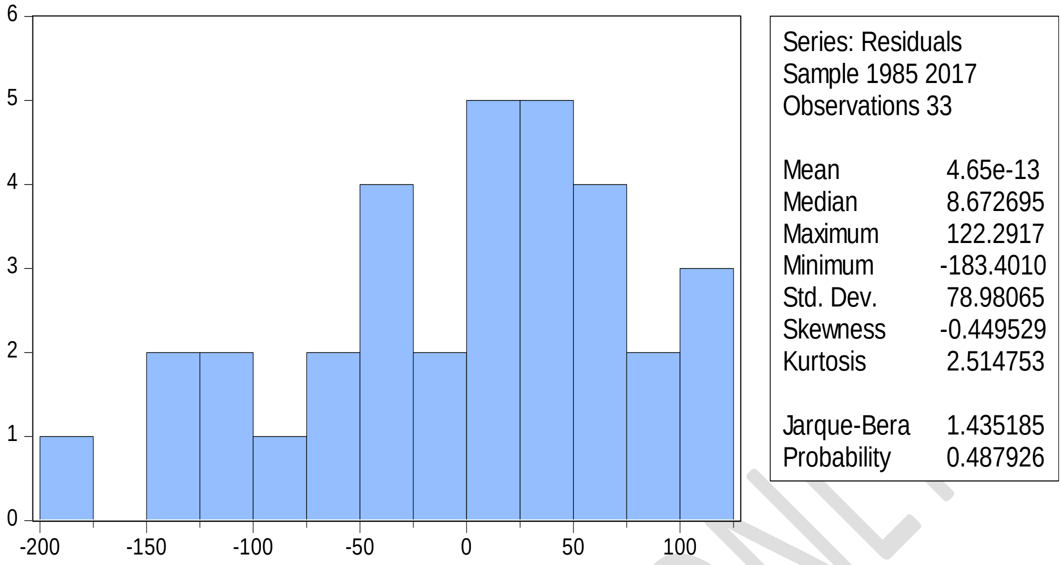
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Sample 1985 2017
Observations 33
Mean 4.65e-13
Median 8.672695
Maximum 122.2917
Minimum -183.4010
Std. Dev. 78.98065
Skewness -0.449529
Kurtosis 2.514753
Jarque-Bera 1.435185
Probability 0.487926
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5
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-200
-150
-100
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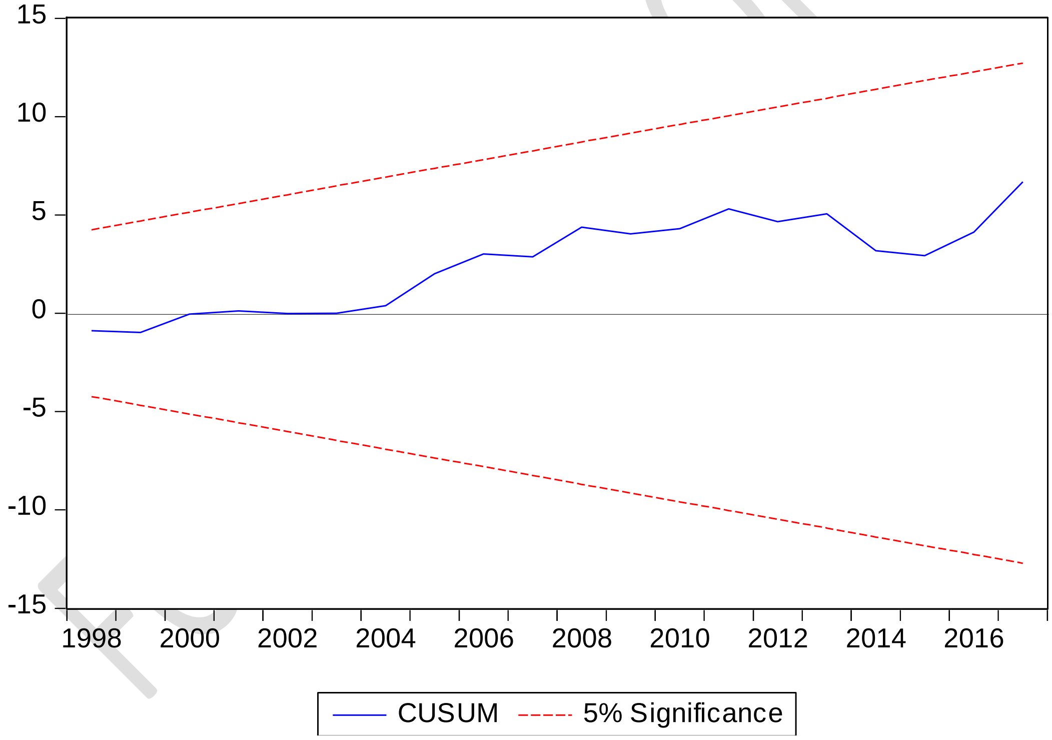
50
100


