Asian Journal of Economics and Empirical Research
Vol. 7, No. 2, 136-146, 2020
ISSN(E) 2409-2622 / ISSN(P) 2518-010X
DOI: 10.20448/journal.501.2020.72.136.146

The Impact of Capital Inflows on Economic Growth in Nigeria: Empirical Evidence from Wavelet Coherence Technique

Tomiwa Sunday Adebayo

Cyprus International University, Nicosia Mersin, Turkey.
Email: twaikline@gmail.com *Tel:* +905338440168

Abstract

The study explores the interaction between capital inflows and economic growth in Nigeria using data between 1981 and 2018. This study utilized the ARDL techniques to catch the short and long-run dynamics among variables utilized, and the granger causality test was utilized to ascertain the direction of causality. Furthermore, the wavelet coherence, a recent and more powerful technique was deployed to verify the co-movement and causality among the variables. Findings from the ARDL techniques depict; (i) there is cointegration among the variables in the long-run; (ii) Gross capital formation impact economic growth positively (iii) foreign aid and FDI inflows have an insignificant impact on economic growth. The Granger causality test reveals; (i) feedback causality between gross capital formation and economic growth; (ii) unidirectional causality was found running from FDI inflows and foreign aid to economic growth. The wavelet coherence provides supportive evidence for the ARDL and Granger causality test. Based on these findings, recommendations were suggested.

Keywords: Gross capital formation, Foreign aid, FDI inflows, Economic growth, Wavelet coherence technique, Granger causality.
JEL Classification: B17; B23; B22.

Citation | Tomiwa Sunday Adebayo (2020). The Impact of Capital Inflows on Economic Growth in Nigeria: Empirical Evidence from Wavelet Coherence Technique. Asian Journal of Economics and Empirical Research, 7(2): 136-146.
History:
Received: 20 March 2020
Revised: 22 April 2020
Accepted: 25 May 2020
Published: 15 June 2020

Publisher: Asian Online Journal Publishing Group

Funding: This study received no specific financial support.
Competing Interests: The author declares that there are no conflicts of interests regarding the publication of this paper.
Transparency: The author confirms that the manuscript is an honest, accurate, and transparent account of the study was reported; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained.
Ethical: This study follows all ethical practices during writing.

Contents

Contribution of this paper to the literature

In the context of Nigeria, using the Two-Gap growth theory, this paper tends to construct growth and development. Though, the Two-Gap growth theory has been deployed by various researchers to propose economic growth and development, however, none of the studies have utilized the wavelet coherence technique to investigate the dynamics between capital inflows and GDP economic growth in the case of Nigeria. Therefore, this research addresses such gaps. This technique is utilized in econophysics to investigate the causality between economic variables. Furthermore, it was also utilized as a robustness check for the Granger causality test and ARDL long and short-run dynamics.

1. Introduction

From the onset of worldwide recognition and growth, nations have recognized that capital inflows from more advanced and wealthier economies to smaller developing economies remain important for the accomplishment and fulfillment of domestic goals to strengthen their citizenship and nation-building. Foreign capital inflows like foreign aid and FDI inflows bring in enormous amounts of foreign currency to developing countries which help in sustaining the balance of payment. UNCTAD (2015) reports that Western donors have given around US$4.14 trillion, which is seven times the GDP of Nigeria, in aid to emerging economies. These inflows are supported by NGOs and other charity bodies, as well as the so-called new donor nations. Yet poverty stays widespread in several developing economies that receive the aid and impoverishment lingers. With over thirty various mineral resources, Nigeria is seen as a resource-rich country with resources including gold, iron ore, coal and limestone. In the wake of the global financial crises between 2008 and 2009, the banking sector effectively recapitalized and increased regulation. Economic growth in Nigeria has since been powered by the development of agriculture, telecommunication, and services. Economic diversification and steady growth have not transcribed into a significant drop in poverty level; with more than 62% of the over 200 million people experiencing severe poverty. Notwithstanding its deep foundations, oil-rich Nigeria has been crippled by an insufficient supply of power, inadequate infrastructure, setbacks in passing regulatory amendments, an outdated land system registration, strict trade policies, an unstable regulatory climate, a sluggish and unreliable justice system, instability and pervasive corruption. New investment in oil and gas has been hampered by regulation and security risks in Nigeria with a continuous fall in output until 2012 with little recovery in 2017. Due to a fall in the price of oil and output, Nigeria falls into recession in 2016 coupled with worsening infrastructure in oil and gas, foreign exchange restrictions, Niger-Delta insurgency and economic policies. Nigeria witnesses GDP growth, as output stabilizes due to the oil price increase in 2017. Nigeria is the third destination for FDI inflows in Africa behind Egypt and Ethiopia (UNCTAD, 2019). In 2018, FDI totaled US$1.9billion compare to US$3.5billion in the previous year in Nigeria (World Bank, 2020). In Nigeria, the major investing nations include the United Kingdom, the Netherlands, the USA, France, and China. These countries are lured into Nigeria due to an advantageous taxation system, low labor cost, availability of resources and a partially privatized economy. Likewise, political turmoil, high tax burden, insecurity majorly in the northern part of the country and corruption are restricting FDI inflows in Nigeria. Not to mention, Nigeria has continually received foreign aid from various donors such as the world bank, United Kingdom, China, Japan, the United States, and European Union, etc. Nigeria receives a grant of $3billion from the United States government between 2010 and 2015. In 2018, Nigeria received aid totaled US$3.3billion (World Bank, 2020). Although these statistics illustrate an enhancement in the GDP growth, but does these statistics mirror the true picture of living standards of Nigerians? The vigor of these indicators influencing the growth is far from factuality (Kolawole, 2013). In this perspective, the Two-Gap theory proposes that the investment-saving gap can be closed by FDI inflows while foreign aid can close the foreign exchange gap. Hence, the shortcomings of foreign exchange and savings gaps can be closed by Foreign aid and foreign direct investment respectively. Though numerous studies have explored capital inflows and growth interactions, they only explore the interaction of foreign aid and foreign direct investment separately on GDP growth. The next section discusses the theoretical and empirical review. The model, data, and methodology are discussed in the third section. The fourth section analyse the empirical findings which is followed by the concluding and policy recommendations section.

2. Literature Review

2.1. The Two-Gap Framework

The concept underneath the two-gap economic growth tactic is that savings and foreign exchange gaps are two distinct and separate limitations in developing economies to realizing their preferred growth rate. The nature of the accounting procedures is followed by the two distinct gaps: investment-savings (I-S) and the import-export (M-X) gaps. It is generally acknowledged that if a country's investment is more than savings, there will be a balance of payment deficit. Likewise, if a nation import surpasses its exports, it creates a trade deficit. As stated by Chaehery and Strout (1956) for a nation to achieve it targeted growth rate, the gap between investment-savings and import-export can be closed by capital inflows.

