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THE NEXUS BETWEEN FOREIGN DIRECT INVESTMENT AND NOMINAL EXCHANGE RATE, REAL GDP, AND CAPITAL STOCK IN TANZANIA

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ABSTRACT

Aim: The paper aims to examine the relationship between FDI and the nominal exchange rate, real GDP, and capital stock in Tanzania using quantitative research methods and an econometric analysis. The analysis aims to provide insights into the factors that affect FDI and contribute to the existing literature on the relationship between FDI and economic growth. **Methods:** This study examines the relationship between FDI inflow, real GDP, capital stock, and the normal exchange rate in Tanzania using a robust research methodology. The study employs STATA 15 software and Akaike's Information Criteria (AIC), Schwarz Information Criteria (SC), Final Prediction Error (FPE), and the Hannan Quinn (HQ) Information Criteria. In addition, the autoregressive model, the Johansen co-integration test, and the Toda-Yamamoto Granger causality (modified WALD) test were employed to determine the optimal lag. **Results:** The results indicate a bidirectional relationship between the nominal exchange rate and FDI in Tanzania, with FDI inflows influencing the nominal exchange rate volatility and vice versa. Furthermore, the results indicate that real GDP, capital stock, and the nominal exchange rate exert a unidirectional influence on FDI influx in Tanzania. **Conclusions:** The nominal exchange rate and capital stock have positive and negative correlations with foreign direct investment. Like many other African economies, Tanzania remains vulnerable to external forces despite making significant strides in stabilizing the exchange rate. It is recommended that the Central Bank of Tanzania – along with those of other African nations with similar economic structures – maintain a stable nominal exchange rate level as an incentive for foreign investors in order to increase the inflow of foreign direct investment.

Key words: Toda-Yamamoto Granger causality, autoregressive model, FDI inflow, real GDP, nominal exchange rate, capital stock

JEL codes: B42, C22, C32, F43

INTRODUCTION

Global predispositions and activities present both significant challenges and opportunities for individual economies. However, regarding macroeconomic variables, foreign direct investment (FDI) is one of the most important determinants of Gross domestic product (GDP), capital stock, employment, inflation, and exchange rate. Additionally, there is a consensus among economist, development practitioners and academia that FDI brings much-needed capital investments to developing countries to achieve economic growth and development. Globally, FDI has become increasingly important in developing nations, particu-

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larly in Africa, prompting policymakers to claim that FDI has improved progress and promoted growth in low- and middle-income countries (LICs) [Zekarias 2016, Shafique and Hussain 2015]. FDI is thought to help economic advancement and development by increasing job creation, managerial skills, and technology transfer [Prakash and Assaf 2001, OECD 2002, Chandana and Peter 2006, Kurtishi-Kastrati 2013, Badr and Ayed 2015, Bibi et al. 2018].

As many developing nations view FDI as an important part of their economic development strategy, FDI inflows have substantially increased worldwide in recent decades. Mergers and acquisitions, which included private-to-private transactions and acquisition through privatization in developing countries, became an increasingly important vehicle for FDI. As a result, several countries have improved their business climate to attract more FDI [Mussa 2015, Letswa et al. 2018, Kurtishi-Kastrati 2013, Bitzer and Görg 2009]. Driven by this, one of the fundamentals of the New Partnership for Africa's Development (NEPAD) aimed to increase FDI inflows to the region [Yin et al, 2021] as a number of African countries and other developing nations regard FDI as an indispensable source of capital and it complements local private investment. It is usually associated with increased job opportunities and enhanced knowledge transfer, as well as promotes economic growth, though a number of firm-level studies refute the notion that FDI increases economic growth [Clark et al. 2011, Grekou and Owoundi 2020, Kuruvilla and Arudsothy 1995].

As per WIR, FDI inflows into Africa decreased by 21.5% from USD 53.2 billion in 2016 to USD 41.8 billion in 2017. This decrease was primarily due to a decrease in foreign investment, particularly from Southern Africa – which continues to struggle in the commodity sector and is experiencing political unrest. Most countries performed differently than others. Many administrations have responded to the current macroeconomic situation; East Africa saw the lowest levels of FDI inflows across Africa, a 3.3% decrease in 2017 [BOT 2018], from a record of USD 2.6 billion in 2016. However, FDI inflows into the East African Community increased by 16.2% in 2017, totaling around USD 3.0 billion. Uganda is the second-largest recipient of FDI inflows among Community Member States after Tanzania. Due to anticipated sustained economic expansion, FDI inflows to Africa were expected to increase in 2018. Macroeconomic fundamentals, commodity prices, and regional cooperation have all improved since the signing of the African Continental Free Trade Agreement [BOT 2018].

According to the World Investment Report of 2018, Tanzania's global share of FDI inflows remained constant between 2013 and 2017 (at 0.1%), while its share in Africa averaged 3.0%. From Fig. 1, the overall trend indicates that FDI inflows to Tanzania are expected to fall to USD 1.2 billion in 2017.

Fig. 1 demonstrates that FDI in Tanzania has exhibited both rising and falling trends since 1990, and more recently, in 2019, the trends indicate that FDI is declining – which may be attributed to various reasons such as low GDP, unstable exchange rate in the country during that period, and the trends show to have sustained. If this trend continues for several years, it may lead to several negative effects since FDI is vital for most developing nations, including Tanzania.

Various factors are considered to influence or attract the flow of foreign capital into developing countries. According to Saidi et al. [2020] and Wako [2021], institutional quality-supported transportation facilities and logistics infrastructure increase FDI attractiveness, influencing economic growth. The global trend shows that FDI is primarily determined by market size, economic growth rate, GDP, nominal exchange rate, infrastructure, natural resources, and political stability [Yimer 2017, Anarfo et al. 2017, Jugurnath et al. 2016, Sane 2016, Hoang and Bui 2015, Omankhanlen 2011, Campos and Kinoshita 2003].

