Business & Social Science
IJRBS

Research in Business & Social Science

IJRBS VOL 13 NO 5 (2024) ISSN: 2147-4478

Available online at www.ssbfnet.com
Journal homepage: https://www.ssbfnet.com/ojs/index.php/ijrbs

The threshold analysis of the Official Development Assistance (ODA), Foreign Direct Investment (FDI), and economic growth in selected African countries

Vincent Muziwakhile Mbongeleni Moloi [(a)]*

[(a)] *University of South Africa, South Africa*

ARTICLE INFO

Article history:

Received 22 May 2024
Received in rev. form 25 June 2024
Accepted 28 July 2024

Keywords:

ODA, FDI, economic growth, Dumitrescu-Hurlin panel causality, African countries

JEL Classification:
B22, B27, F23, F15

ABSTRACT

There is a scarcity of research on the analysis of thresholds of official development assistance (ODA), foreign direct investment (FDI), and economic growth in Africa. Most of the studies focused on analysing the correlation between official development assistance (ODA) or foreign direct investment (FDI) and economic growth. This study stands out from others by adopting a comprehensive approach to analyse the threshold analysis of ODA, FDI, and economic growth in many countries on a continental scale. We examine the threshold for ODA, FDI, and economic growth by analysing annual data from 1980 to 2018 in 30 African countries. The primary method used for the estimation was the panel threshold regression approach. The threshold analysis test assessed the impact of ODA, FDI, and economic growth. The current study utilised threshold analysis and found a positive coefficient of 0.0620, indicating a favourable correlation between FDI and economic growth. On the contrary, the negative coefficient of 0.0683 shows a detrimental correlation between ODA and economic growth. Therefore, officials must enforce the level of ODA that is necessary to stimulate FDI and foster economic growth in Africa. Furthermore, it is crucial for authorities to implement a monitoring system to closely monitor these thresholds and adjust the policy accordingly in response to changing economic situations. The findings of this study will not only contribute to academic discourse, but will also provide vital perspectives for politicians, practitioners, enterprises, and foreign investors on how to effectively implement policies that stimulate economic growth and attract foreign investment in Africa. Furthermore, this study offers recommendations for further research in the domain of international capital flows.

Introduction

Emerging countries rely heavily on official development assistance (ODA) and foreign direct investment (FDI) for financial support (Rao, Sethi, Dash, & Bhujabal, 2023). According to Ocran, Senadza, and Osei-Assibey (2020), ODA is the main channel through which wealthy countries provide financial assistance to less developed countries with the goal of boosting their economies and general well-being. In emerging and low-income countries that struggle to attract FDI, ODA can serve as a supplement to other development funding sources and, in certain cases, even assist create the domestic and international conditions that are favourable to FDI (Rao et al., 2023). In a nutshell, ODA seeks to stabilise economies hit by supply shocks, bolster political institutions, finance health and educational infrastructure, and encourage economic growth (Cudjoe, 2024).

According to Wehncke, Marozva, and Makoni (2022), ODA has the potential to improve capital efficiency and promote private investment and FDI in developing economies that lack access to capital and technological expertise. This, in turn, can stimulate sustained economic growth. However, the notion that ODA has a catalytic impact on FDI, or that ODA and FDI are mutually strengthening, or that it stimulates economic growth, lacks strong empirical evidence (Younsi, Bechtini & Khemili, 2021). On the other hand, FDI occurs when an investor from one country acquires an asset in another country to gain control over that asset (Makoni,

* *Corresponding author. ORCID ID: 0000-0002-1004-1899*

https://doi.org/10.20525/ijrbs.v13i5.3574

2021). For an investment to be considered as FDI, it must be of a substantial amount that allows the foreign investor to have some level of control or influence over the management of the domestic company (Makoni, 2021). To establish a stable and long-lasting role that goes beyond that of a mere investor in the economy of a foreign country, the International Monetary Fund (IMF) (1993) regards FDI as an investment strategy aimed at securing favourable managerial positions for investors. Furthermore, the investment objective should be to establish a durable and lasting relationship with the host country (Cossa, 2015).

The purpose of this study is to analyse the threshold analysis between ODA, FDI and economic growth in African countries. The paper focuses on a sample of 30 African countries from the 1980s to 2018, a period characterised by increasing trade and financial openness in the region. ODA has emerged as a substantial financial resource for underdeveloped nations since the post-World War II (Upadhyaya, Pradhal, Dhakal, & Bhandari, 2007). The phenomenon of ODA has attracted significant interest from academia, policymakers, and investors, especially due to its remarkable growth since the 1940s (Jakupec & Kelly, 2015). Pitzen (2016) explains that the increase in ODA flows can be attributed to the implementation of innovative sustainable development approaches, the intricate dynamics between emerging and established donors, and the importance of ODA in shaping the foreign policy stance of the donor.

The remainder of the article is organised as follows. The second section provides an overview of the pertinent literature on ODA, FDI, and economic growth. The third section focuses on the data and the empirical technique. Empirical approaches encompass the baseline model and robust econometric techniques. The fourth section delineates the ethical protocol implemented by this study. The fifth section is dedicated to the discussion of the results. The final section of the article provides a concise summary of the findings of the article.

Literature Review

Conceptual and Theoretical Review

Various theories of ODA, FDI, and economic growth such as the dual gap, the international trade theory, the eclectic paradigm theory, the internalisation theory, the neoclassical growth theory, and endogenous growth theory has been employed by scholars to better understand ODA, FDI, and economic growth (see Appiah-Otoo, Acheampong, Song, Obeng, and Appiah, 2022; Azam and Feng, 2022; Mohamed and Celen, 2022; Duresa, 2022). The theoretical foundation of this paper is derived from the existing literature on ODA, FDI and economic growth. Dual-gap theory suggests that expanding disposable domestic savings boosts economic growth in recipient countries (Nyoni & Bonga, 2017). Therefore, Smith (2002) developed the theory of international trade to indicates that the production factors are inflexible between the countries in the world, complete information is publicly available on opportunities for foreign trade, and the traditional imports and exports are considered the only method of transferring goods and services across national boundaries (Moloi, 2023). According to Maduane-Komape and Tshehla (2024), the eclectic paradigm theory developed by Dunning (1977) emphasises that multinational enterprises (MNEs) expand overseas through FDI if competitive, location, and international advantages are met. The internationalisation theory developed by Buckley and Casson (2018) suggests that investment firms should have a maximum investment where all the advantages of future transactions merely cover the associated costs (Casson, Dark, and Gulamhussen, 2009). Therefore, Solow (1956) developed the neoclassical growth theory to suggest that investments will dwindle, and interest rates will increase in the non-existence of international investment (Matekenya & Moyo, 2023). Finally, the endogenous growth theory developed by Romer (1986) highlighted that technological developments are unplanned activities attributed to firm investments in capital (Matekenya & Moyo, 2023).