As Adelman and Chenery (1966) stated, saving gap will arise when savings is less than the domestic investment needed to attain the desired growth rate of the economy. Capital inflows can be deployed to breach the saving gap to attain the desired growth rate in the economy. The same analogy goes for the import-export gap. Hence, if the import is more than export, a foreign-exchange gap will surface which can be closed by capital inflows. The national income accounting identities can be utilized to depict these gaps by employing aggregate expenditure equals aggregate output approach.

$$E - Y = I - S = M - X = F \quad (1)$$

In Equation 1, national expenditure is depicted by E, income is depicted by I, the output is represented by Y, imports is illustrated by M, X mirrors exports, F stands for net capital inflows.

Saving constraints will surface in the economy when the saving gap is more than the foreign exchange gap. Likewise, the foreign exchange constraint will surface in the economy when the savings gap is less than the foreign exchange gap. Foreign aid needed in each gap would be dissimilar since the gaps are disparate and independent.

Basically, if local investors (through domestic commercial banks) obtain access to the global financial market, the foreign exchange and savings gaps could be resolved by the financing domestic (excess) investment out of the savings from developed economies that is, through capital inflow. According to Bender and Löwenstein (2005) foreign aid, portfolio investment by foreigners, and foreign direct investment are examples of capital inflows.

$$I - S = F \quad (2)$$

$$M - X = F \quad (3)$$

Savings and foreign exchange gaps is depicted by Equation 2 and 3. Thus, the foreign capital inflows comprise of both foreign aid (ODA) and foreign direct investment (FDI) as depicted in Equation 4.

$$F = FDI + ODA \quad (4)$$

Most economic reasoning for conferring special opportunities to lure FDI is predicated on the assumption that FDI close the gap between rich and impoverished countries besides generating technology transfers and spillovers. Theoretically, GDP growth is impacted by FDI in several ways. The Solow neoclassical growth model proposes that economic growth is improved by FDI by incorporating the capital stock. The Solow view is accepted by several studies that propose that domestically owned production is less productive compared to foreign-owned production (Haddad & Harrison, 1993). This perspective, which is premised on the studies of Rivera-Batiz and Romer (1991) and Grossman and Helpman (1991) buttresses the theoretical assumption in the literature. This strategy also attempts to relate FDI flows with global trade, changes in technology, and growth relationships (Driffield & Jones, 2013; Romer, 1990). Yet, out of 25 studies, only six countries observed FDI and GDP growth interaction to be positive (Görg & Greenaway, 2004). This effect reflects a scenario labeled as 'stylized fact' by Herzer and Klasen (2008). Utilizing Vietnam as a case study, Nguyen (2020) explored the interaction between FDI inflows and international trade (export and import) on GDP growth utilizing data spanning between 2000 and 2018. The result obtained illustrates positive interaction between GDP growth, and export and import. Yusoff (2014) examined the interaction between export, foreign direct investment, government expenditure, and GDP growth in Malaysia employing the VECM and Toda Yamamoto causality test. Findings show that export, FDI inflows, and government expenditure influence growth positively. Additionally, One-way causality was found running from FDI inflows, exports, and government expenditure to GDP growth. In Pakistan Ali, Ahmad, and Sadiq (2019) investigated the FDI-Growth nexus utilizing ARDL approach to cointegration and utilizing time-series data between 1975 and 2015. Findings from this study reflect a negative link between GDP growth and FDI inflows. Furthermore, in the short-run and long-run, economic growth is impacted positively by trade openness. The Impact of FDI Inflows on economic growth of Seychelles was examined by Yusheng, Agyapong, Bentum-Micah, and Aboagye (2019) utilizing yearly data between 1985 and 2018, and deploying ordinary least square to establish this relationship. The investigators proved a positive and significant link between FDI inflows and GDP growth. Olofin, Aiyegbusi, and Adebayo (2019) analyzed the link between FDI inflows and economic growth in Nigeria using FMOLS to demonstrate this interaction and employing time series data. The result portrays that net trade and human capital, and FDI inflows, have a positive relationship with GDP growth while imports impact growth negatively. Okoro, Nzotta, and Alajekwu (2019) used yearly data covering 32 years (1986-2016) to investigate the interaction between capital inflows and GDP growth in Nigeria. The Johansen and OLS techniques were used to verify these dynamics. Findings through the Johannsen cointegration show that there is cointegration among the variables employed in the long run while the OLS mirrors that both FDI inflows, and remittances impact growth positively. However, external debt and foreign aid have an insignificant link with GDP growth. Abhyankar and Tudekar (2020) explored the determinants of growth in India utilizing time-series data from 1980 and 2018, and multiple regression techniques. The investigators discovered a positive and significant link between FDI inflows, gross domestic savings, gross capital formation, and economic growth.

2.2. Aid-Growth Relationship

Foreign assistance reaches a nation in the form of private capital and/or public capital. Nevertheless, public foreign assistance is far more crucial for speeding up growth in the economy than private foreign capital. Developing economies financial desires are so high that private foreign investment will only partly address the financing issue. For example, social spending such as education, medical services and public health is not financed by Private foreign investment. Although indirectly adding to the economic efficiency and competitiveness of the economy. Overall, these initiatives do not produce direct benefits and could thus be funded by grants from industrialized economies and international agencies. Foreign aid, therefore, enables industrialisation, in constructing overhead economic capital, and in generating greater chances for employment. Nevertheless, as Griffin and Enos (1970) stated foreign aid contributes to a decrease in domestic savings whereas Papanek (1973) demonstrates that in some nations, foreign aid promotes savings such that increase in foreign aid will lead to increase in investment, though in some other nations it dissuades savings and increase in foreign aid inflow contributes to decrease in investment. It is also conceived that aid opponents take the position that, this is a form of wealth transfer through sending money specifically to wealthy people in the developing world through poor people in wealthier nations (Papanek, 1973). Economic growth is not influence by foreign assistance, though there is a conditional impact when associated with a 'balanced' monetary and fiscal policy climate as shown by Burnside and Dollar (2000) and Easterly, Levine, and Roodman (2004). Additionally, Bauer (1976) claimed that foreign assistance had damaging effects on beneficiary nations. Sabra (2016) examined the determinants of growth in selected MENA economies and considered foreign aid to impact growth and savings negatively, though positive and significant link was found between foreign aid and consumption. Employing the Two-Gap theory, Kolawole (2013) investigated the Aid-Growth nexus in Nigeria utilizing data covering 31 years (1980-2011). The ARDL techniques were utilized, and the author observed a negative link between FDI inflows and GDP growth whereas no significant interaction was found between foreign aid and economic growth. Furthermore, investment influence economic growth positively and the granger causality test shows that both foreign aid and FDI inflows does not cause economic growth in Nigeria. Utilizing Sub-Saharan Africa (SSA) as a case study, Mah and Yoon (2020) investigated the Aid-Growth nexus using data between 1994 and 2015. Aid was divided into loan and grant, and the investigators observed that grant has a positive and significant link with growth while loan has negative and