15
10
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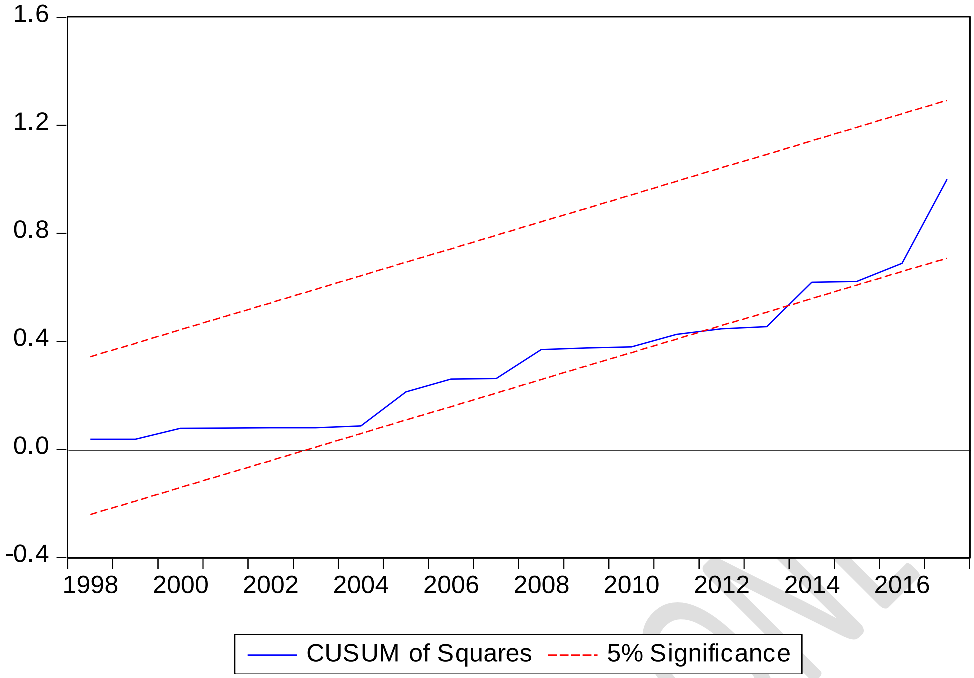
5% Significance



CO-INTEGRATION TEST (BOUNDS TEST)

Wald Test:			
Equation: Untitled			
Test Statistic	Value	df	Probability
F-statistic	18.30415	(12, 20)	0.0000
Chi-square	219.6498	12	0.0000
Null Hypothesis: C(2) = C(3) = C(4) = C(5) = C(6) = C(7) =			
C(8) = C(9) = C(10) = C(11) = C(12) = C(13) = 0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(2)		-0.439029	0.192079
C(3)		-0.201765	0.203667
C(4)		0.668561	0.163518
C(5)		-0.276952	0.137096
C(6)		0.027973	0.072369
C(7)		0.027607	0.120519
C(8)		0.263967	0.122305
C(9)		0.164025	0.117692
C(10)		30.66771	10.44980
C(11)		-0.136188	1.230122
C(12)		3.020978	1.472721
C(13)		0.621631	3.724439
Restrictions are linear in coefficients.			

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Computation of Long Run Coefficient Using Ardl Approach Capg

Wald Test:			
Equation: Untitled			
Test Statistic	Value	df	Probability
t-statistic	6.182649	20	0.0000
F-statistic	38.22515	(1, 20)	0.0000
Chi-square	38.22515	1	0.0000
Null Hypothesis: (C(6) + C(7) + C(8) + C(9)) / (1 - (C(2) + C(3) + C(4) + C(5))) = 0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
(C(6)+C(7)+C(8)+C(9))/(1-C(2)-C(3)-C(4)-C(5))		0.387111	0.062612
Delta method computed using analytic derivatives.			