Scholars have recently focused on the effects of capital stock, nominal exchange rate, and real GDP on FDI. Chadee and Schlichting [2017] examined various aspects of FDI in the Asia-Pacific region and concluded that it benefited the entire region's macroeconomy. Borensztein et al. [2018] conducted a study in five developing countries and concluded that FDI benefits least-developed countries (LDCs) only if the existing human capital in these countries can adopt modern technologies and able to perform some technological innovation. Using a two-stage growth accounting model to assess the relationship between recent rapid

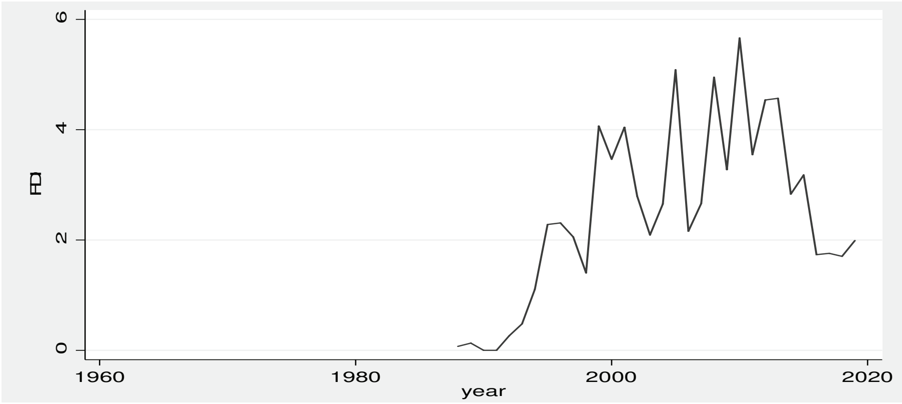

Fig. 1. Trends of FDI inflow in Tanzania from 1960 to 2019
Source: author's calculation.

economic growth in China and the role of FDI inflows, Whalley and Xin [2010] concluded that the sustainability of both China's exports and the overall trend performance of growth may be jeopardized if FDI inflows plateau in the future. However, Karimi and Yusop [2019] used a basic OLS regression to examine the Malaysian growth-FDI scenario and discovered that various factors may influence whether FDI helps or hinders economic growth.

Previous studies conducted in Tanzania that are important in informing FDI policy have focused on economic growth, wage differentials, employment, technology spillover, and foreign trade effects; however, the linkage between FDI and nominal exchange rate, capital stock, and real GDP has been pitifully studied, and conclusions on this matter are still mitigated. Worded differently, previous studies that used cross-country data, such as Msuya [2007] and Mpanju [2012], did not focus solely on Tanzanian FDI inflows and their relationship to other variables.

This study focuses on the relationship between the nominal exchange rate, capital stock, and real GDP on FDI by examining the direction of causation between the variables using a vector autoregressive econometric model, and it seeks to significantly contribute to the existing body of literature by employing an econometric methodology (Toda and Yamamoto – T-Y) to analyze the direction of causality between the four variables and the Johansen test was used for the co-integration test (long run relationship) of the variables of the study. To the best of our knowledge, the methodology used for testing causality (T-Y) is crucial for addressing the weaknesses of the Granger causality test because (T-Y) can test the long-term relationship over a longer period of time than the Granger causality test can (as per the study period from 1990 to 2019), and it does so by applying more variables independently than previous research on the topic.

THEORETICAL FRAMEWORK

This study is built on dynamic macroeconomic and capital market theories. According to the active approach, changes in the macroeconomic environment, including GDP, domestic investment, real exchange rate, productivity, and openness, are all drivers of FDI flows and dictate when investments should be made. FDIs, according to this theory, serve as a long-term function of multinational strategy [Dankwa et al. 2018, Jugurnath et al. 2016]. One of the oldest theories, Capital Market Theory (CMT), holds that interest rates determine FDI [Jugurnath et al. 2016]. CMT concentrates on three factors that entice FDI to developing nations: 1) an undervalued exchange rate, which allows for lower production costs in the host country; 2) long-term investments in developing nations, the most common of which are FDI rather than stock purchases; 3) control of the hosting economy assets, which is linked to a lack of knowledge about host country securities [Kofarbai 2015].

EMPIRICAL REVIEW

Shetty, Manley, and Kyaw [2019] investigated the effects of exchange rate volatility on FDI mergers and acquisitions. The analysis of abnormal returns in their study confirms no consistent relationship between real exchange rate volatility and bidder returns when looking at the relationship between cross-border mergers and acquisitions of 591 US firms from 2001 to 2010. Nonetheless, they discovered a statistically significant positive impact of bidder returns on exchange rate volatility. Furthermore, they discovered a significant relationship between bidder experience abroad and bidder returns, as well as deal size and bidder return.

Behname [2012] investigated the impact of FDI on economic growth in Southern Asia from 1977 to 2009. The Im, Pesaran, and Shin [2003] unit root test revealed that the variables were stationary in level, and the Hausman [1978] test demonstrated the need to apply the random effects model. After estimating the model, they concluded that FDI has a positive and significant impact on economic growth, and variables such as capital formation, economic infrastructure, capital formation, and human capital positively impact GDP. However, technological gap inflation and population growth harm economic growth.

The study by Mtumwa [2019] examined the relationship's relevance using time-series data spanning the years 1980 to 2016. Infrastructure development, macroeconomic variables, and the exchange rate all had a significant effect on the flow of FDI to Tanzania. Surprisingly, a country's degree of openness was found to have little effect on FDI influx. Natural resource availability and market size were discovered to significantly affect the flow of FDI. These results can primarily assist Tanzanian policymakers in making informed decisions when developing policies to attract more FDI to the country.