significant interaction with growth. Furthermore, both investment and education have positive and significant interactions with growth. Onyibor, Bah, and Tomiwa (2018) explored Aid-Growth interaction among the five poorest nations in the world utilizing data between 1985 and 2015. Findings from the ARDL techniques show that foreign aid impact growth significantly during the period of study. Furthermore, there is evidence of a positive and significant link between investment in Burundi and Congo in the long run. Babalola, Mohd, Ehigiamusoe, and Onikola (2019) looked into the dynamics among foreign aid, foreign trade and economic growth in Nigeria by utilizing yearly data between 1980 and 2015 and utilizing the Error Correction Model (ECM) to explore both the short and long-run interactions. The authors found that all the variables are cointegrated in the long-run and both FDI inflows and foreign aid positively and significantly influence growth in the long run. With the core objective to critically explore the GDP growth determinants in lower-middle-income countries and utilizing random effect model to verify this relationship, Wadud (2017) observed that current account balance, FDI inflows, investment, and remittance have positive interaction with GDP growth while exports, imports, and inflation have an insignificant link with GDP growth.

3. Data, Model, and Methodology

3.1. Data and Model

To investigate the interaction between GDP growth (Y) which is the dependent variable and gross capital formation (GCF), foreign aid (ODA) and FDI inflows (FDI) which represent the independent variables, this paper utilized yearly data spanning between 1981 and 2018. These secondary data were gathered from the world bank (WB), and central Bank of Nigeria (CBN). The trends of the key variables are portrayed in Figure 1, 2, and 3 respectively.

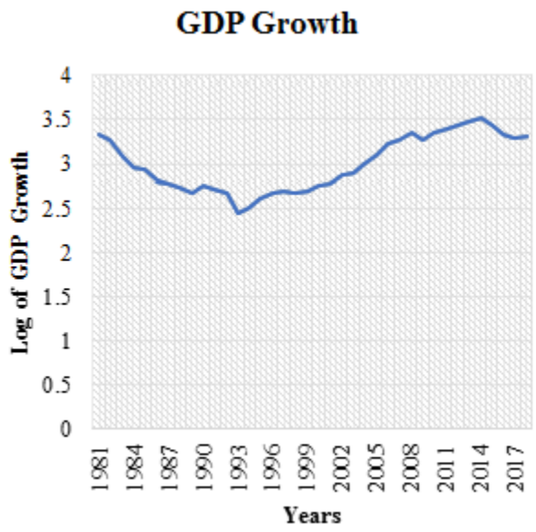

Figure-1. GDP Growth between 1981 & 2018.
Source: World Bank (2020).

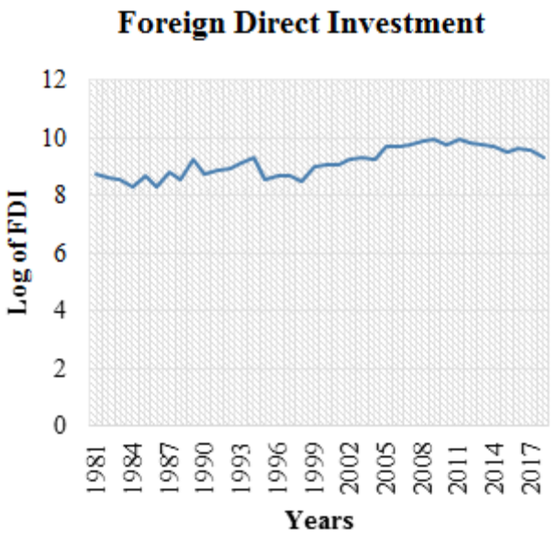

Figure-2. FDI between 1981 & 2018.
Source: CBN (2020).

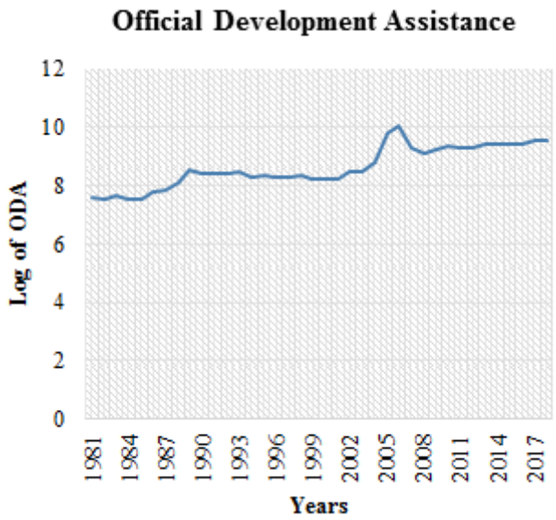

Figure-3. ODA between 1981 & 2018.
Source: World Bank (2020).

Table-1. Descriptive statistics.

Source	WB	CBN	WB	WB
Variables Code	Y	GCF	FDI	ODA
Mean	3.0019	10.593	9.1618	8.6193
Median	2.9505	10.551	9.2008	8.4365
Maximum	3.5082	11.167	9.9465	10.058
Minimum	2.4317	10.091	8.2768	7.5011
Std. Dev.	0.3192	0.2745	0.5067	0.7045
Skewness	0.0621	0.1308	-0.0123	0.1473
Kurtosis	1.5735	1.9564	1.7467	1.9730
Jarque-Bera	3.2463	1.8324	2.4878	1.8071
Probability	0.1972	0.4000	0.2882	0.4051
Observations	38	378	38	38

Note: WB, & CBN represents World Bank & Central bank of Nigeria respectively.

Brief information about the variables utilized is described by the Table 1. The skewness and Kurtosis values must not be greater than 1 and 3 respectively to mirrors normal distribution. Based on the yardstick for normal distribution, all the variables utilized depicts characteristics of normal distribution. Furthermore, the probability of the Jarque–Bera illustrates that all indicators utilized mirror normal distribution.