Although research has been done on the relationship between ODA, FDI, and economic growth over the years, the literature is scant compared to literature available on the threshold analysis between ODA, FDI and economic growth. Furthermore, most existing studies on the topic focused on only two variables (FDI and economic growth or ODA and economic growth). They did not take a broad perspective of looking at three variables (ODA, FDI, and economic growth) and in particular African countries. Considering this context, this study explores the threshold analysis between ODA, FDI, and economic growth.

Empirical Review and Hypothesis development

Using the system approach model, Wehncke, Makoni, and Marozva (2022), investigated the relationship between FDI, ODA, and Economic growth in developing countries with annual data ranging from 2000 to 2018. Wehncke *at al*., (2022) revealed a positive deterministic relationship between FDI and economic growth in all time periods for the sampled countries. Their study is limited to Generalised method of moments (GMM) while our study focuses on the panel threshold regression method. In the same vein, Wehncke, Makoni, and Marozva (2022) explored the nexus between economic growth, FDI, and ODA for 20 selected African countries from 2000 to 2018. Their study utilised the Autoregressive distributed lag (ARDL) method. They found a notable positive long-term cointegrating relationship between official development assistance and economic growth, and between economic growth and foreign direct investment, as well as a cointegrating link between ODA and FDI. Economic growth was found to promote ODA, while FDI was found to encourage economic growth and official development assistance was found to promote economic growth in the long-run. The ARDL method employed by their study is commonly known for its inability to precisely estimate long-term associations in the presence of structural breaks or non-stationary data without making suitable adjustments whereas the panel threshold regression analysis is commonly known for its ability to deal with endogeneity issues.

A study by Zardoub and Sboui (2021) investigated the impact of FDI, remittances, and ODA on economic growth in developing countries. The study covered forty-one developing countries during a period ranging from 1990 to 2016 following an annual data frequency. Using panel data approach, the findings showed that the use of economic-type solutions to resolve some of the shortcomings encountered in terms of unexpected effects. On the other hand, the findings indicate evidence of an ambiguous effect of financial flows on economic growth. Our study utilised the panel threshold regression approach, which can capture non-linear relationships and regime shifts within panel data by allowing different regimes or thresholds to influence the dependent variable. This allowed us to avoid the limitations of GMM, which are often criticised for its potential inefficiency in small samples and its sensitivity to instrument choice.

However, focusing on Indonesia, Sijabat (2022) investigated the association of economic growth, foreign aid, foreign direct investment, and gross capital formation for the period 1970 to 2019. Their study used the Granger causality test for the direction of causality between ODA, FDI, gross capital formation, and economic growth. The findings showed a positive one-way causality between ODA and GDP, as well as between FDI and GDP. Furthermore, the study did not prove a causal relationship between ODA and GCA in Indonesia. It is difficult to generalise these findings to other nations because their study focused exclusively on Indonesia. Nguyen (2020) also explored the impact of FDI, ODA, and exports on economic growth in Vietnam for the period 1990 to 2013. Their study employed a linear approach. They found that the relationship between FDI (net inflows), ODA, exports, and GDP (current) has a positive effect at a 1% significance level during that period. The limitation of their study is that it only focused on Vietnam, while our study focused on thirty selected African countries, and therefore their findings cannot be generalised. On the contrary, Younsi, Bechtini, and Khemili (2021) investigated the effects of ODA, FDI, and domestic investment on economic growth in African countries using fixed effects and system-GMM estimators. Their study found that ODA and FDI have a significant positive complementing effect on economic growth. Furthermore, it is shown that FDI complements domestic investment (DI), while the coupled effect of ODA and DI remains weak in catalysing growth. Furthermore, the results indicate that the complementarity between ODA–FDI–DI positively influences economic growth, revealing that ODA and FDI work as a complement factor to DI and enhance its effectiveness in promoting economic growth.

In case of South Asian economies, Das and Sethi (2020) used Granger causality test and vector error correction model to analyse the effect of FDI, remittances, and ODA on economic growth with time series data for the period 1980 to 2016. Their results indicated that foreign direct investment and remittances have a significant impact on economic growth in India, whereas in Sri Lanka, foreign aid and remittances play a significant role in enhancing economic growth. Also focusing on South Asia as well as South-East Asia Rao, Sethi, Dash, and Bhujabal (2023) examined the interrelationship among ODA, FDI, and economic growth using system-GMM with the time series data for the period 1980 to 2016. Their study found that while ODA is negatively associated with FDI as well as growth, FDI positively influences growth.

The literature suggests that there is a complex and diverse relationship between official development assistance, foreign direct investment, and economic progress in certain African countries. Therefore, based on a thorough analysis of the studies in this part and a comprehensive understanding of the intricate dynamics of these connections, this paper formulated a hypothesis that is related to the research issue, as stated below.

H1: There is a threshold level of combined ODA and FDI above which economic growth in selected African countries significantly more substantial.

Hence, using the dynamic panel threshold regression approach, this hypothesis suggests conducting a threshold analysis of official development assistance, foreign direct investment, and economic growth in specific African countries.

Research and Methodology

This section presents a concise overview of the regression model, and the methodology utilised in the study, as well as a description of the data used for the analysis.

Data collection and explanation

This analysis used yearly balanced panel data from 1990 to 2018 obtained from the World Bank development indicators for 30 selected African countries: South Africa, Morocco, Nigeria, Kenya, Ghana, Cote d'Ivoire, Tunisia, Uganda, Tanzania, Mozambique, Democratic Republic of Congo, Mali, Niger, Senegal, Malawi, Rwanda, Burkina Faso, Madagascar, Central African Republic, Chad, Sierra Leone, Guinea, Togo, Namibia, Guinea-Bissau, Gabon, Comoros, Swaziland, Botswana and Mauritius. This study employed annual data from 1980 to 2018 to perform a thorough analysis, ensuring the trustworthiness and consistency of the data. Economic statistics, especially those acquired from recognised sources such as the World Bank, undergo rigorous validation procedures to guarantee accuracy and completeness. This study relies on a comprehensive and meticulously evaluated data collection from 2018 and earlier, providing a stable foundation to examine the threshold between ODA, FDI and economic growth in Africa. Extending the duration of data collection may lead to inaccuracies or exclusions in the data due to delays in reporting or changes in data collection procedures. This could potentially compromise the accuracy of the analysis and the dependability of the conclusions. Therefore, by exclusively considering data up to 2018, this study may perform a more rigorous and reliable investigation of the threshold between the variables of interest.