Masanja [2018] investigated the degree to which FDI influences Tanzanian economic growth by employing (OLS) estimation techniques and macroeconomic time series data from 1990 to 2013. The independent and dependent variables were regressed. The findings indicate that FDI has positive but contributed insignificantly to the nation's economic growth during the specified period. The results contradict the conventional wisdom about FDI-led growth. Hitherto, a large concentration of FDI in the manufacturing and mining sectors, but less in tourism and agriculture, which have a trickle-down effect on the rest of the economy, could be the reason for such a general feeble contribution. The remaining variables in the regression model appear to perform admirably in favor of economic growth, with human capital stock having the most significant positive coefficient. Although not as significant as human capital stock, the financial system or capital market efficiency and domestic capital formation have positive coefficients. Government spending and the inflation rate have been found to harm the economy. These findings imply that the government should consider human capital stock as critical to all its development and economic strategies.

In his study, Adeniyi [2020] investigated the impact of FDI and inflation on economic growth in five randomly selected African countries. The study used data mapper and UNCTAD time series from 1996 to 2018, and the variables of interest were FDI inflows, GDP per capita (economic growth), and inflation rate. As a rule of thumb, the unit root test and regression analysis were run to estimate the objectives, and the results indicate that FDI positively impacts economic growth in all five countries studied. Except for Egypt, inflation tends to harm economic growth in four of the five countries studied.

Sengupta and Puri [2020] endeavored to investigate the structure of FDI in the Indian subcontinent and India's neighbors, such as Pakistan, Nepal, Bangladesh, and Sri Lanka, as well as reconnoiter the relationship between FDI and GDP. Regression was used in their study to investigate the relationship between one or more prognosticators or experimental variables and one regressing variable. The findings revealed that the different economic policies of the respective countries played a role in explaining the difference in the quantum of the flow, that there is a relationship between FDI and GDP, and that FDI is instrumental in enhancing the economic growth of the countries included in the study in all cases.

According to Ciobanu's [2020] study on the impact of FDI on Romania's economic growth, there is co-integration between the variables once real GDP and FDI are dependent variables. In addition, it was discovered that the primary factors influencing long-term economic growth in Romania are the labor force, FDI, and trade openness. In the long run, the growth of the labor force, the GDP, imports, and exports all support the growth of FDI.

The examination of the exchange rate and FDI in Nigeria by Okonkwo et al. [2021] from 1981 to 2018 shows a favorable correlation between real and nominal exchange rates and FDI. The study is comparable to that of Xing [2006], who noted that China is more alluring for FDI and suggested that the CBN ought to provide a sufficient flow of foreign currency on the currency exchange market and maintain a sustainable level of exchange rate to draw in more foreign direct investment. Empirical evidence suggests that one of the key variables affecting Japanese direct investment in China is the real exchange rate between the Yuan and the Yen. The devaluation of the Yuan caused FDI from Japan to increase significantly because FDI is flexible in how it reacts to changes in actual exchange rates.

Omri [2014] did a study concerning the link between foreign investment, domestic capital, and economic growth in the MENA region. This study employed a "growth model" context coupled with a simultaneous equations model estimated by the general method of moments (GMM) to examine the connections between FDI, local capital, and economic progress in 13 MENA nations covering a period of 1990 up to 2010. The findings show a link between regional capital and foreign direct investment throughout the region.

MODEL AND DATA

The study uses secondary time series data from the World Bank (The Penn World Table), notably the world development indicators. The data set is obtained from the World Bank. The data sources were chosen because they are the most reliable and are used by nearly every Tanzanian researcher.

On the other hand, the World Bank's databank offers a variety of data arrangement tools that allow required data to be organized in the desired format and can be directly downloaded from an Excel file. The data set includes real GDP in millions of US dollars, FDI inflows (as percentage of GDP), capital stock (as a percentage of GDP), and the nominal exchange rate. The dataset is updated annually and spans the years 1960 to 2019. Time series data used to study the causal relationship between GDP in millions of US dollars, FDI inflows (% of GDP), capital stock (% of GDP), and the nominal exchange rate. The study employs STATA 15 in all of its analyses, including computing and drawing figures – which were all accomplished using the program.

The vector autoregressive model (VAR) is a popular, flexible, and uncomplicated multivariate time series analysis tool. It is used to study the effects of the regressors variables on the regressing variables [Zivot and Wang 2003]. The univariate autoregressive model is a natural progression from the dynamic multivariate autoregressive model. The VAR model has been confirmed to be particularly effective in characterizing time series for the economy and finance dynamic behavior and predicting simultaneous equations based on time series models and sophisticated theory models. Forecasts from VAR models are highly adaptable because they can be changed and made dependent on the possible future paths of specified variables in the model [Zivot and Wang 2003].

The vector autoregressive model was specified as follows:

$$FDI_t = f\,(RGDP_t\; CST_t\; NEXR_t) + \mu_t$$

Whereas μ_t represent the stochastic term.

To generate a linear equation from equation 1.1, the Cobb Douglass log linear is applied, where equation 1.1 becomes:

$$FDI_t = \alpha_0 \left((FDI_{t-1})^{\alpha_1} \; (RGDP_t)^{\alpha_2} \; (CST_t)^{\alpha_3} \; (NEXR_t)^{\alpha_3} \; \left(\mu_t^{\varepsilon_t}\right) \right)$$

Since equation 1.2 is multiplicative, when transformed to a natural logarithm, the equation becomes:

$$\ln FDI_t = \alpha_0 + \alpha_1 \ln RGDP_t + \alpha_2 \ln CST_t + \alpha_3 \ln NEXR_t) + \varepsilon_t$$

Therefore, the vector autoregressive model becomes:

$$\ln FDI_t = \alpha_0 + \alpha_1 \ln FDI_{t-1} + \alpha_2 \ln RGDP_t + \alpha_3 \ln CST_t + \\ + \alpha_4 \ln NEXR_t + \varepsilon_t$$

The explanatory variables coefficients in equation 1.3 represent the explained variable's long-run elasticities.

In this study, the augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1981) is used to test for unit roots to avoid spurious regression in a time series analysis.

A stationarity test is crucial for the time series variables (observations) to avoid spurious regression estimations. Therefore, in testing for stationarity, the most common estimator used in this study is the augmented Dickey-Fuller (ADF) test.