3.2. Econometric Methodology

This paper utilized the Two-Gap framework to explore the long and short-run dynamics between GDP growth, and gross capital formation, FDI inflows and foreign aid. The natural logarithm of the variables utilized was taken. This is performed to reduce skewness and deviation (Barro, 1991). The first thing is to formulate the economic function which is illustrated in Equation 5;

$$Y = f(GCF, FDI, ODA) \quad (5)$$

This is followed by formulating the study's economic model below;

$$Y_t = \theta_0 + \theta_1 GCF_t + \theta_2 FDI_t + \theta_3 ODA_t \quad (6)$$

After formulating the economic model, the study formulates the econometric model as depicted in the Equation 7 below;

$$Y_t = \theta_0 + \theta_1 GCF_t + \theta_2 FDI_t + \theta_3 ODA_t + \varepsilon_t \quad (7)$$

In Equation 8 above, Y represents economic growth, GCF denotes gross capital formation, FDI stands for foreign direct investment and ODA represents foreign aid.

3.2.1. ARDL Approach

The two-step created by Engle and Granger (1987) approach was generally utilized in parameter estimation in cointegration procedures. The ARDL model created by Pesaran and Shin (1998) merged two phase-procedures between Engle and Granger in a single step in an attempt to investigate the path of causation between variables. The cointegration by Johansen (1988) and Johansen and Juselius (1990) is less superior to the ARDL technique. While the traditional method of cointegration measures long-run interactions within the framework of an equation system, the ARDL method utilizes one reduced form equation (Pesaran & Shin, 1998). The method also generates reliable predictions of long-run interactions and appropriates t-statistics (Inder, 1993).

Moreover, the ARDL method will not necessitate pre-testing of the parameters, suggesting that the test is feasible unless the fundamental regression is I(0), or I(1), or mix of both. The simplicity of the approach makes it different from the other approaches since in most instances the time series data are integrated of the same order. Furthermore, the ARDL method eliminates the substantial number of requirements needed by traditional cointegration testing. Any of which include the amount (if any) of dependent and independent variables to be used in the framework, the variations in the order of variables being implemented, and the treatment of deterministic components and the number of lags.

The findings of traditional cointegration experiments are usually susceptible to the process and numerous alternate options available in the calculation procedure (Pesaran & Shin, 1998). Nevertheless, behind the ARDL

approach, various optimum lags can be used with minimal sample data, making it appropriate for this analysis. The ARDL method is consequently, as stated by Ghatak and Siddiki (2001) a more statistically meaningful method for evaluating the cointegration relationship in small samples.

$$\Delta Y_t = \theta_0 + \sum_{i=1}^{l} \theta_1 \Delta Y_{t-i} + \sum_{i=1}^{l} \theta_2 \ \Delta GCF_{t-i} \ + \sum_{i=1}^{l} \theta_3 \ \Delta FDI_{t-i} + \sum_{i=1}^{l} \theta_4 \ \Delta ODA_{t-i} + \varpi ECT_{t-1} + \ \varepsilon_{t-i} \quad (8)$$

In Equation 8, the first difference operator is illustrated by $\mathbf{\Delta}$, θ_0 mirrors constant term, $\theta_1, \theta_2, \theta_3, \ and \ \theta_4$ are short-run elasticities concerning the exogenous variables, ARDL model lag order is represented by ί, an error correction term is represented by ϖECT_{t-1}, ε_t stands for the error disturbance and time is depicted by t.
Also, the robustness of the ARDL cointegration was checked utilizing the FMOLS and DOLS.

3.2.2. Granger Causality Test

The interaction between the variables is determined by the ARDL approach however, the causality direction of variables can't be determined by the ARDL approach. Thus, Granger (1969) suggested a causality approach to ascertain the casualty direction between variables. The general form of the Granger causality is depicted by Equation 9 & 10.

$$T_t = \theta_o + \sum_{i=1}^{t1} \theta_i T_{t-1} + \sum_{i=1}^{k2} \beta_i S_{t-1} + \varepsilon_t \quad (9)$$

$$S_t = \delta_o + \sum_{i=1}^{t3} \delta_i S_{t-1} + \sum_{i=1}^{k4} \vartheta_i T_{t-1} + \mu_t \quad (10)$$

In equayion 9 and 10, the lag length is indicated by t, and k, and ε_t and μ, represents their error terms which is presumed to be distinct (white noise) from each other. The Granger causality test is very simple to conduct and use.

3.2.3. Wavelet Approach

The wavelet techniques created by Goupillaud, Grossmann, and Morlet (1984) was utilized to investigate co-movement between GDP growth, foreign aid, FDI inflows, and gross capital formation in Nigeria. One-dimensional time data decomposition into the bidimensional time-frequency represents the leading innovation of wavelet techniques. This enables capturing the long-run and short-run causality between the economic growth and the exogenous variables in the current study. A multi-scale framework of disintegration yields a standard structure for demonstrating frequency-dependent activity for examining the linkage between economic growth and the exogenous variables in Nigeria. Non-stationarity represents the major attribute of most variables utilized in economic or finance based research. Additionally, if it is discovered that the time series data have a structural break(s), time-domain causality tests with parameters fixed will suffer.

The wavelet (ψ) is part of the Morlet wavelet family in this study, Equation 11 illustrates the Morlet equation.

$$\psi(t) = \pi^{-\frac{1}{4}} e^{-i\varpi t} e^{-\frac{1}{2}t^2} \quad p(t), t = 1,2,3,4 \ldots, T. \quad (11)$$

The main parameters of the wavelet are, (f) which indicates frequency, and (k) which stands for location or time. Whereas the underlying feature of the k parameter is the exact location of a wavelet in time, the frequency parameter regulates the deformed wavelet for localizing different frequencies. According to Gokmenoglu, Kirikkaleli, and Eren (2019) by converting the equation of the wavelet, it is possible to generate ψ_{kt} first. The Equation 12 depicted below for this transition is:

$$\psi_{k,f}(t) = \frac{1}{\sqrt{h}} \varpi \left(\frac{t-k}{f} \right), \ k, f \in \mathbb{R}, f \neq 0 \quad (12)$$

As a function of k and f given time series data p(t), the continuous wavelet can be constructed from ψ as follows:

$$Wp(k,f) = \int_{-\infty}^{\infty} p(t) \frac{1}{\sqrt{f}} \varpi \left(\frac{t-k}{f} \right) dt, \quad (13)$$

In Equation 13, the preceding equation, the reconstructed actual time series p(t) with the respective ψ coefficient is depicted as follows;

$$p(t) = \frac{1}{C_\varpi} \int_0^{\infty} \left[\int_{-\infty}^{\infty} \left| \mathrm{w}_p(a,b) \right|^2 da \right] \frac{db}{b^2} \quad (14)$$