This study utilised dynamic panel threshold regression approach developed by Tong and Tong (1983) to analyse first hitting time (FHT). This method was selected due to address the limitations of earlier threshold models. These dynamic panel threshold model offer improvements in the following aspects: (1) used the forward orthogonal transformation method to eliminate specific fixed effects from the country, in contrast to previous models that utilised the norm during transformation; (2) integrated time series and cross section data in a panel threshold data analysis; (3) evaluated the endogenous regressor; (4) took into account the possibility that the dependent variable could be affected by its own lagged value; and (5) used the GMM estimation method that addresses the issue of endogeneity.

Furthermore, Girma (2005) states that the primary issue with the threshold regression model is the uncertainty surrounding the threshold or cut-off value. This uncertainty necessitates the determination of the threshold, which in turn requires the application of non-standard econometric theory for reliable inference. In addition, Caner and Hansen (2004) argue that threshold regression models are superior because they estimate the threshold parameters instead of relying on arbitrary values to determine the threshold levels. Moreover, Moralles and Moreno (2020) consider the threshold regression approach to be a robust strategy for examining the unique characteristics of developing economies. Moralles and Moreno (2020) highlighted the importance of assessing the resilience and precision of control variables before calculating the threshold model.

The following threshold specification, in our view, is the most effective framework for identifying the presence of contingency effects and for providing a useful way to demonstrate how ODA affects the characteristics of FDI and economic growth:

$$GR_i = \alpha X_i + \begin{cases} \beta_1 FDI_i + \varepsilon_i, & ODA \leq \Upsilon \\ \beta_2 FDI_i + \varepsilon_i, & ODA \geq \Upsilon \end{cases}$$

Where GR is the average economic growth rate over the 1990 to 2018 period, FDI is foreign direct investment, and X is a vector of variables hypothesised to affect economic growth, including FDI. ODA variables function as sample splitting (or threshold) variables in this model. The above specification allows the effects of FDI on growth to take two different values depending on whether the level of ODA is lower or higher than the threshold level.

Two points are made here. The first is to determine the estimate of and the slope parameters α and β's. We determine by experimenting with the above equation 1 with all values of Υ, and $\hat{\gamma}$ is the minimiser of the residual sum of squares calculated across all values of and (Alfada, 2019). Once ŷ is identified estimates of the slope parameters follows trivially as $\hat{\alpha}$ (ŷ) and β (ŷ). The second issue is to assess the significance of the threshold parameterΥ. Since Υ is not identified under the null, we conduct inferences via a model-based bootstrap whose validity and properties have been established in Hansen (2000). In summary, our objective is to first measure the existence of the threshold and if the data supported it to assess the statistical significance of β_1 *and* β_2 in the above equation, and if it is supported by the data.

Ultimately, the study aimed to analyse the threshold of the ODA, FDI, and Economic Growth in Selected African countries by running the dynamic panel threshold regression approach.

Ethical considerations

All procedures used in this study were completely compliant with established ethical guidelines for research with non-human participants. There was stringent oversight of copyright, plagiarism, and fabrication concerns, and proper acknowledgement was given to all sources used. Prior to beginning data collection, a formal ethical clearance certificate was received from the Ethics Review Committee of UNISA research (Finance, Risk and Banking) research (Ethics permission number: 2020_CEMS_FRMB_003).

Results and Discussions

The study used variables such as ODA, FDI, and economic growth. The choice of these factors was based on their expected interrelationships. Following the empirical research technique demonstrated in the study conducted by Wehncke, Marozva and Makoni (2022), the variables were measured as follows: the percentage (%) of net ODA inflow in relation to gross national income (GNI), the % of net FDI inflow in relation to gross domestic product (GDP) and GDP per capita.

Table 1 presents a summary of the four main unit root tests performed in Stata: LLC, IPS, ADF-Fisher chi-square and PP-Fisher chi-square. These tests were completed using three alternative terms for deterministic options: no trend, intercept with trend, and individual intercept. All variables in the analysis of the current study are subjected to first-order integration for the unit root test, as indicated in Table 1. This indicates that they remain fixed or unchanged when the initial difference is taken. Thus, this implies that the variables exhibit cointegration because they do possess stationarity at the same level. Furthermore, Tables 2 and 3 present correlation and descriptive analysis between the variables being studied. Furthermore, the variables show low correlations, suggesting that multicollinearity is not a fundamental problem. Finally, the presence of cross-sectional dependence in the models was evaluated using the Pesaran test. The test results were deemed insignificant, suggesting that the cross sections were unrelated.

Table 3 provides descriptive statistics, indicating that the average value of the variable GR (economic growth) is 1.55%. This mean value is lower than the average GDP growth rate recorded in other comparable developing market economies, as demonstrated by Ozekhome (2017). Significantly, the recorded GR growth rate is at its lowest, indicating a negative growth of 47.50%. This suggests

that African countries are currently unable to attract international funds. On the other hand, the maximum GDP growth rate recorded is 37.54%, which could suggest a period of economic recovery for a country in the sample that had a low or negative economic starting point. Furthermore, the sample has a standard deviation of 4.87 from the mean, indicating the degree of variation in GR values.

Table 1: Panel Unit root test

Variable	No trend	Intercept and Trend	Individual Intercept	Decision
Panel Unit root test using the LLC.				
FDI	-3.93273***	-9.77178***	-6.74358***	I (1)
GR	-12.7556***	-16.1517***	-16.2913***	I (1)
ODA	-8.37241***	-6.43103***	-5.42063***	I (1)
Panel unit root tests using IPS.				
FDI	-	-11.1624***	-7.62667***	I (1)
GR	-	-18.0394***	-18.3381***	I (1)
ODA	-	-6.74427***	-4.66801***	I (1)
Panel unit root testing using ADF to Fisher Chi-square				
FDI	97.2116***	231.874***	183.356***	I (1)
GR	400.598***	425.461***	410.281***	I (1)
ODA	158.895***	145.904***	122.326***	I (1)
Panel unit root testing using PP - Fisher Chi-square				
FDI	148.959***	228.129***	189.271***	I (1)
GR	537.165***	806.760***	525.644***	I (1)
ODA	163.616***	154.204***	116.831***	I (1)

***; **; * indicates that the null hypothesis of unit root tests is rejected at 1%, 5% and 10%, respectively. All the tests are at first difference. Probabilities for all the tests assume asymptotic normality except for Fisher tests which are computed using the asymptotic Chi-square distribution. FDI represents foreign direct investment, GR represents economic growth, ODA represents official development assistance.