K

Wald Test:			
Equation: Untitled			
Test Statistic	Value	df	Probability
t-statistic	3.115893	20	0.0054
F-statistic	9.708788	(1, 20)	0.0054
Chi-square	9.708788	1	0.0018
Null Hypothesis: (C(10)) / (1 - (C(2) + C(3) + C(4) + C(5))) = 0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(10) / (1 - C(2) - C(3) - C(4) - C(5))		24.55017	7.879018
Delta method computed using analytic derivatives.			

EXG

Wald Test:			
Equation: Untitled			
Test Statistic	Value	df	Probability
t-statistic	-3.646921	20	0.0016
F-statistic	13.30003	(1, 20)	0.0016
Chi-square	13.30003	1	0.0003
Null Hypothesis: (C(11) + C(12)) / (1 - (C(2) + C(3) +C(4) + C(5))) = 0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
(C(11) + C(12)) / (1 - C(2) - C(3) - C(4) - C(5))		-2.309338	0.633229
Delta method computed using analytic derivatives.			

GR

Wald Test:			
Equation: Untitled			
Test Statistic	Value	df	Probability
t-statistic	0.166388	20	0.8695
F-statistic	0.027685	(1, 20)	0.8695

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Chi-square	0.027685	1	0.8679
Null Hypothesis: (C(13)) / (1 - (C(2) + C(3) +C(4) + C(5))) = 0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(13) / (1 - C(2) - C(3) - C(4) - C(5))		0.497629	2.990780
Delta method computed using analytic derivatives.			

CONSTANT

Wald Test:			
Equation: Untitled			
Test Statistic	Value	df	Probability
t-statistic	0.117941	20	0.9073
F-statistic	0.013910	(1, 20)	0.9073
Chi-square	0.013910	1	0.9061
Null Hypothesis: C(1) / (1 - (C(2) +C(3) +C(4) +C(5))) = 0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
C(1) / (1 - C(2) - C(3) - C(4) - C(5))		10.85608	92.04708
Delta method computed using analytic derivatives.			

ECM

Wald Test:			
Equation: Untitled			
Test Statistic	Value	df	Probability
t-statistic	-20.53653	20	0.0000
F-statistic	421.7491	(1, 20)	0.0000
Chi-square	421.7491	1	0.0000
Null Hypothesis: -(1 - (C(2) +C(3) +C(4)+C(5))) = 0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)		Value	Std. Err.
-1 + C(2) + C(3) + C(4) + C(5)		-1.249185	0.060827
Restrictions are linear in coefficients.			

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Null Hypothesis: MANY has a unit root				
Exogenous: Constant				
Lag Length: 1 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			0.662821	0.9895
Test critical values:	1% level		-3.632900	
	5% level		-2.948404	
	10% level		-2.612874	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(MANY)				
Method: Least Squares				
Date: 01/11/19 Time: 01:47				
Sample (adjusted): 1983 2017				
Included observations: 35 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
MANY(-1)	0.021859	0.032979	0.662821	0.5122
D(MANY(-1))	0.441550	0.180632	2.444473	0.0202
C	20.20756	85.73763	0.235691	0.8152
R-squared	0.267458	Mean dependent var		137.9749
Adjusted R-squared	0.221674	S.D. dependent var		299.3156
S.E. of regression	264.0645	Akaike info criterion		14.07208
Sum squared resid	2231362.	Schwarz criterion		14.20540
Log likelihood	-243.2614	Hannan-Quinn criter.		14.11810
F-statistic	5.841747	Durbin-Watson stat		1.541609
Prob(F-statistic)	0.006876			

Null Hypothesis: D(MANY) has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3.288132	0.0232
Test critical values:		1% level	-3.632900	
		5% level	-2.948404	
		10% level	-2.612874	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(MANY,2)				
Method: Least Squares				
Date: 01/11/19 Time: 01:48				
Sample (adjusted): 1983 2017				
Included observations: 35 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(MANY(-1))	-0.492957	0.149920	-3.288132	0.0024
C	66.63351	49.02439	1.359191	0.1833
R-squared	0.246779	Mean dependent var		-2.726000
Adjusted R-squared	0.223954	S.D. dependent var		297.1975
S.E. of regression	261.8117	Akaike info criterion		14.02857
Sum squared resid	2261997.	Schwarz criterion		14.11745
Log likelihood	-243.5000	Hannan-Quinn criter.		14.05925
F-statistic	10.81181	Durbin-Watson stat		1.589855
Prob(F-statistic)	0.002401			