As illustrated in Equation 14, the wavelet power spectrum (WPS) is used to catch instability and to get a deep understanding of the time series variables.

$$WPS_p(k,f) \left| W_p(k,f) \right|^2 \quad (15)$$

In Equation 15, the wavelet coherence method's key novelty is that the methodology helps the current research to imagine some correlation between GDP growth and other independent variables in causalities based on merged time-frequency. The time-series cross wavelet transform (CWT) is depicted Equation 16:

$$W_{pq}(k,f) = W_p(k,f) \overline{W_q(k,f)} \quad (16)$$

In Equation 16, $W_p(k,f)$ stands for the CWT of p(t) and q(t), and the value of squared WTC is denoted by $W_{pq}(k,f)$. $R^2(k,f)$. The is illustrated in Equation 17

$$R^2(k,f) = \frac{\left|S\left(f^{-1}W_{pq}(k,f)\right)\right|^2}{S\left(f^{-1}\left|W_p(k,f)\right|^2\right)S\left(f^{-1}\left|W_q(k,f)\right|^2\right)} \quad (17)$$

In Equation 17, zero (0) correlation between two series will surface if the $R^2(k,f)$ gets closer to 0 whereas correlation will show whenever $R^2(k,f)$ is close to 1, which spherical thick black line illustrates and also indicated by warmer color (red). Although, the $R^2(k,f)$ values did not show the sign of the interaction. Hence, Torrence and Compo (1998) suggests a method that can detect Wavelet coherence by using variations by deferrals in two time-series wavering signals. wavelet coherence at the different level is depicted in the Equation 18 as follows;

$$\phi_{pq}(k,f) = \tan^{-1}\left(\frac{\mathrm{L}\left\{S\left(f^{-1}W_{pj}(k,f)\right)\right\}}{O\left\{S\left(f^{-1}W_{pj}(k,f)\right)\right\}}\right) \quad (18)$$

Wherein L and O represent an imaginary operator and a real component operator as illustrated in Equation 18

4. Empirical Findings

4.1. Unit Root Test

Unit root tests are applied to the GDP growth and the other exogenous variables to assess the order of integration by utilizing ADF, PP, and KPSS unit root tests. The indicators under investigation are presumed to contain no structural breaks when implementing the specified tests. The outcomes of those tests are depicted in Table 2. Furthermore, taking into account that variables could have structural breaks, the Zivot-Andrews (ZA) unit root test that can sense one structural break, and Lee Strazicich (LM) unit test that can detect two structural breaks were utilized.

Table-2. Unit root test.

Variables	ADF (K &T)	Decision	PP (K & T)	Decision	KPSS (K & T)	Decision
Y	-4.50*	I(1)*	-4.47*	I(1)*	0.16**	I(0)**
GCF	-3.49**	I(1)**	-3.68***	I(0)***	0.19**	I(0)**
ODA	-5.50*	I(1)*	-5.56*	I(1)*	0.14***	I(0)**
FDI	-9.82*	I(1)*	-9.92*	I(1)*	0.182**	I(0)**

Note: *, ** & *** signifies 1%, 5%, & 10% level of significance. K. and K. & T indicate constants and constant and trend.

Table-3. Unit root with structural break (s).

Variables	ZA (K & T)	Decision	LM	Decision
Y	-6.70* {2004}	I(1)*	-5.05* {2007} [2013]	I(1)*
GCF	-5.12** {2007}	I(1)**	-7.69* {2004} [2010]	I(1)*
ODA	-6.14* {2007}	I(1)*	-8.02* {2002} [2006]	I(1)*
FDI	-11.21* {1999}	I(1)*	-11.04* {1991} [1994]	I(1)*

Note: *, ** & *** signifies 1%, 5%, & 10% level of significance. K. and K. & T indicate constants and constant and trend. {}, & [] signifies first and second break respectively.

In Tables 2 and 3 respectively, it can be observed that all the variables have a structural shift respectively. It is also disclosed that findings of unit root with structural breaks are unidentical to those without structural breaks. Based on the results of the Zivot-Andrews and Lee Strazicich unit root test, the null hypothesis of a unit root at their level cannot be dismissed at significance level of 5%. It can therefore be assumed that structural breaks tend to influence on the behavior of the unit root and that the series is incorporated in a mixed order i.e. I (0) and I(1).

4.2. ARDL Bounds Test

Table-4. Bounds test.

ARLD Cointegration Test		
Function	**Y =F(GCF FDI, ODA)**	
Lag structure	1, 4, 3, 4	
F-stat	6.64*	
	Lower Bound	Upper Bound
10%	2.45	3.52
5%	2.86	4.01
1%	3.74	5.06

Note: * stands for 1% significance levels.

The long-run cointegration among the variables is portrayed in the Table 4 utilizing the ARDL Bounds test. The ARDL Bounds test portrays evidence of cointegration among the variables. The following thing is to investigate the long-run interaction between the dependent and the independent variables after the long-run cointegration is confirmed.

4.3. ARDL Long-Run and Short-Run Result

Table-5. ARDL long run estimate.

Regressors	Coefficient	Std-Error	t-Stat	Prob
Long-run coefficients of the ARDL (1, 4, 3, 4) model of Y				
Y	0.339477	0.154388	2.198848	0.039**
GCF	0.948410	0.093140	10.18265	0.0000*
FDI	0.026304	0.027111	0.970227	0.3430
ODA	-0.023287	0.028403	-0.819858	0.4215
C	-6.657110	1.599162	-4.162874	0.0004
R^2	0.997828	F-statistic	302.7490	
Adj-R^2	0.995078	Prob(F-stat)	0.00000	
ECM Representation of the ARDL (1, 4, 3, 4) Model of Y				
ΔGCF	0.948410	0.073377	12.92524	0.0000*
ΔFDI	-0.072824	0.025997	-2.801238	0.0107**
ΔODA	0.086250	0.022975	3.754041	0.0012*
ECM(-)	-0.660523	0.119885	-5.509619	0.0000

Note: *, & **, stands for 1%, 5%, level of significance.

Table-6. Robust check.

Panel M: FMOLS Estimate				
Regressors	**Coefficient**	**Std-Error**	**t-Stat**	**Prob**
Y	0.289407	0.068127	4.248074	0.0008*
GCF	0.944189	0.061856	15.26425	0.0000*
FDI	0.028919	0.018130	1.595111	0.1264
ODA	-0.020862	0.018782	-1.110747	0.2799
C	-6.343023	1.128117	-5.622664	0.0000
Panel N: DOLS Estimate				
Regressors	Coefficient	Std-Error	t-Stat	Prob
Y	0.339477	0.147866	2.295836	0.0321**
GCF	0.948410	0.089205	10.63179	0.0000*
FDI	0.040860	0.027330	1.495027	0.1498
ODA	-0.023287	0.027203	-0.856021	0.4016
C	-6.657110	1.531605	-4.346492	0.0003

Note: *, & **, stands for 1%, 5%, level of significance.