Source: *Author's own computations*

Table 2: Correlation Analysis

Variables	FDI	GR	ODA
FDI	1,000		
GR	0.095***	1,000	
ODA	-0,041	-0,099***	1,000

***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Source: *Author's own computations*

Table 3: Descriptive Analysis

Variable	Obs	Skewness	Kurtosis	Jarque-Bera	Prob	Median	Mean	Std. Dev.	Range	Min	Max
FDI	870	4.71	34.20	38506.22***	0.00	1.85	3.00	5.17	42.05	-8.59	50.64
GR	870	-1.55	26.38	20165.03***	0.00	1.79	1.55	4.87	-9.96	-47.50	37.54
ODA	870	2.79	16.39	7626.21***	0.00	6.89	9.28	10.08	94.76	-0.19	94.95

Notes: Obs= Number of observations; Std. Dev. = Standard deviation. FDI represents foreign direct investment, GR represents economic growth, and ODA represents official development assessment.

Source: *Author's own computation*

The variable FDI had a mean value equivalent to 3.0% of the GDP. Marandu, Mburu, and Amanze (2019) determined that the limited proportion of FDI directed towards Africa can be attributed to the strategy used by African countries to encourage FDI. This strategy focuses primarily on offering incentives rather than fostering a local climate that is favourable for entrepreneurial activities. The findings of our study support the assertion made by Marandu *et al*. (2019), since we also observed an average of 3.0% for FDI. One

of the African countries sampled had the lowest contribution of FDI to Gross Domestic Product (GDP) at -8.59%. The negative value indicates a capital deficit, suggesting that the outflow of FDI outweighed the intake of FDI in Africa. On the other hand, the highest recorded percentage of FDI was 50.64%. This high proportion indicates stability for a country in the sample that has a low or negative baseline of FDI. Furthermore, the sample mean of the FDI values has a standard deviation of 5.17, which signifies the extent of variation in the FDI values around the average.

In contrast, ODA, which is one of the main independent variables, has an average value of 9.28%. On average, 9.28% of the gross national income (GNI) of the African countries sampled during the analysis period was derived from ODA. However, the mean ODA for the selected African countries is lower compared to a composite index of similar research conducted in emerging or developing markets. This index indicated a comparison mean of 19.60% (see to Hongli & Vitenu-Sackey, 2020). Among the countries included in the sample, the lowest percentage of the contribution of ODA to gross national income is -0.19%, while the highest is 94.95%. The substantial disparities observed in ODA values can be ascribed to the arduous economic and socioe-conomic circumstances encountered by African countries. The persistent adverse effect of ODA is a consequence of political instability, which caused a decrease in the influx of foreign capital from multinational corporations (MNCs). This, in turn, has contributed to elevated levels of unemployment and poverty (Hongli & Vitenu-Sackey, 2020). In addition to the direct impact of foreign capital inflows, corruption has also impeded ODA and economic progress, resulting in an extreme poverty rate in Africa (Hongli & Vitenu-Sackey, 2020). The ODA has a standard deviation of 10.08, which represents the degree of variation in the ODA values from the average.

Furthermore, by establishing the threshold between ODA, FDI and economic growth, policymakers gain valuable understanding of the function and mutual reliance of these factors in Africa. The study used dynamic panel threshold model to analyse the threshold between these three factors. Thus, the panel threshold model tests determine the threshold level. This is seen in Table 4 below.

According to Tsaurai (2017), this study recorded all the data collected to eliminate any divergence in the panel threshold regression caused by extreme observations. All data from the panel regression threshold were transferred to Microsoft Excel spreadsheets for data analysis, in addition to the current study. The results of the threshold regression approach are presented in Table 4.

Summary of the FDI threshold levels

Table 41: Threshold estimator in single threshold model; FDI Threshold estimator (Level = 95)

Model	Threshold	Lower	Upper
Th-1	0.0002	0.0000	0.0055

Source: Author's own computation

In Table 4 above, the Th-1 threshold estimator represents the estimator used in single threshold models. The current study is based on the single threshold model, where the null hypothesis (Ho) states that β1 is equal to β2, indicating the absence of a threshold effect. The alternative hypothesis (H1) states that β1 is not equal to β2, suggesting the presence of a threshold effect. The analysis reveals that the estimated value of the single model is 0.0002, with a 95% confidence range ranging from 0.0000 to 0.0055. To identify a singular threshold effect, we perform 300 bootstrap replications. For example, when considering a significant level of 1%, the F statistic is calculated to be 90.38, which exceeds the critical value of 26.3873. The bootstrap p-value of 0.0000 indicates a high level of statistical significance. Due to the rejection of the null hypothesis of the linear model, it can be concluded that FDI and economic growth have a non-linear link. In addition, there is also a threshold impact present.

Table 5: Threshold effect in single threshold model: FDI Threshold effect test (bootstrap = 300 300 300):

Threshold	RSS	MSE	Fstat	Prob	Crit10	Crit5	Crit1
Single	1.6004	19.0686	90.38	0.0000	15.1283	19.0432	26.3873

Source: *Author's own computation*

The present work establishes the thresholds by estimating the model using one, two, or three thresholds and documenting the results. All three bootstrap experiments utilise the same number of bootstrap iterations. The F statistic and the associated bootstrap p-value are presented in Table 6.

Table 2: Results of the threshold effects in different threshold models: *FDI*

Model	Threshold	Lower	Upper
Th-1	0.0002	0.0000	0.0055
Th-21	0.0002	0.0000	0.0055
Th-22	-0.9707	-1.3412	-0.8405
Th-3	0.8309	0.7597	0.8408

Threshold effect test (bootstrap = 300 300 300):

Threshold	RSS	MSE	Fstat	Prob	Crit10	Crit5	Crit1
Single	1.6004	19.0686	90.38	0.0000	15.1283	19.0432	26.3873
Double	1.5704	18.7066	16.28	0.0400	10.7358	14.2171	28.9497
Triple	1.5504	18.4356	12.36	0.1000	11.9063	14.1589	21.0965

Source: Author's own computation

The results indicate that the F1 statistics exceed the crucial value of 1% at a significance level of 26.3873, given the presence of a single threshold (with H0: linear model; H1: single threshold model). The F1 statistic is highly significant, as indicated by the bootstrap p-value of 0.0000. When doing the double threshold test (with H0: single threshold model; H1: double threshold model), the statistic F2 (F2 value of 16.28 > Crit5 value of 14.22) is also statistically significant, with a bootstrap p-value of 0.0400. The threshold effect test indicates that the value of F3 is 12.36, which is higher than the critical value of 11.9063 at a significance level of 10. The bootstrap p-value of the F statistic for the triple threshold test is not statistically significant (0.1000). The data provided above suggests that the model has two thresholds.

The present study computes the triple threshold model to determine the precise value of the triple threshold. The data suggest that the estimations for the three criteria are 0.0002% and -0.9707%.