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Null Hypothesis: CAPG has a unit root				
Exogenous: Constant				
Lag Length: 4 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-0.113564	0.9396
Test critical values:	1% level		-3.653730	
	5% level		-2.957110	
	10% level		-2.617434	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(CAPG)				
Method: Least Squares				
Date: 01/11/19 Time: 01:49				
Sample (adjusted): 1986 2017				
Included observations: 32 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CAPG(-1)	-0.009236	0.081325	-0.113564	0.9105
D(CAPG(-1))	0.546025	0.179916	3.034886	0.0054
D(CAPG(-2))	-0.438138	0.211583	-2.070761	0.0484
D(CAPG(-3))	0.006947	0.222776	0.031183	0.9754
D(CAPG(-4))	-0.573605	0.225346	-2.545439	0.0172
C	95.41968	79.75591	1.196396	0.2423
R-squared	0.652161	Mean dependent var		87.20888
Adjusted R-squared	0.585268	S.D. dependent var		540.7574
S.E. of regression	348.2459	Akaike info criterion		14.71106
Sum squared resid	3153155.	Schwarz criterion		14.98588
Log likelihood	-229.3769	Hannan-Quinn criter.		14.80215
F-statistic	9.749431	Durbin-Watson stat		1.871982
Prob(F-statistic)	0.000025			

Null Hypothesis: D(CAPG) has a unit root				
Exogenous: Constant				
Lag Length: 3 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-5.655684	0.0000
Test critical values:	1% level		-3.653730	
	5% level		-2.957110	
	10% level		-2.617434	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(CAPG,2)				
Method: Least Squares				
Date: 01/11/19 Time: 01:50				
Sample (adjusted): 1986 2017				
Included observations: 32 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CAPG(-1))	-1.479404	0.261578	-5.655684	0.0000
D(CAPG(-1),2)	1.019932	0.199530	5.111672	0.0000

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D(CAPG(-2),2)	0.575175	0.191406	3.004991	0.0057
D(CAPG(-3),2)	0.581633	0.210024	2.769364	0.0100
C	89.86126	61.80938	1.453845	0.1575
R-squared	0.594318	Mean dependent var		31.31912
Adjusted R-squared	0.534217	S.D. dependent var		500.8487
S.E. of regression	341.8208	Akaike info criterion		14.64905
Sum squared resid	3154719.	Schwarz criterion		14.87807
Log likelihood	-229.3848	Hannan-Quinn criter.		14.72497
F-statistic	9.888646	Durbin-Watson stat		1.876560
Prob(F-statistic)	0.000046			

Null Hypothesis: K has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-4.764098	0.0005
Test critical values:	1% level		-3.626784	
	5% level		-2.945842	
	10% level		-2.611531	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(K)				
Method: Least Squares				
Date: 01/11/19 Time: 01:52				
Sample (adjusted): 1982 2017				
Included observations: 36 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
K(-1)	-0.281685	0.059127	-4.764098	0.0000
C	3.026165	0.840537	3.600273	0.0010
R-squared	0.400317	Mean dependent var		-0.571555
Adjusted R-squared	0.382679	S.D. dependent var		2.818454
S.E. of regression	2.214452	Akaike info criterion		4.481840
Sum squared resid	166.7291	Schwarz criterion		4.569813
Log likelihood	-78.67312	Hannan-Quinn criter.		4.512545
F-statistic	22.69663	Durbin-Watson stat		1.488864
Prob(F-statistic)	0.000035			

Null Hypothesis: EXG has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			1.297327	0.9982
Test critical values:	1% level		-3.626784	
	5% level		-2.945842	
	10% level		-2.611531	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(EXG)				
Method: Least Squares				
Date: 01/11/19 Time: 01:53				
Sample (adjusted): 1982 2017				

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Included observations: 36 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXG(-1)	0.064056	0.049376	1.297327	0.2033
C	3.496013	5.343944	0.654201	0.5174
R-squared	0.047167	Mean dependent var		8.494167
Adjusted R-squared	0.019142	S.D. dependent var		22.43585
S.E. of regression	22.22008	Akaike info criterion		9.093822
Sum squared resid	16786.88	Schwarz criterion		9.181795
Log likelihood	-161.6888	Hannan-Quinn criter.		9.124527
F-statistic	1.683056	Durbin-Watson stat		1.940153
Prob(F-statistic)	0.203253			