Consider the ADF test as that:

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta Y_{t-i} + \varepsilon_i$$

The hypotheses of equation 1.4 are as hereby described below:

H_0: $\delta = 0$ *under this assumption the series are found not to be stationary*

H_0: $\delta < 0$ *under this alternative hypothesis the series are stationary*

Estimating the p from the VAR estimation of the variables in their levels is necessary because it is always unknown. There are various lag length criteria that can be used to determine the p. such as Akaike's Information Criterion (AIC), Schwarz Information Criterion (SC), Final Prediction Error (FPE), and the Hannan Quinn (HQ) Information Criterion [Zhang and Zhang 2018].

The co-integration test is performed after testing the series stationarity to assess the existence of the long-run relationship between variables. In this study, the co-integration test is performed using the Johansen co-integration test, which applies maximum likelihood in testing for the long-run relationship among multivariate vector autoregressive models (VAR model).

Consider a VAR model of vector *k*; given a vector being *I* (1) or integrated in order, the explained variable can be written as:

$$Y_t = \alpha_t Y_{t-1} + \alpha_t Y_{t-2} + \ldots \ldots \ldots \ldots + \alpha_k Y_{t-k} + \varepsilon_t$$

Whereas Y_t and ε_t are the n × 1 vectors of which equation 1.5 can be rewritten as:

$$\Delta Y_t = \sum_{i=1}^{k-1} \omega_i Y_{t-i} + \prod Y_{t-1} + \mu_0 + \varepsilon_t$$

of which:

$$\prod = \sum_{i=1}^{k} \alpha_i - 1 \quad \text{and} \quad \omega_i = -\sum_{j=i+1}^{k} \alpha_j$$

By which, there are *n × r matrices* as well as α and β each with *'r'* ranking with a matrix of $\prod = \alpha\beta'$ and $\beta' Y_t$ (said to be stationary). However, this depends on whether the reduced rank $r < n$, α and individual columns of β are the adjustment parameters in the VECM and co-integrating vector, respectively – whereby *r* is the number of co-integrating relationships.

After testing for co-integration, we then adopted a vector error correction model (VECM) to capture the long-run and the short-run dynamics. To estimate the relationship of FDI, real GDP nominal exchange rate, and capital stock in Tanzania, the following equations have been used for the estimations:

$$\ln FDI_t = \alpha_0 + \sum_{i=1}^{n} \theta \ln CPS_t + \sum_{i=1}^{n} \psi \ln N\_EXT_t + \\ + \sum_{i=1}^{n} \eta \ln RDGP_t + \varepsilon_t$$

$$\Delta \ln FDI_t = \alpha_0 + \sum_{i=1}^{n} \theta \Delta \ln CPS_t + \sum_{i=1}^{n} \psi \Delta \ln N\_EXT_t + \\ + \sum_{i=1}^{n} \eta \Delta \ln RDGP_t + \varepsilon_t$$

Therefore, FDI_t, represents the relationship between real GDP, capital stock and nominal exchange rate for the period of 60 years (1960–2020) while ε_t is the coefficient of the Error correction term (ECT_{t-1}). This study is important and intriguing since few current studies in Tanzania have been able to integrate multiple variables impacting FDI covering a very long period of time. Therefore, the analysis and discussion of findings have relied on proportional techniques.

The co-integration test verifies the existence of long-term equilibrium relationship between variables. A long-run equilibrium relationship or ECM is applied if there is a co-integration relationship. If there is no co-integration relationship, the difference variable analyses the short-term relationship. In contrast, the Granger causality is a method of determining if one variable helps predict another. Traditional Granger causality testing methods should ensure the stability of time series data, and the integration process should be clear. However, the effectiveness of the Granger causality test is poor if the time series integration process is different or unclear and the facts that it is weak in testing the causality of the long-term period data. As an alternative, the T-Y (TY) method is used [Toda and Yamamoto 1995].

The Toda-Yamamoto causality test applies a modified Wald test statistic to test zero restrictions on the parameters of the original VAR (k) model. The test has an asymptotic (χ^2) distribution with k degrees of freedom. The test essentially involves two stages.

The first stage determines the optimal lag length (k) and the maximum order of integration (d) of the variables in the system. The lag length, k is obtained in the process of the VAR in levels among the variables in the system by using different lag-length criteria such as AIC or SBC. The unit root testing procedure, such as Dickey-Fuller [1981] ADF and Phillips-Perron [1985] tests may be used to identify the order of integration,

The second stage uses the modified Wald procedure to test the VAR (k) model for causality. The optimal lag length is equal to $p = [k + d(\max)]$. In the case of a bivariate (Y, X) relationship, the Toda and Yamamoto [1995] causality test is represented as follows:

$$Y_t = \sum_{i-1}^{v} \beta 1 j \times Y_{t-1} + \sum_{i-k+1}^{k+d\,max} \beta 2 j \times Y_{t-1} + \\ + \sum_{i-1}^{v} M1j + v_t$$

$$X1_t = \sum_{i-1}^{v} R1j \times X_{t-1} + \sum_{i-k+1}^{k+d\,max} R2j \times X_{t-1} + \\ + \sum_{i-1}^{v} H1j + e_t$$

$$X2_t = \sum_{i-1}^{v} P1j \times X2_{t-1} + \sum_{i-k+1}^{k+d\,max} P2j \times X2_{t-1} + \\ + \sum_{i-1}^{v} L1j + \Omega_t$$

$$X3_t = \sum_{i-1}^{v} K1j \times X3_{t-1} + \sum_{i-k+1}^{k+d\,max} K2j \times X3_{t-1} + \\ + \sum_{i-1}^{v} G1j + \Pi_t$$

Where Y_t = FDI, $X1_t$ = real GDP, $X2_t$ = norminal exchange rate, $X3_t$ = capital stock and v_t, e_t, $'\Omega_t$, Π_t are residuals.