Table 7: Double threshold model estimation: **FDI**

Model	Threshold	Lower	Upper
Th-1	0.0002	0.0000	0.0055
Th-21	0.0002	0.0000	0.0055
Th-22	-0.9707	-1.3412	-0.8405

Threshold effect test (bootstrap = 300 300 300):

Threshold	RSS	MSE	Fstat	Prob	Crit10	Crit5	Crit1
Single	1.6004	19.0686	90.38	0.0000	15.1283	19.0432	26.3873
Double	1.5704	18.7066	16.28	0.0400	10.7358	14.2171	28.9497

Source: *Author's own computation*

Fixed effects regression results are reported in Table 8. Regression estimates can be presented as follows:

$$growth_{it} = 2.0872 + 0.0620FDI_{it}d(FDI_{it} \leq 0.0002)[0.37]^{**} - 0.3987FDI_{it}d(0.0002 < FDI_{it} \leq -0.9707) + 0.0587FDI_{it}d(FDI_{it} > -0.9707)[-9.91]^{**}[1.95]^{***}$$

*(** and *** denotes level of statistical significance at 5% and 1%, respectively)*

Table 3: Regression Estimates: Double threshold model

Fixed effects (within) regression					**Number of Obs =**	**870**
Group variable: Name					Number of groups =	30
R-sq: within = 0.1855					Obs per group: Min =	29
between = 0.0014					Avg =	29.0
overall = 0.1333					Max =	29
					F (12,828) =	15.71
corr (u_i, xb) = -0.2888					Prob > F =	0.00
GR	**Coef.**	**Std. Err.**	**T**	**P>ltl**	**[95% Conf.**	**Interval]**
_cat#c.FDI						
0	0.0620	0.1694	0.37	0.714	-0.2704	0.3944
1	-0.3987	0.0402	-9.91	0.000	-0.4777	-0.3197
2	0.0587	0.0302	1.95	0.052	-0.0004	0.1180
3	-0.0099	0.0311	-0.32	0.749	-0.0709	0.0511
_cons	2.0872	1.0716	1.95	0.052	-0.0161	4.1906
sigma_u	1.7212					
sigma_e	4.3381					
rho	0.1360					
f test that all u_i=0:		F (29,828)	=2.52		Prob>F =	0000

Source: Author's own computation

At a significance level of 5%, the F statistic of 2.52, along with the null hypothesis that all ui = 0, provides evidence that the fixed-effect model is appropriate. The bootstrap processes yield p-values that provide statistical evidence supporting the existence of thresholds at the 10% significance level.

The slope estimate in the threshold analysis regression model quantifies the effect of FDI under three distinct conditions.

i. When FDI $\leq$ 0.0002%, the positive coefficient of 0.0620 implies a positive relationship between FDI and economic growth.

ii. When 0.0002% < FDI $\leq$ -0.9707: the negative coefficient of -0.3987 suggests that economic growth is negatively related to FDI.

iii. When FDI > -0.9707, a positive effect of FDI on economic growth. However, it is not as strong as it was in the first regime, with a coefficient of only 0.0587.

When the level of FDI is above the second threshold, the smaller coefficient also indicates a weaker connection between these two variables. The statement indicates that, considering the current ability of host nations to absorb FDI, the ideal amount of FDI would be 0.0002% of the gross domestic product (GDP). Consequently, the contribution of FDI to economic growth diminishes after it exceeds this threshold level.

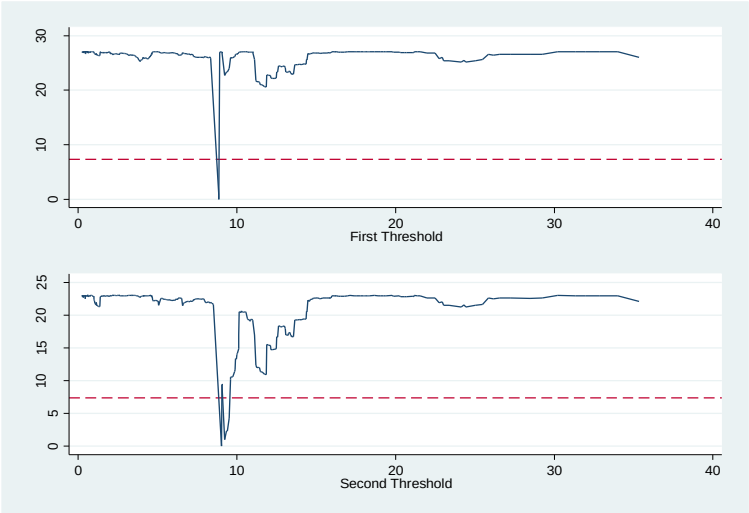

Figure 1: FDI First and Second sample split: Confidence interval construction for threshold *Source: Authors Computation*

Figure 1 illustrates the division between the initial and subsequent samples. When estimating a single threshold model, the first step involves generating and using the likelihood ratio function to estimate the likelihood ratio. At the coordinates 0.0002 and -0.9707, the likelihood ratio is precisely zero, marking the initial threshold estimate.

Summary of the ODA threshold levels

Table 9: Threshold estimator in single threshold model: ODA Threshold estimator (Level = 95):

Model	Threshold	Lower	Upper
Th-1	8.8161	8.7609	8.8543

Source: *Author's own computation*

In Table 9 above, the threshold estimator is denoted as Th-1, which represents the estimate used in a single threshold model. The current study is based on the single threshold model, where the null hypothesis (Ho) states that β1 is equal to β2, indicating the absence of a threshold effect. The alternative hypothesis (H1) states that β1 is not equal to β2, suggesting the presence of a threshold effect. The analysis reveals that the estimated value of the single model is 8.8161, accompanied by a 95% confidence interval ranging from 8.7609 to 8.8543.

The present investigation showed that using 300 bootstrap replications was sufficient to identify a solitary threshold effect. The F statistic in this example is 5.33, which is less than the critical value of 11.8671 at a 1% significance level. On the contrary, a p-value of 0.2033 in the bootstrap test suggests that the result is statistically significant. As a result, the null hypothesis of the linear model must be rejected. Therefore, the correlation between ODA and economic growth is not a simple linear relationship, but rather a complex one with a threshold effect.

Table 10: Threshold effect in Single threshold model: ODA Threshold effect test (bootstrap = 300 300 300):

Threshold	RSS	MSE	F-stat	Prob	Crit10	Crit5	Crit1
Single	1.7804	21.1774	5.33	0.2033	7.4943	8.7932	11.8671

Source: *Author's own computation*

The study used a sequential estimation approach to identify the number of thresholds by fitting models with one, two, and three thresholds. All three bootstrap tests utilise the same number of bootstrap samples to produce results. Table 11 displays the F statistic and its corresponding bootstrap p-value.