Null Hypothesis: D(EXG) has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-5.041648	0.0002
Test critical values:	1% level		-3.632900	
	5% level		-2.948404	
	10% level		-2.612874	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(EXG,2)				
Method: Least Squares				
Date: 01/11/19 Time: 01:53				
Sample (adjusted): 1983 2017				
Included observations: 35 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXG(-1))	-0.869683	0.172500	-5.041648	0.0000
C	7.601041	4.145514	1.833558	0.0758
R-squared	0.435108	Mean dependent var		0.033060
Adjusted R-squared	0.417990	S.D. dependent var		29.96593
S.E. of regression	22.86089	Akaike info criterion		9.152177
Sum squared resid	17246.47	Schwarz criterion		9.241054
Log likelihood	-158.1631	Hannan-Quinn criter.		9.182858
F-statistic	25.41822	Durbin-Watson stat		1.963214
Prob(F-statistic)	0.000016			

Null Hypothesis: GR has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=9)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-5.021786	0.0002
Test critical values:	1% level		-3.626784	
	5% level		-2.945842	
	10% level		-2.611531	
*MacKinnon (1996) one-sided p-values.				
Augmented Dickey-Fuller Test Equation				
Dependent Variable: D(GR)				
Method: Least Squares				
Date: 01/11/19 Time: 01:54				
Sample (adjusted): 1982 2017				

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Included observations: 36 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GR(-1)	-0.838109	0.166895	-5.021786	0.0000
C	4.528681	1.368260	3.309811	0.0022
R-squared	0.425853	Mean dependent var		-0.341667
Adjusted R-squared	0.408967	S.D. dependent var		7.532610
S.E. of regression	5.790972	Akaike info criterion		6.404430
Sum squared resid	1140.202	Schwarz criterion		6.492403
Log likelihood	-113.2797	Hannan-Quinn criter.		6.435135
F-statistic	25.21833	Durbin-Watson stat		1.881560
Prob(F-statistic)	0.000016			

	MANY	CAPG	K	EXG	GR
1981	1558.7	5.6681	35.22126337	0.61	-13.1
1982	1764.89	4.5699	31.95332745	0.6729	-0.2
1983	1167.89	3.2134	23.00650187	0.7241	-5.1
1984	1018.91	2.5681	14.22397108	0.7649	-2
1985	1416.79	2.4144	11.9652411	0.8938	9.7
1986	1373.66	2.2778	15.15382424	2.0206	2.5
1987	1398.1	6.8277	13.60752506	4.0179	0.69
1988	1618.25	8.9006	11.87108007	4.5367	9.9
1989	1665.09	12.3627	11.74232373	7.3916	7.2
1990	1670.73	18.5158	14.25014084	8.0378	12.8
1991	1829.34	17.9262	13.73267907	9.9095	4.8
1992	1758.61	62.1583	12.74817398	17.2984	2.9
1993	1706.7	74.5791	13.55003308	22.0511	2.2
1994	1670.72	46.232	11.16542818	21.8861	0.9
1995	1592.49	206.905	7.065756396	21.8861	2.5
1996	1599.94	129.4041	7.289924173	21.8861	5
1997	1609.83	202.9649	8.356728899	21.8861	2.8
1998	1412.44	195.956	8.601609965	21.8861	2.7
1999	1459.02	204.3923	6.994107587	92.6934	1.1
2000	1505.66	234.0758	7.017880509	102.1052	5.4
2001	1666.49	327.20666	7.579868476	111.9433	4.4
2002	1813.81	378.82645	7.009922739	120.9702	3.8
2003	1918.09	498.8158541	9.904054169	129.3565	10.4
2004	2143.45	458.9171042	7.393370121	133.5004	33.7
2005	2350.98	613.3875399	5.458996498	132.147	5.4
2006	2574.29	680.7657626	8.265864774	128.6516	8.2
2007	2823.53	856.7176653	9.249636844	125.8331	6.8
2008	3079.04	1141.756574	8.323477015	118.5669	6.3
2009	3323.41	2359.345404	12.08816419	148.8802	6.9
2010	3578.64	3762.61095	16.5551956	150.298	7.8
2011	4216.18	3219.250425	15.53394339	153.8616	4.9
2012	4783.66	2217.192241	14.16254015	157.4996	4.3
2013	5826.36	1215.134056	14.16872621	157.3112	5.4
2014	6684.22	213.0758717	15.0835333	158.5526	6.3
2015	6586.62	788.9823129	14.8271756	193.2792	2.7
2016	6483.22	1791.040497	14.67542	305.18	-1.6
2017	6594.01	2793.098682	14.6453	306.3999	0.8

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