The Wald tests were then applied to the first k coefficients matrices using the standard χ^2 statistics. The null hypothesis is constructed so that X does not cause Y; similarly, the second hypothesis does not cause X. The Seemingly Unrelated Regression (SUR) approach is used to estimate the system described by equations 11–14 [Rambaldi and Doran 1996]. The hypothesis is then put to the test using a Wald test. The calculated Wald statistic has a k-degrees-of-freedom asymptotic chi-square distribution.

RESULTS

The results in Table 1 show that the average annual inflow of FDI in Tanzania for 59 years was 0.0463406%. In contrast, the lowest recorded FDI was –8.508473%, and the highest FDI recorded was 1.7348%. Moreover, the nominal exchange rate between US Dollar and Tanzanian shillings from 1960 to 2019 was 4.621%, the lowest ever at 1.9488%, while the highest was recorded at 7.7355%.

On the other hand, Tanzania had an average real GDP of 10.34% from 1960 to 1921, with a minimum of 9.029% and a maximum of 11.84%. Over the years 1960–2021, the average capital stock recorded in the country was 11.206%, while the minimum was 9.71 and the maximum was 12.88%.

Fig. 2 shows that to test for the stationarity, we must include drift for the variables to be stationary.

Table 1. Descriptive Statistics

Variables	Mean	Standard Deviation	Min	Max
LnFDI	.0463406	1.778024	–8.508473	1.734082
N_Exchange rate	4.62085	2.38128	1.948818	7.735524
Real GDP	10.34279	.7556901	9.029381	11.84804
Capital stcok	11.20676	.7966173	9.716331	12.88934

Source: author's computation.

This is signified by the presentation of the variables in the Fig. 2. Moreover, these figures for foreign direct investment (FDI), capital stock, real GDP, and nominal exchange rate show that the variables may not be stationary; hence, the need to be further reexamined by the augmented Dickey-Fuller, which will give numerical interpretation of the variables' status towards stationarity (unit root).

To prevent erroneous results, it is crucial to do a pretest for the statistical features of the variables, such as a non-stationarity test for time series data. Table 2 displays the outcomes of the unit root test for the variables utilized in this study. The unit root test results indicate that all the variables are integrated of order one, I (1).

Because Granger causality and vector autorepression analysis use lagged variables, the number of lags to be included in the causality tests is critical [Karimi 2011]. The study had to conduct a practical test to establish the correct number of lags to be used by STATA command of vector autoregression selection order criteria to calculate the final prediction error (FPE), Akaike's information criterion (AIC), Schwartz's

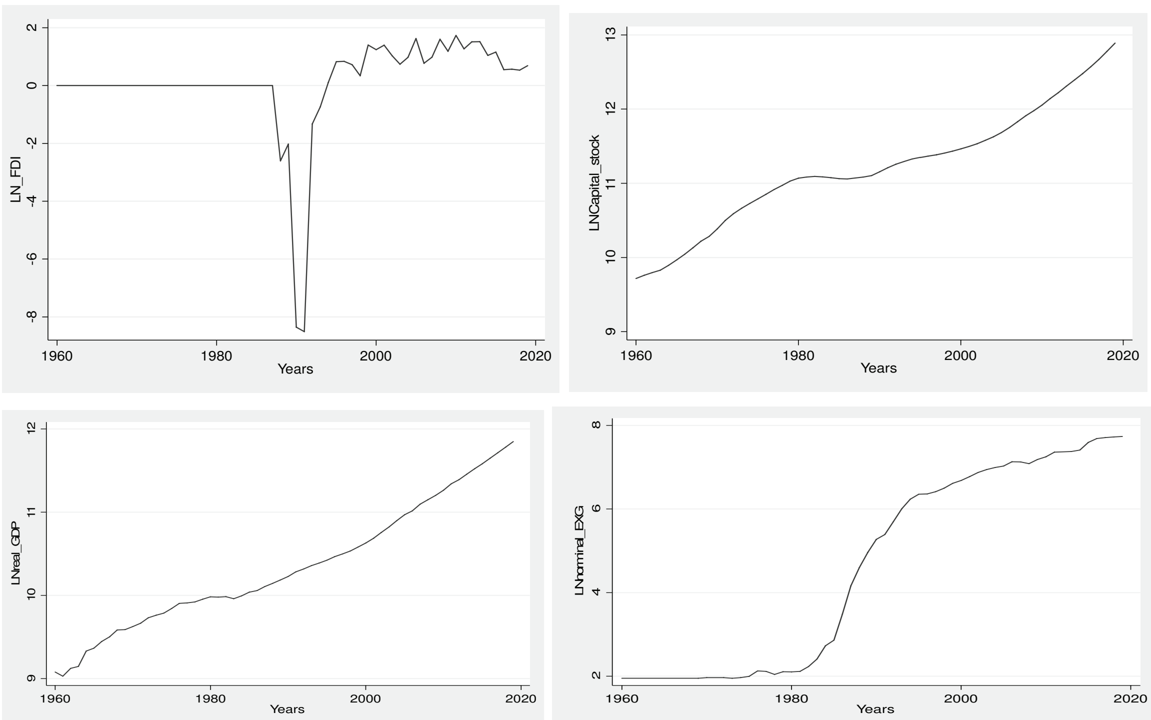

Fig. 2. Time Series Plot of Variables to analyze Trends
Source: author's calculation.

Table 2. Unit Root Tests utilizing the augmented Dickey-Fuller test results

Variables	Level			First Differences		
	None	Constant	Constant and Drift	None	Constant	Constant and Drift
ln (FDI)	–3.068	–3.044	–3.044	–3.226	–3.199**	–3.199**
	(1.95)	(–2.923)	(–1.672)	(1.95)	(–2.924)	(–1.673)
ln (Real GDP)	11.65	1.768	1.768	6.812	1.094**	1.094**
	(–1.95)	(–2.923)	(–1.672)	(–1.95)	(–2.924)	(–1.673)
ln (N_Exchange rate)	4.427	0.241	0.241	0.929	–0.725**	–0.725**
	(–1.95)	(–2.923)	(–1.672)	(–1.95)	(–2.924)	(–1.673)
ln (Capital stock)	11.337	10.036	10.036	5.353	5.224**	5.224**
	(–1.95)	(–2.924)	(–1.673)	(–1.95)	(–2.924)	(–1.674)

Notes: Number in parentheses are the critical values at a 5% significance level. ** indicate significance at a 5% level.