Table 11: Threshold effects in different threshold models: ODA: Threshold estimator (Level = 95):

Model	Threshold	Lower	Upper
Th-1	8.8161	8.7609	8.8543
Th-21	8.8679	8.6018	8.9258
Th-22	9.0389	8.5120	9.1460
Th-3	11.8552	11.1682	11.8913

Threshold effect test (bootstrap = 300 300 300):

Threshold	RSS	MSE	Fstat	Prob	Crit10	Crit5	Crit1
Single	1.78004	21.1774	5.33	0.2033	7.4943	8.7932	11.8671
Double	1.73004	20.5839	24.25	0.0433	12.5385	22.0744	52.1904
Tripe	1.72004	20.4019	7.50	0.4900	24.8145	31.6564	43.1682

Source*: Author's own computation*

The F1 statistic of 5.33 is less than the critical value of 11.8671 at a 1% significance level in the test for a single threshold. The null hypothesis is a linear model, whereas the alternative hypothesis is a single threshold model. Therefore, the F1 statistic exhibits a statistically significant p-value of 0.2033 when using bootstrap sampling. The bootstrap p-value of 0.0433 (F2 = 24.25 Crit2 = 22.0744) indicates that there is a significant difference in the double threshold test (H0: single threshold model, H1: double threshold model). However, the F3 critical value is 7.50, which corresponds to the 10th percentile of the significant level of 24.8145. The bootstrap p-value of the F statistic for the triple threshold test is not statistically significant (0.4900). Based on the data presented, the model has two thresholds.

The study recalculated the triple threshold model to determine the precise value of the threshold. Furthermore, the results of the study indicated that the projected thresholds were 8.8679% and 9.0389%.

Table 12: Double threshold model estimation: ODA Threshold estimator (Level = 95):

Model	**Threshold**	**Lower**	**Upper**
Th-1	8.8161	8.7609	8.8543
Th-21	8.8679	8.6018	8.9258
Th-22	9.0389	8.5120	9.1460

Threshold effect test (bootstrap = 300 300 300):

Threshold	**RSS**	**MSE**	**Fstat**	**Prob**	**Crit10**	**Crit5**	**Crit1**
Single	1.78004	21.1774	5.33	0.2033	7.4943	8.7932	11.8671
Double	1.73004	20.5839	24.25	0.0433	12.5385	22.0744	52.1904

Source: *Author's own computation*

Fixed effects regression is reported in Table 13. Regression estimates can be presented as follows:

$$growth_{it} = 3.1833 - 0.0683ODA_{it}d(ODA_{it} \leq 8.8679)[-1.36]^{***} + 2.1506ODA_{it}d(8.8679 < ODA_{it} \leq 9.0389) + 0.2621ODA_{it}d(ODA_{it} > 9.0389)[5.36]^{**}[2.88]^{**}$$

*(** and *** denotes level of statistical significance at 5% and 1%)*

Table 4: Regression Estimates: Double threshold model

Fixed effects (within) regression				**Number of obs**	**=**	**870**
Group variable: name				Number of groups	=	30
R-sq: within = 0.1055				Obs per group: Min	=	29
between = 0.0082				Avg=		29.0
overall = 0.0743				Max=		29
				F (12,828)	=	8.14
corr (u_i, xb) = -0.3233				Prob > F	=	0.0000
GR	**Coef.**	**Std. Err.**	**T**	**P>ltl**	**[95% Conf.**	**Interval]**
_cat#c.ODA						
0	-0.0683	0.0502	-1.36	0.174	-0.1668	0.0319
1	2.1506	0.4010	5.36	0.000	1.3637	2.9378
2	0.2621	0.0909	2.88	0.004	0.0836	0.4406
3	0.0044	0.0532	0.08	0.934	-0.0999	0.1088
_cons	3.1833	1.1409	2.79	0.005	0.9439	5.4228
sigma_u	1.6177					
sigma_e	4.5461					
rho	0.1124					
f test that all u_i=0:		F (29,828)	= 2.32		Prob>F =	0.0001

Source: Author's own computation

The fixed-effect model is appropriate when all values of ui are equal to zero. Therefore, the F statistic is 2.32 with a significant level of 5%. The bootstrap p-values indicate that there is a significant impact of the threshold at the 10% level of significance.

The regression model's threshold analysis reveals that the slope of the regression line indicates the impact of ODA in three distinct regions.

i. When ODA < 8.8161%, the negative coefficient of 0.0683 implies a negative relationship between ODA and economic growth.
ii. When 8.8161% < ODA < 9.0389%: the positive coefficient of 2.1506 suggests that economic growth is positively related to ODA.
iii. When ODA > 9.0389%, a positive effect of ODA on economic growth is back; however, it is not as strong as it was in the first regime, with a coefficient of only 0.2621.

When the ODA exceeds the second threshold, the lesser coefficient implies a less strong correlation between these two variables. Therefore, based on the latest study findings, it is recommended that the existing absorptive capacity is established at 9.0389% of GDP. This is because higher levels of ODA result in fewer advantages for economic growth.

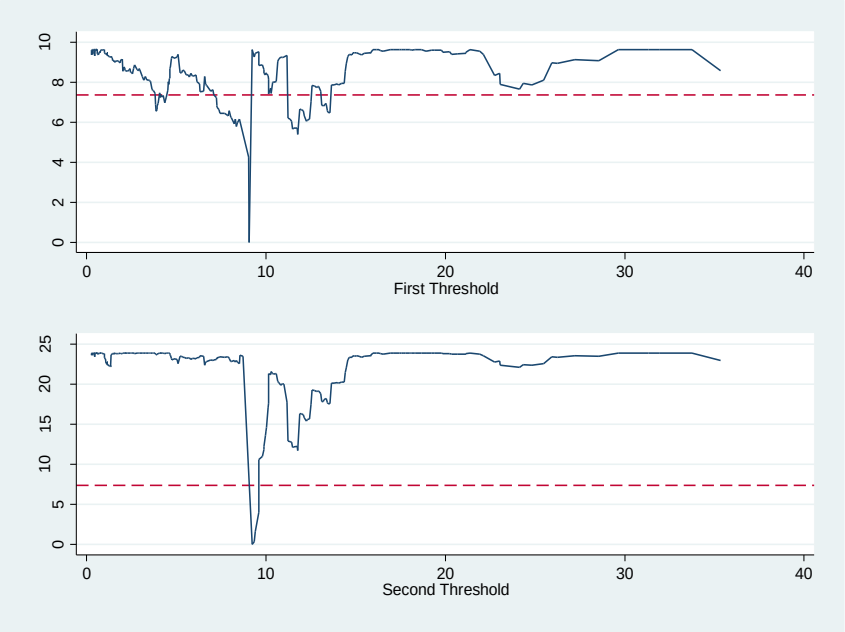

Figure 2: First and Second sample split: Confidence interval construction for threshold*; Source: Authors Computation*

As depicted in Figure 2 above, the initial and subsequent sample divisions align perfectly. Thus, the initial stage involves the existence of the likelihood ratio function in the estimation of a single threshold model. The initial threshold estimate is determined to be 8.8679% and 9.0389%, with a likelihood ratio of zero.