To examine the long and short run dynamics between economic growth and the other exogenous variables, the ARDL techniques was deployed. The study further utilized the FMOLS and DOLS to verify the result of the ARDL long-run interaction. The FMOLS and the DOLS provide a supportive evidence for ARDL long-run result. The findings from the ARDL long run estimation in Table 5 shows; (i) 0.94% increase in GDP growth is as a result of a 1% rise in GCF keeping other factors constant. This finding aligns with the work of Kolawole (2013); Mah and Yoon (2020); Onyibor et al. (2018) and Adebayo (2020); (ii) no significant relation was found between FDI and GDP growth. This outcome complies with Herzer and Klasen (2008); Kolawole (2013) and Görg and Greenaway (2004) but does not agree with the study of Abhyankar and Tudekar (2020) and Olofin et al. (2019); and (iii) the link between foreign aid and GDP growth is insignificant. This outcome aligns with the view of Burnside and Dollar (2000) and Easterly et al. (2004) but does not comply with the study of Babalola et al. (2019) and Mah and Yoon (2020).

Furthermore, in the short run, ECM is statistically significant with the appropriate sign (-0.66) which illustrates that shocks in the short run can be adjusted back to equilibrium by 66% each year.

4.4. Diagnostic Test

To ensure whether this model is good or not suffering from any form of misspecification, various diagnostic tests were employed. Table 7 depicts the diagnostic tests utilized.

Table-7. Diagnostic tests.

Diagnostic Tests	F-Stat (P-value)
Normality Test (T)	1.59(0.45)
Breusch-Pagan-Godfrey Test (0)	0.50 (0.90)
Breusch–Godfrey LM test (M)	1.57 (0.17)
Ramsey Test (Y)	0.33 (0.57)

4.4.1. Stability Test

To determine the stability of the model, the CUSUM, and CUSM of square are employed. Figures 4, and 5 below depict the outcome of the CUSUM, and CUSM of square at 5% significance level.

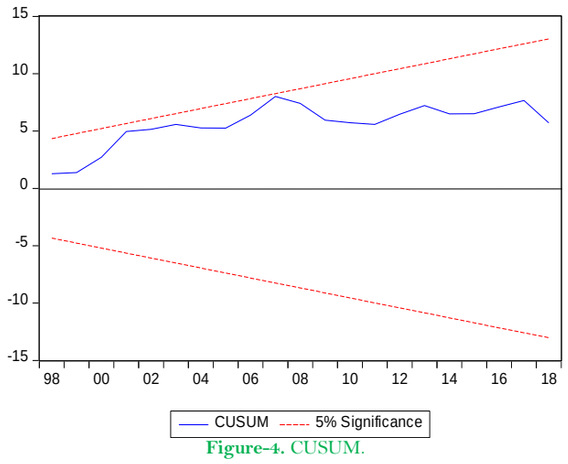

Figure-4. CUSUM.

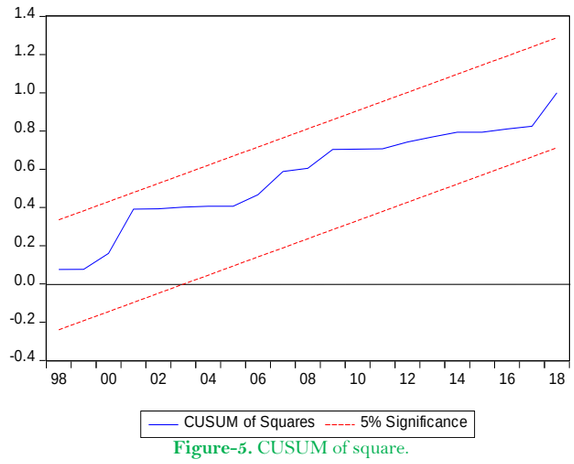

Figure-5. CUSUM of square.

4.5. Granger Causality Test

Though, the ARDL approach ascertains the interaction between variables, however, it can't determine the causality direction. Hence, the causality test proposed by Granger (1969) was deployed in the present study to capture the direction of causality.

Table-8. Causality test.

	Direction of Causality	F-stat	P-Value	Decision
Granger Causality	Y → GCF	8.21385	0.0014*	Reject Ho
	GCF → Y	3.41818	0.0456**	Reject Ho
	Y → FDI	0.01342	0.9867	Do Not Reject Ho
	FDI → Y	6.89090	0.0033*	Reject Ho
	Y→ ODA	1.69658	0.1999	Do Not Reject Ho
	ODA→ Y	4.70292	0.0165**	Reject Ho

Note: → stands for direction of the direction of causality, *, ** and *** mirror significance at 1%, & 5% levels, correspondingly. Optimal lag for the model has been selected using SC information criteria (Lag=2).

The findings from the Granger causality in Table 6 above depicts; (i) feedback causality between gross capital formation and GDP growth; (ii) unidirectional causality was found running from FDI inflows; and (iii) one-way causality running from foreign aid to economic growth. These findings show that employed variables are vital determinant of growth in Nigeria.

4.6. Wavelet Coherence Result

To explore the co-movement between economic growth and gross capital formation, FDI inflows and foreign aid in Nigeria. The wavelet approach result is utilized to explain this question. The time is depicted by the x-axis. The frequency is illustrated by the y-axis. The cone-shaped grey line depicts the cone of influence in Figures 6, 7 and 8 whereas 5% level of significance is depicted by the black contour shape tested against AR(1). In the Figures 6, 7 and 8, zero dependency is illustrated by cold (blue) between two-time series variables while high dependency is illustrated by warmer red (hot) color.

Table-9. Wavelet interpretation table.

Arrows Direction	Interpretation
Rightward arrows	Positive correlation between variables
Leftward arrows	Negative correlation between variables
Rightward and up or leftward down	Second variable cause first variable
Leftward and up, or rightward and down	The first variable cause second variable

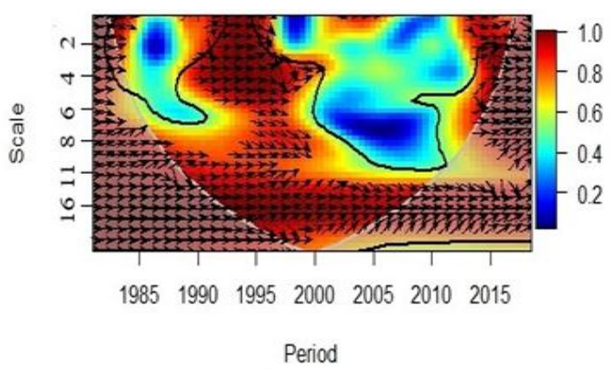

Figure-6. WTC between Y & GCF.