Source: author's calculation.

Bayesian information criterion (SBIC), and Hannan and Quinn information criterion (HQIC) lag-order selection statistics (varsoc). The exact ideal for the causality connection test should use four-lag to provide precise guesstimates following Schwartz's Bayesian information criterion (SBIC) requirements. The four-lag version of the dependent variable from the Granger causality model was used in the study.

Where, LR: Sequential Modified LR Test Statistic (each test at 5% level), FPE: Final Prediction Error, AIC: Akaike information Criterion, SBIC: Schwarz Bayesian Information Criterion, HICQ: Hannan Quinn Information Criterion.

The results in Table 3 show that the most convenient and optimal lag is at order 2. This choice offers the best likelihood of delivering accurate estimations, as evidenced by receiving four stars in LR, FPE, AIC, and HQIC. This indicates that, according to all these criteria, lag 2 is found to be the best option. In contrast, lag 4 only meets one criterion, which is AIC and LR. Therefore, this study's estimations have been made using the optimal lag at order 2.

Figure 3 findings underline the results portrayed in Table 3 that the optimal lag order is at lag two, which is represented by column 2. The presence of such movements indicates variations in the changes of the variables under different integration.

The null hypothesis for the trace test is that the number of co-integration vectors is $r = r \times < k$, as opposed to the alternative that $r = k$.

Table 3. Choice for selecting the order for the Vector Autoregressive model

Lags	LL	LR	*df*	*p*	FPE	AIC	HQIC	SBIC
0	–204.634				0.020236	7.4512	7.50729	7.59587
1	231.652	872.57	16	0.0000	6.10E–09	–7.55901	–7.27858	–6.83567
2	299.111	134.92	16	0.0000	9.9e–10*	–9.3968	–8.89202*	–8.09479*
3	304.43	10.64	16	0.8310	1.50E–09	–9.01537	–8.28624	–7.13469
4	331.191	53.521*	16	0.0000	1.10E–09	–9.39968*	–8.44619	–6.94032

* Indicates lag order selected by the criterion

Source: author's calculation.

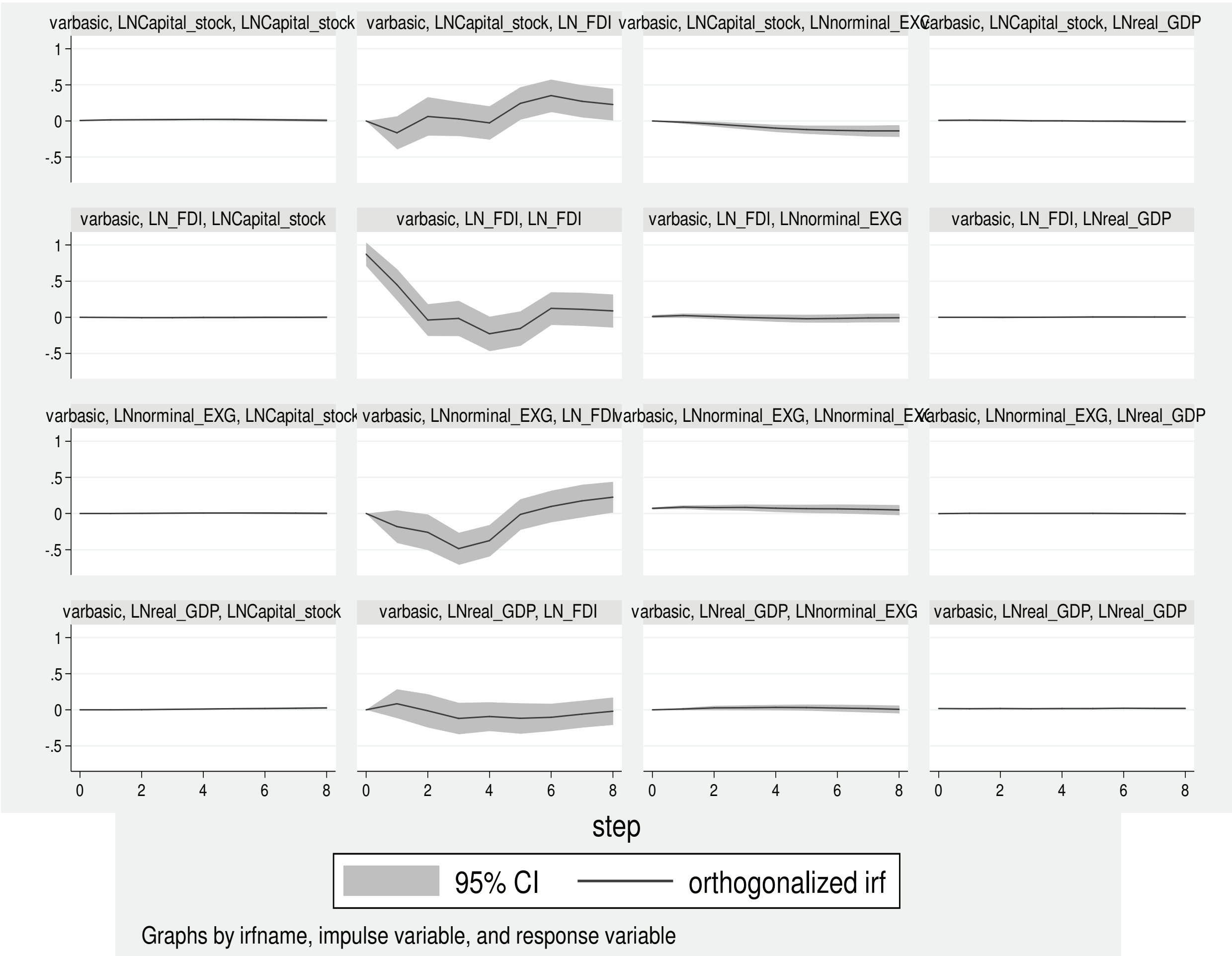

Fig. 3. Results of the analysis
Source: author's calculation.