Conclusions

The objective of this study was to perform a threshold analysis to investigate the relationship between ODA, FDI, and economic growth in a sample of African countries. The analysis used annual data from 1980 to 2018 and used panel threshold regression analysis. The results suggest a positive coefficient of 0.0620, which indicates a favourable correlation between FDI and economic growth. The negative coefficient of 0.0683 indicates a negative correlation between ODA and economic growth, suggesting a detrimental relationship. Consequently, it is imperative for officials to ensure the enforcement of the appropriate level of ODA to promote FDI and facilitate economic growth in Africa. In conclusion, it is of utmost importance for authorities to establish and deploy a comprehensive monitoring system to closely track and oversee these thresholds. This will enable them to make necessary adjustments to the policy in response to any fluctuations or shifts in the economic landscape. The study's findings will make significant contributions to academic discourse and offer valuable perspectives for politicians, practitioners, companies, and foreign investors. These insights will guide the effective implementation of policies aimed at stimulating economic growth and attracting foreign investment in Africa. Furthermore, this study provides suggestions for future research in the field of international capital flows. Future research efforts should prioritise conducting a comparative analysis of different regions such as SADC or MENA within the African continent.

In summary, policymakers and international organisations should focus on creating tailored ODA policies that give priority to industries like infrastructure, technology, and education that have a strong potential for attracting foreign direct investment (FDI) in order to increase the study's practical value. Additionally, ensuring that ODA levels are optimal to support FDI inflows would be made easier by implementing adaptive policy frameworks and regular impact evaluations. To foster sustained economic growth, African governments and foreign investors can establish partnerships that will better connect ODA activities with the unique requirements of foreign investors. Lastly, to customise ODA and FDI policies to local contexts, region-specific strategies based on comparative analysis of regions such as SADC and MENA should be established.

Limitations

The study encountered inherent limitations, despite diligent efforts made to address reliability and validity concerns. The original objective of the study was to include all African countries. However, due to the limited accessibility to certain secondary data covering a 28-year timeframe, only a total of 30 countries were ultimately incorporated into the analysis, which required the exclusion of 24 countries. Furthermore, this study is limited to a specific group of 30 countries that were chosen based on their economic size and previous activities involving foreign capital flows, such as ODA and FDI. The data set collected from selected African countries over a period of 28 years was considered sufficient for the study's objectives, despite some limitations and restrictions.

Acknowledgements

The author read and agreed to the published version of the manuscript.

Author Contribution: All the work done in the manuscript was done by VMM Moloi
Informed Consent Statement: Ethics approval was obtained for this study.
Data Availability Statement: The data used in this paper is publicly available on the World Bank Indicators.

References

Alfada, A. (2019). The destructive effect of corruption on economic growth in Indonesia: A threshold model. Heliyon, 5 (10), e02649. https://doi.org/10.1016/j.heliyon.2019.e02649.

Appiah-Otoo, I., Acheampong, A. O., Song, N., Obeng, C. K., & Appiah, I. K. (2022). Foreign Aid-Economic Growth Nexus in Africa: Does Financial Development Matter? *International Economic Journal*, Vol 36(3), pp. 418-444. https://doi.org/10.1080/10168737.2022.2083653.

Azam, M., & Feng, Y. (2022). Does foreign aid stimulate economic growth in developing countries? Further evidence in both aggregate and disaggregated samples. *Quality & Quantity Journal*, Vol 56(2), pp. 533-556. https://link.springer.com/article/10.1007/s11135-021-01143-5.

Buckley, P. J. & Casson, M. (2018). Marketing and the multinational: Extending Internalisation Theory, *Journal of the Academy of Marketing Science*, 39(4), pp. 492 - 508. https://doi.org/10.4337/9781788110068.00010.

Caner, M. & Hansen, B.E. (2004). Instrumental variable estimation of a threshold model. *Econometric theory*, *20*(5), pp.813-843. DOI: https://doi.org/10.1017/S0266466604205011.

Casson, M., Dark, K. & Gulamhussen, M. A. (2009). Extending Internalisation Theory: From the multinational enterprise to the knowledge-based empire. *The Journal of International Business Review*, 18(3), pp. 236 - 256. https://doi.org/10.1016/j.ibusrev.2008.12.005.

Cossa, J. (2015). *Violent Crime and Foreign Direct Investment: The South African Case* (Master's Thesis, Graduate School of International Studies). Available at: https://s-space.snu.ac.kr/handle/10371/126365.

Cudjoe, P. (2024). *The Ghana Beyond Aid, exploring its efficacy as a plan for national development* (Doctoral dissertation). Available at: https://hdl.handle.net/1946/46830.

Das, A. & Sethi, N. (2020). Effect of foreign direct investment, remittances, and foreign aid on economic growth: Evidence from two emerging South Asian economies. *Journal of Public Affairs*, *20*(3), p.e2043. https://doi.org/10.1002/pa.2043.

Dunning, J.H. (1977). Trade location of economic activity and the MNE: In search of an eclectic approach, in B. Ohlin, *the international allocation of economic activity*. London: Macmillan. Available at: https://link.springer.com/chapter/10.1007/978-1-349-03196-2_38.

Duresa, M. K. (2022). Effect of Foreign Aid on Economic Growth and Investment in Ethiopia. *International Journal of Economics, Finance and Management Sciences*, Vol 10(1), pp. 12-27. https://doi.org/10.11648/j.ijefm.20221001.12.

Girma, S. (2005). Absorptive capacity and productivity spillovers from FDI: a threshold regression analysis. *Oxford bulletin of Economics and Statistics*, *67*(3), pp.281-306. https://doi.org/10.1111/j.1468-0084.2005.00120.x.

Hansen, B. E. (2000). Sample splitting and threshold estimation. *Econometrica*, *68*(3), 575-603. https://doi.org/10.1111/1468-0262.00124.

Hongli, J., & Vitenu-Sackey, P. A. (2023). Assessment of the effectiveness of foreign aid on the development of Africa. *International Journal of Finance & Economics*, *28*(1), 79-92. https://doi.org/10.1002/ijfe.2406.

International Monetary Fund (IMF). (1993). International Monetary Fund, Balance of Payment Manual, 5th edition. Available at: https://www.elibrary.imf.org/display/book/9781557753397/9781557753397.xml.