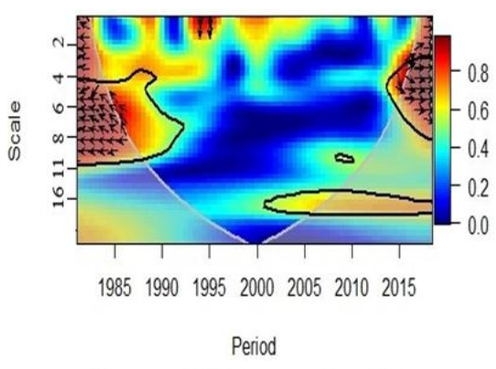

Figure-7. WTC between Y & ODA.

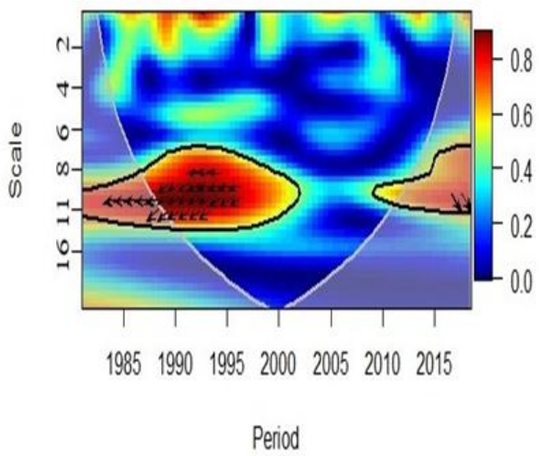

Figure-8. WTC between Y & FDI.

The wavelet coherence between economic growth and gross capital formation is depicted in Figure 6. The rightward arrow depicts a positive correlation between economic growth and gross capital formation. Furthermore, Rightward and up arrows at the thick black contour signifies there is a feedback causality between GDP growth and gross capital formation between 1982, and 1985, between 1990 and 2010, and 2013 and 2017. The WTC between GDP growth and foreign aid is illustrated in Figure 7. The leftward arrows between 1983, and 1987 mirrors a negative correlation between GDP growth and foreign aid. No significant interaction was found between GDP growth and foreign aid between 1990 and 2012. However, a positive correlation was found between GDP growth and foreign aid between 2013 and 2016. Also the rightward up and leftward down denotes foreign aid cause GDP growth can be rejected at a significant level of 5% between 1983 and 1987, between 2013 and 2016. This finding provides supportive evidence for the granger causality test. The WTC between economic growth and FDI inflows is depicted by Figure 8. The leftward arrows illustrate a negative correlation between economic growth and FDI inflows between 1987 and 1997. Additionally, leftward and down arrows signify that FDI inflows does not cause GDP growth can be rejected at 5% significant level. This result complies with the Granger causality result.

5. Conclusion and Policy Direction

Although several studies have been conducted exploring the impact of capital inflows on economic growth in emerging and developed economies, however, the time-frequency dependency of economic growth in the viewpoint of gross capital formation, foreign direct investment, and foreign aid is explored for the first time utilizing time series data between 1981 and 2018. Therefore, this study addresses the gaps in the literature in regards to Nigeria. The study utilized the ARDL approaches to catch the short and long-run dynamics among variables utilized, and the granger causality test was utilized to ascertain the direction of causality. In addition, the wavelet coherence technique, a recent technique in econometrics was utilized to capture correlation and causality dynamics in the short and long run at various scales. Findings from the ARDL techniques depict; (i) there is evidence of cointegration among the variables in the long run; (ii) gross capital formation impart economic growth significantly; (ii) foreign aid and FDI inflows have an insignificant impact on economic growth. The Granger causality test discloses; (i) feedback causality between gross capital formation and economic growth; (iii) unidirectional causality was found running from FDI inflows; and (iii) one-way causality running from foreign aid to GDP growth. These findings show that employed variables are a vital determinant of growth in Nigeria. The wavelet coherence approach provides further supportive evidence for the ARDL, and granger causality test.

The study suggests; (i) favorable incentives that will lure more FDI inflows cotangent on sound macroeconomic policy environment should be implemented by the government; (ii) for foreign aid to be effective in Nigeria, sound macroeconomic policy environment must be put of ground.

Although the empirical analysis of this paper is solid by utilizing ARDL, Granger causality and the recent wavelet coherence technique, further studies should be conducted in several nations using different techniques and more variables.

References

Abhyankar, A., & Tudekar, A. (2020). Effect of falling savings and investment: It's impact on India's growth rate. *Studies in Indian Place Names*, *40*(54), 11-15.

Adebayo, T. S. (2020). New insights into export-growth nexus: Wavelet and causality approaches. *Asian Journal of Economics, Business and Accounting*, *15*(2), 32-44.Available at: https://doi.org/10.9734/ajeba/2020/v15i230212.

Adelman, I., & Chenery, H. B. (1966). Foreign aid and economic development: The case of Greece. *The Review of Economics and Statistics*, *23*(Febuary), 1-19.

Ali, M., Ahmad, T. I., & Sadiq, R. (2019). Empirical investigation of foreign direct investment and current account balance in East Asian economies. *Pakistan Journal of Commerce and Social Sciences (PJCSS)*, *13*(3), 779-795.

Babalola, S. J., Mohd, S., Ehigiamusoe, K. U., & Onikola, H. (2019). Impact of foreign direct investment, aid and trade on economic growth in Nigeria. *Journal of Developing Areas*, *53*(4), 15-31.Available at: https://doi.org/10.1353/jda.2018.0067.

Barro, R. J. (1991). Economic growth in a cross section of countries. *The Quarterly Journal of Economics*, *106*(2), 407-443.

Bauer, P. T. (1976). Western guilt third world poverty. *Quadrant*, *20*(4), 12-18.

Bender, D., & Löwenstein, W. (2005). Two-gap models: Post-Keynesian death and neoclassical rebirth (No. 180). IEE Working Papers.

Burnside, C., & Dollar, D. (2000). Aid, policies, and growth. *American Economic Review*, *90*(4), 847-868.

Chaehery, H., & Strout, A. (1956). Foreign assistance and economic development. *American Economic Review*, *43*(2), 56-78.