The trace test differs from the alternative hypothesis in that at least one co-integrating link (exposed by the number of direct amalgamations). The alternative view for the maximum eigenvalue test is K0 + 1 (instead of K > K0). In this situation, there is only one way to combine the non-stationary variables to construct a stationary process, which is the essence of rejecting the null hypothesis.

The null hypothesis of Johansen's co-integration test is that there is no co-integration among variables. We reject the null hypotheses if the trace and maximum statistics values are more significant than the critical values at 5% and 1%, respectively. Table 4 shows the results of the co-integration study, and there is at least one co-integrating vector among the four variables included in the model because both the trace statistics and maximum statistics values are greater than the critical values at the 5% and 1% significance levels, respectively. It can also be argued that the relationship between FDI, capital stock, real GDP, and the nominal exchange rate exhibits a distinct long-run equilibrium.

Findings in Table 5 show that the nominal exchange rate is positively and significantly influencing the FDI in Tanzania at lagged 2. In contrast, an increase in the nominal exchange rate increases the FDI by 43 at a 1% significant level. But also, the results show that the nominal exchange rate is negatively and significantly influencing the FDI in Tanzania at lagged 1, whereas

Table 4. Co-integration test based on Johansen's Test Approach

Maximum rank	parms	LL	Eigenvalue	Trace statistic	5% critical value	1% critical value
0	20	275.4227		72.5966	47.21	54.46
1	27	290.2357	0.39998	42.9704	29.68	35.65
2	32	304.6879	0.39247	14.0662*1*5	15.41	20.04
3	35	311.631	0.21291	0.1799	3.76	6.65
4	36	311.721	0.0031			
Maximum rank	parms	LL	Eigenvalue	Max statistic	5% critical value	1% critical value
0	20	275.4227		29.6262	27.07	32.24
1	27	290.2357	0.39998	28.9043	20.97	25.52
2	32	304.6879	0.39247	13.8862	14.07	18.63
3	35	311.631	0.21291	0.1799	3.76	6.65
4	36	311.721	0.0031			

Source: author's calculation

Table 5. Vector Autocorrelation Results

	(1)	(2)	(3)	(4)
VARIABLES	LnFDI	LnN_Exch	LnRGDP	LnC_stock
L.lnFDI	0.711198***	–0.0011796	–0.001275	–0.0016995
	(0.1212203)	(0.0084961)	(0.0025288)	(0.0010563)
L2.lnFDI	–0.216629*	–0.0285***	0.001938	0.0004679
	(0.1250837)	(0.0087669)	(0.0026094)	(0.0010899)
L.lnN_Exch	–4.394915***	1.457689***	0.0259178	0.0111034
	(1.279401)	(0.0896705)	(0.0266899)	(0.0111482)
L2.lnN_Exch	4.349639***	–0.53337***	–0.02257	–0.01686
	(1.259065)	(0.0882452)	(0.0262657)	(0.010971)
L.lnRGDP	1.669813	0.4618632	0.7804465***	0.026924
	(5.367416)	(0.3761909)	(0.111971)	(0.0467695)
L2.lnRGDP	–0.318275	0.2438064	0.3556799***	0.0893656
	(5.913151)	(0.4144403)	(0.1233558)	(0.0515248)
L.lnC_stock	–8.591673	–3.54872***	–0.0282405	1.674271***
	(10.43405)	(0.7313008)	(0.2176675)	(0.0909181)
L2.lnC_stock	7.873839	3.134297***	–0.1060926	–0.7648523***
	(8.765979)	(0.614389)	(0.1828693)	(0.0763832)
Constant	–4.860144	–2.07932***	0.139527	–0.1447401*
	(7.503903)	(0.5259327)	(0.1565408)	(0.065386)
STRENGTH OF INSTRUMENTS				
AIC		–9.50762		
HQIC		–9.00946		
SBIC		–8.22872		
Log likelihood		311.721		
FPE		8.82E–10		

*** p <0.01, ** p <0.5, *p <0.1

Source: author's calculation.

an increase in the nominal exchange rate decreases the FDI by 43% at a 1% significant level.

Additionally, the findings in Table 5 show that the nominal exchange rate is positively and significantly influencing the capital stock in Tanzania at lagged 2, whereas an increase in the nominal exchange rate increases the capital stock by 31 at a 1% significant level. But also, the results show that the nominal exchange rate is negatively and significantly influencing the capital stock in Tanzania at lagged 1, whereas an increase in the nominal exchange rate decreases the capital stock by 35 at a 1% significant level.

The T-Y Granger causality results in Table 6 indicate that we reject both the null hypothesis that the nominal exchange rate does not Granger cause FDI and the null hypothesis that FDI does not Granger cause the nominal exchange rate. Therefore, we can infer that there is a two-way relationship between the nominal exchange rate and foreign direct investment. And there is evidence of rejecting the null hypothesis that real GDP, nominal exchange rate, and capital stock together do not Granger cause FDI inflow in Tanzania, and there is a unidirectional cause from all variables to FDI inflow in the country.

indicate a bidirectional causal relationship, with the nominal exchange rate influencing FDI at a 1% significance level. These findings align with Okonkwo et al.'s [2021] research, which explored the connection between Nigeria's exchange rate and FDI and found that both real and nominal exchange rates positively affected FDI.

However, these results contrast with those of Cavallari and d'Addona [2013], who investigated the determinants of FDI, including both nominal and real volatility. Their study concluded that, on one hand, both nominal and real volatility strongly discourage foreign investments, while output and exchange rate volatility are critical factors when deciding whether to invest in a foreign country. Additionally, interest rate volatility is believed to significantly influence the volume of foreign investments..