Jakupec, V. & Kelly, M. (2015). Financialisation of official development assistance. *International journal of economics, commerce, and management*, 3(2), pp. 1-18. Available at: 10536/DRO/DU:30069698.

Maduane-Komape, R. and Tshehla, M. (2024). Foreign divestment, financial development, and economic growth nexus in selected African countries: Autoregressive Distributed Lag (ARDL) Approach. International Journal of Research in Business and Social Science (2147-4478), 13(3), pp.233-247. https://doi.org/10.20525/ijrbs.v13i3.3238.

Makoni, P.L. (2021). FDI, stock market development and institutional quality: An African perspective. https://doi.org/10.5430/ijfr.v12n5p141.

Marandu, E. E., Mburu, P. T., & Amanze, D. (2019). An analysis of trends in foreign direct investment inflows to Africa. *International Journal of Business Administration*, *10*(1), 20-32. https://doi.org/10.5430/ijba.v10n1p20.

Matekenya, W. & Moyo, C. (2023). Foreign divestment, economic growth and development in South Africa: an empirical analysis. *Journal of Chinese Economic and Foreign Trade Studies*, *16*(1), pp.4-21. https://doi.org/10.1108/JCEFTS-01-2022-0006.

Mohamed, H., & Çelen, A. (2022). Impact of foreign financial aid on Uganda's economic growth. *International Academic Journal of Economics and Finance*, 3 (7), pp. 429 - 446. Available online at: https://iajournals.org/articles/iajef_v3_i7_429_446.pdf.

Moloi, V.M.M. (2023). The Impact Of Exchange Rate, Interest Rate, And International Trade In Selected Southern African Development Community (Sadc) Countries: An Ardl Approach. *Eurasian Journal of Economics and Finance*, *11*(3-4), pp.144-158. https://doi.org/10.15604/ejef.2023.11.0304.004.

Moralles, H.F. & Moreno, R. (2020). FDI productivity spillovers and absorptive capacity in Brazilian firms: A threshold regression analysis. *International Review of Economics & Finance*, *70*, pp.257-272. https://doi.org/10.1016/j.iref.2020.07.005.

Nguyen, C.H. (2020). The impact of foreign direct investment, aid and exports on economic growth in Vietnam. *The Journal of Asian Finance, Economics and Business*, *7*(10), pp.581-589. https://doi.org/10.13106/jafeb.2020.vol7.no10.581.

Nyoni, T., & Bonga, W. G. (2017). Foreign aid–economic growth nexus: A systematic review of theory and evidence from developing countries. *Dynamic Research Journals' Journal of Economics & Finance*, 2(7), pp. 01-16. Available at SSRN: https://ssrn.com/abstract=3015807.

Ocran, M.K., Senadza, B. & Osei-Assibey, E. (2020). Foreign aid and economic development. In *Contemporary Issues in Development Finance* (pp. 140-168). Routledge. Available at: https://www.taylorfrancis.com/chapters/edit/10.4324/9780429450952-6/foreign-aid-economic-development-matthew-kofi-ocran-bernardin-senadza-eric-osei-assibey.

Ozekhome, H. O. (2017). Foreign aid, Foreign direct investment and Economic growth in ECOWAS countries: Are there diminishing returns in the aid- growth nexus? *The West African Journal of Monetary and Economic Integration*, 17(1), pp. 61 - 84. Available at: https://hdl.handle.net/10419/264237.

Pitzen, L. L. (2016). *Japan's changing official development assistance: How institutional reforms affected the role of Japan's private sector in ODA delivery*. Working papers in contemporary Asian studies; 52(1). Centre for East and South-East Asian Studies, Lund University. Available at: https://lucris.lub.lu.se/ws/files/3609115/8857229.pdf.

Rao, D.T., Sethi, N., Dash, D.P. &, Bhujabal, P. (2020). Foreign Aid, FDI and Economic Growth in South-East Asia and South Asia. *Global Business Review*. https://doi.org/10.1177/0972150919890957.

Romer, P.M. (1986). Increasing returns and long-run growth. *Journal of political economy*, *94*(5), pp.1002-1037. Available at: https://www.journals.uchicago.edu/doi/epdf/10.1086/261420.

Sijabat, R. (2022). The association of economic growth, foreign aid, foreign direct investment, and gross capital formation in Indonesia: Evidence from the Toda–Yamamoto approach. *Economies*, *10*(4), p.93. https://doi.org/10.3390/economies10040093.

Smith, A. (2002). An Inquiry into the Nature and Causes of the Wealth of Nations. *Readings in economic sociology*, 6-17. https://doi.org/10.1002/9780470755679.

Solow, R. M. (1956). A contribution to the theory of economic growth. *The quarterly journal of economics*, *70*(1), 65-94. https://doi.org/10.2307/1884513.

Tong, H. & Tong, H. (1983). Threshold models. *Threshold models in non-linear time series analysis*, pp.59-121. Available at: https://link.springer.com/chapter/10.1007/978-1-4684-7888-4_3.

Tsaurai, K. (2017). *The impact of financial sector development on foreign direct investment in emerging markets* (Doctoral dissertation, University of South Africa). Available at: https://core.ac.uk/download/pdf/85157624.pdf.

Upadhyaya, K. P., Pradhal, G., Dhakal, D., & Bhandari, R. (2007). Foreign aid, FDI and economic growth in East European countries. *Journal of Economic Bulletin*, (1), pp. 1-9. Available at: URL: http://economicsbulletin.vanderbilt.edu/2007/volume6/EB-07F20001A.pdf.

Wehncke, F. C., Marozva, G., & Makoni, P. L. (2022). Economic Growth, Foreign Direct Investments and Official Development Assistance Nexus: Panel ARDL Approach. *Economies*, *11*(1), 4. https://doi.org/10.3390/economies11010004.

Wehncke, F.C., Makoni, P.L. & Marozva, G. (2022). Nexus Between FDI, ODA and Economic Growth in Developing African Countries: A Systems Approach. *Economic Research Guardian*, *12*(2). Available at: https://www.ecrg.ro/files/p2022.12(2)15y2.pdf.

Younsi, M., Bechtini, M. & Khemili, H. (2021). The effects of foreign aid, foreign direct investment, and domestic investment on economic growth in African countries: Nonlinearities and complementarities. *African Development Review*, *33*(1), pp.55-66. https://doi.org/10.1111/1467-8268.12490.

Zardoub, A. & Sboui, F. (2021). Impact of foreign direct investment, remittances and official development assistance on economic growth: panel data approach. *PSU Research Review*, *7*(2), pp.73-89. Available at: https://www.emerald.com/insight/2399-1747.htm.

Publisher's Note: SSBFNET stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.