Driffield, N., & Jones, C. (2013). Impact of FDI, ODA and migrant remittances on economic growth in developing countries: A systems approach. *The European Journal of Development Research*, *25*(2), 173-196.Available at: https://doi.org/10.1057/ejdr.2013.1.

Easterly, W., Levine, R., & Roodman, D. (2004). Aid, policies, and growth: Comment. *American Economic Review*, *94*(3), 774-780.Available at: https://doi.org/10.1257/0002828041464560.

Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: Representation, estimation and testing. *Econometrica, 55*(2), 251-276.Available at: https://doi.org/10.2307/1913236.

Ghatak, S., & Siddiki, J. U. (2001). The use of the ARDL approach in estimating virtual exchange rates in India. *Journal of Applied Statistics, 28*(5), 573-583.Available at: https://doi.org/10.1080/02664760120047906.

Gokmenoglu, K., Kirikkaleli, D., & Eren, B. M. (2019). Time and frequency domain causality testing: The causal linkage between FDI and economic risk for the case of Turkey. *The Journal of International Trade & Economic Development, 28*(6), 649-667.Available at: https://doi.org/10.1080/09638199.2018.1561745.

Görg, H., & Greenaway, D. (2004). Much ado about nothing? Do domestic firms really benefit from foreign direct investment? *The World Bank Research Observer, 19*(2), 171-197.Available at: https://doi.org/10.1093/wbro/lkh019.

Goupillaud, P., Grossmann, A., & Morlet, J. (1984). Cycle-octave and related transforms in seismic signal analysis. *Geoexploration, 23*(1), 85-102.Available at: https://doi.org/10.1016/0016-7142(84)90025-5.

Granger, C. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica, 37*(3), 424-438.Available at: https://doi.org/10.2307/1912791.

Griffin, K. B., & Enos, J. L. (1970). Foreign assistance: Objectives and consequences. *Economic Development and Cultural Change, 18*(3), 313-327.Available at: https://doi.org/10.1086/450435.

Grossman, G. M., & Helpman, E. (1991). Trade, knowledge spillovers, and growth. *European Economic Review, 35*(2–3), 517–526.

Haddad, M., & Harrison, A. (1993). Are there positive spillovers from direct foreign investment?: Evidence from panel data for Morocco. *Journal of Development Economics, 42*(1), 51-74.

Herzer, D., & Klasen, S. (2008). In search of FDI-led growth in developing countries: The way forward. *Economic Modelling, 25*(5), 793-810.Available at: https://doi.org/10.1016/j.econmod.2007.11.005.

Inder, B. (1993). Estimating long-run relationships in economics: A comparison of different approaches. *Journal of Econometrics, 57*(1-3), 53-68.Available at: https://doi.org/10.1016/0304-4076(93)90058-d.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control, 12*(2-3), 231-254.Available at: https://doi.org/10.1016/0165-1889(88)90041-3.

Johansen, S., & Juselius, K. (1990). Maximum likelihood estimation and inference on cointegration—with applications to the demand for money. *Oxford Bulletin of Economics and Statistics, 52*(2), 169-210.Available at: https://doi.org/10.1111/j.1468-0084.1990.mp52002003.x.

Kolawole, B. O. (2013). Foreign assistance and economic growth in Nigeria: The two-gap model framework. *American International Journal of Contemporary Research, 3*(10), 153-160.

Mah, J. S., & Yoon, S.-C. (2020). The effects of grants and loans on economic growth in Sub-Saharan Africa: Considering different types of income level. *The Journal of International Trade & Economic Development, 2*(4), 1-15.

Nguyen, H. H. (2020). Impact of foreign direct investment and international trade on economic growth: Empirical study in Vietnam. *The Journal of Asian Finance, Economics and Business (JAFEB), 7*(3), 323-331.

Okoro, C., Nzotta, S., & Alajekwu, U. (2019). Effect of International Capital Inflows on Economic Growth of Nigeria.

Olofin, O. P., Aiyegbusi, O. O., & Adebayo, A. A. (2019). Analysis of foreign direct investment and economic growth in Nigeria: Application of spatial econometrics and fully modified ordinary least square (FMOLS). *Foreign Trade Review, 54*(3), 159-176.Available at: https://doi.org/10.1177/0015732519851631.

Onyibor, K., Bah, S. İ., & Tomiwa, A. (2018). Aid-growth relationship: Evidence from a co-integratıon analysis for the five poorest countries of the world. *EUL Journal of Social Sciences, 9*(2), 121-137.

Papanek, G. F. (1973). Aid, foreign private investment, savings, and growth in less developed countries. *Journal of Political Economy, 81*(1), 120-130.Available at: https://doi.org/10.1086/260009.

Pesaran, M. H., & Shin, Y. (1998). An autoregressive distributed-lag modelling approach to cointegration analysis. *Econometric Society Monographs, 31*, 371-413.Available at: https://doi.org/10.1017/cbo9781139052221.011.

Rivera-Batiz, L. A., & Romer, P. M. (1991). International trade with endogenous technological change. *European Economic Review, 35*(4), 971-1001.

Romer, P. M. (1990). Endogenous technological change. *Journal of Political Economy, 98*(5, Part 2), S71-S102.

Sabra, M. M. (2016). Remittances impact on economic growth, domestic savings and domestic capital at the presence of ODA and FDI in selected MENA countries. *International Journal of Academic Research in Business and Social Sciences, 6*(5), 2222-6990.

Torrence, C., & Compo, G. P. (1998). A practical guide to wavelet analysis. *Bulletin of the American Meteorological Society, 79*(1), 61-78.

UNCTAD, U. (2015). World investment report 2015: Reforming international investment governance. United Nations Publications Customer Service, 253.

UNCTAD, S. (2019). Unctad stat data center. World statistical database. Retrieved from: https://bit.ly/21GbfKX. [Accessed 2019, January 15].

Wadud, M. (2017). Macroeconomic determinants of economic growth in lower middle income countries. *Macroeconomic Determinants of Economic Growth in Lower Middle Income Countries (September 17, 2017)*.

World Bank. (2020). World Bank data center. Retrieved from: https://data.worldbank.org/indicator/. [Accessed 2 March 2020].

Yusheng, K., Agyapong, S. A., Bentum-Micah, G., & Aboagye, A. K. (2019). Impact of Foreign Direct Investment Inflows on Economic Growth in Small Island Developing States (Seychelles).

Yusoff, M. B. (2014). Foreign direct investment, exports, education, and growth in Malaysia. *Global Business and Economics Review, 16*(2), 111-122.Available at: https://doi.org/10.1504/gber.2014.060180.