According to Cavallari and d'Addona [2013], the findings suggest that the host country's interest rate volatility negatively impacts FDI flows. Foreign direct investment decreases by an average of 2.55% for every 1% increase in foreign volatility. This implies that an increase in domestic volatility has little effect on foreign investment. In other words, making a direct investment in a nation with significant (high) nominal exchange rate volatility will result in a riskier stream of earnings, which is inversely related to returns. Given the significant causal relationship between the nominal exchange rate and FDI, Tanzania's low levels of

Table 6. Toda-Yamamoto Causality (modified WALD) Test Results

Null hypothesis	chi-sq	d	Probability	Granger Causality
Nominal exchange rate does not Granger cause FDI	12.019	2	0.002	Bidirectional causality N_exch ⟷ FDI
FDI does not Granger cause the nominal exchange rate	15.584	2	0.000	
Capital stock does not Granger cause FDI	0.9530	2	0.621	No causality
FDI does not Granger cause capital stock	2.8568	2	0.24	
Real GDP does not Granger cause FDI	0.2476	2	0.884	No causality
FDI does not Granger cause real GDP	0.5670	2	0.753	
All variable does not Granger cause FDI	15.404	6	0.017	Unidirectional All ⟶ FDI

Source: author's calculation.

DISCUSSION

The Granger causality analysis, denoted as (T-Y), suggests that the nominal exchange rate has a significant impact on FDI flows to Tanzania. The results

FDI may be attributed to previous ineffective nominal exchange rate strategies.

Furthermore, the T-Y Granger causality test results demonstrate that real GDP, capital stock, and the nominal exchange rate all have a significant impact on FDI inflows in Tanzania. There is a unidirectional relationship from real GDP, capital stock, and the nominal exchange rate jointly to foreign direct inflow in Tanzania at a 1 percent significance level. This result aligns with the findings of Anyanwu & John [2021], who examined the determinants of FDI in Africa. Using the dynamic panel data framework, the study shows that FDI inflows to Africa depend on accumulation economies, the presence of natural resources, real GDP growth, domestic and global FDI policies, among other factors. Several specific results are noteworthy. First, real GDP growth positively influences the location of FDI. Secondly, the presence of natural resources/stocks tends to attract resource-seeking FDI. Lastly, large economies are the most significant driver of FDI inflows to Africa.

CONCLUSIONS

The T-Y Granger causality test, which employs the vector autoregressive model to represent the association between various measures as they change over time, was used to establish variable causality, i.e., how variables depend on each other. Its p-value, similar to the nominal exchange rate, is less than a 5% significance level; consequently, the null hypothesis is rejected. This leads to the conclusion that the nominal exchange rate Granger causes foreign direct investment inflow in the country. However, the combined effect of the variables – capital stock, real GDP, and nominal exchange rate – has a p-value of 0.017, which is below the 5% significance threshold, indicating that it Granger drives FDI into the nation.

On the other hand, the Granger causality test demonstrates that foreign direct investment causes changes in the nominal exchange rate in Tanzania.

Both the nominal exchange rate and capital stock exhibit both positive and negative correlations with foreign direct investment. Tanzania, like many other African economies, remains vulnerable to external forces despite making significant strides in stabilizing the exchange rate. It is recommended that the Central Bank of Tanzania, along with those of other African nations with similar economic structures, maintains a stable nominal exchange rate level as an incentive for foreign investors to increase the inflow of foreign direct investment.

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ZWIĄZEK MIĘDZY BEZPOŚREDNIMI INWESTYCJAMI ZAGRANICZNYMI A NOMINALNYM KURSEM WALUTOWYM, REALNYM PKB I ZASOBEM KAPITAŁU W TANZANII

STRESZCZENIE

Cel: Celem artykułu jest zbadanie relacji między BIZ a nominalnym kursem walutowym, realnym PKB i zasobem kapitału w Tanzanii za pomocą ilościowych metod badawczych i analizy ekonometrycznej. Celem analizy jest dostarczenie wglądu w czynniki, które wpływają na BIZ oraz wniesienie wkładu do istniejącej literatury na temat związku między BIZ a wzrostem gospodarczym. **Metody:** Poddano analizie związek między napływem BIZ, realnym PKB, zasobem kapitału i normalnym kursem walutowym w Tanzanii przy użyciu solidnej metodologii badawczej. W badaniu wykorzystano oprogramowanie STATA 15 i kryteria informacyjne Akaike (AIC), kryteria informacyjne Schwarz (SC), błąd ostatecznej prognozy (FPE) i kryteria informacyjne Hannan Quinn (HQ). Ponadto do określenia optymalnego opóźnienia zastosowano model autoregresji, test kointegracji Johansena i test przyczynowości Toda-Yamamoto (zmodyfikowany WALD). **Wyniki:** Wskazano, że istnieje dwukierunkowa zależność między nominalnym kursem walutowym a BIZ w Tanzanii, tj. czym napływ BIZ wpływa na zmienność Nominalnego Kursu Walutowego, a Nominalny Kurs Walutowy Wpływa na napływ BIZ. Ponadto wyniki wskazują, że realny PKB, zasób kapitału i Nominalny Kurs Walutowy wywierają jednokierunkowy wpływ na napływ BIZ do Tanzanii. **Wnioski:** Nominalny kurs walutowy i zasób kapitału mają zarówno dodatnie, jak i ujemne korelacje z bezpośrednimi inwestycjami zagranicznymi. Tanzania, podobnie jak wiele innych gospodarek afrykańskich, pozostaje podatna na siły zewnętrzne, mimo znacznych postępów w dążeniu do stabilizacji kursu walutowego. Zaleca się, aby Bank Centralny Tanzanii wraz z bankami innych krajów afrykańskich o podobnej strukturze gospodarczej utrzymywał stabilny nominalny poziom kursu walutowego jako zachętę dla inwestorów zagranicznych do zwiększenia napływu bezpośrednich inwestycji zagranicznych.

Słowa kluczowe: przyczynowość Grangera, model autoregresji, napływ BIZ, realny PKB, nominalny kurs walutowy, kapitał