RURAL PLANNING JOURNAL
Website: https://journals.irdp.ac.tz/index.php/rpj

DOI: https://doi.org/10.59557/rpj.25.2.2023.19

Relationship between Foreign Exchange Reserves and Economic Growth in Tanzania: Application of Wald Granger-Causality Test

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Abstract

The study investigates the causal relationship between foreign exchange reserves and economic growth in Tanzania from 1990-2021. The study employed the Wald Granger-Causality Test to examine the causal relationship between variables. The results from the Wald Granger-Causality-Test revealed the unidirectional causal effect of economic growth on foreign exchange reserves. This implies that the value of economic growth can be used to predict the future value of foreign exchange reserves in Tanzania in the short and long run. In contrast, foreign exchange reserves cannot be used to predict the economic growth movement. Furthermore, findings indicated that foreign exchange reserves positively affect economic growth in the long run, implying that increasing foreign exchange reserves increases financial growth. Due to these findings, it can be concluded that foreign exchange reserves act as an integral catalyst for sustainable development in a country. Improving monetary policies and reserve management strategies would strike a balance between holding reserves and managing external debt. While reserves can be used to service debt and enhance creditworthiness, excessive reliance on reserves for debt servicing may deplete the buffer needed for crisis management. Policymakers must consider the country's specific circumstances and continually assess and adapt strategies to promote sustainable economic growth.

Keywords: Foreign Exchange Reserves, Economic Growth, Vector-Error Correction Model (VECM), Wald Granger-Causality-Test.

1. Introduction

Foreign exchange reserves are assets held by a central bank or other monetary authority, usually in various reserve currencies, primarily the United States dollar and, to a lesser extent, the Euro (Ito and McCauley, 2020). Foreign reserve means to reserve foreign currency, including banknotes, bonds, T-bills, and other government securities. The authority of this reserve is controlled and maintained by the Central Bank of a country. There are many reasons to reserve foreign currency, but mainly, it is to manage the currency's value. In addition, adequate reserves allow central banks to intervene in the foreign exchange market to stabilize or influence their currency's value. A stable exchange rate provides confidence to businesses, investors, and the public as it reduces uncertainty related to currency fluctuations (Basu and Varoudakis, 2013).

In recent years, international reserve accumulation has accelerated rapidly, reaching 16.7 percent of global GDP in 2013 from 5.3 percent in 1990. The bulk of the increase occurred in emerging market countries, reaching as high as 28 percent of the GDP (World Bank, 2022). The Asian countries held about 64.2 percent of global reserves in 2013, compared to about 23.4 percent in 1990. China has been the most significant reserve holder in absolute volume. Due to the potential impact on global interest rates, economic growth, and financial stability, it is essential to

accumulate foreign exchange reserves in the economy. On the other hand, strong economic growth follows the accumulation of foreign exchange reserves to create resilience to external shocks (Shrestha, 2016).

In recent decades, foreign reserves have increased in many developing countries. The foreign exchange (FX) reserves of emerging market economies (EMEs) have increased since the early 1990s. The average level reached almost 30% of GDP in 2018 from about 5% in 1990 (Arslan and Cantu, 2019). On the other hand, (Fukuda and Kon, 2008) found that an increase in foreign exchange reserves raises both liquid and total debt while shortening debt maturity. It also leads to a decline in consumption, although investment and economic growth may improve when the tradable sector is capital-intensive.

Developing countries need more foreign exchange reserves, which could be used as capital to address the development and welfare demands of the nation (Kargbo, 2012). The accumulation of foreign exchange reserves contributes to the economic growth of developing countries by increasing both the investment/ GDP ratio and the capital productivity (Polterovich and Popov, 2003). When foreign reserves increase due to increased export of goods and services, it would be better for the economy to generate more jobs and strengthen the internal economy (Dooley *et al*., 2003). In addition, foreign exchange reserves can be directed towards trade facilitation programs, including export credit, trade financing, and support for businesses engaged in international trade. This can boost exports, increase foreign exchange earnings, and enhance economic growth (Dhungel, 2022).

Over the past decade, despite rapid population growth, Tanzania has achieved relatively strong economic growth and a slight decline in poverty rates. The country's macroeconomic performance continues to show remarkable resilience against the lingering effects of the COVID-19 pandemic and the war in Ukraine, but it remains vulnerable to global economic uncertainties. After recovering slightly to 4.9 percent in 2021, Tanzania's gross domestic product (GDP) growth dipped to 4.7 percent in 2022. GDP growth is expected to rebound to 5.2 percent in 2023 due to expected improvements in global economic conditions and domestic reforms to support economic activity and inclusive growth (World Bank, 2022).

Much of the country's development success over the decade was predicated on its strategic maritime location, rich and diverse natural resources, socio-political stability, and rapidly growing population. With an area of 947,000 square kilometres, Tanzania has a population of about 61.5 million, of which about a third live in urban areas. Tanzania's 2021 GDP was $67.8 billion, while its per capita income 2021 was about $1,136 (Rwigema, 2022).

Tanzania's foreign exchange reserves shrank by $439.3 million during the first half of the 2018/19 financial year as it furthered its loan repayment pace while conducting several big infrastructure projects (BoT, 2019). This implies a renewed demand for foreign currency by the country's corporate bodies, the government, and importers, which outweighed forex inflows. A report by the Bank of Tanzania (BoT) puts the country's gross official reserves at $5.044 billion at the end of December 2018, down from $5.484 billion at the end of June 2018. The slight fall was the result of foreign debt servicing.

Tanzania's foreign exchange reserves increased by 3.1% in the third quarter of 2019, a sign of increased foreign income using December 2018 reserves as a base (BoT, 2019). It was impossible to establish the source of the increase, but foreign exchange reserves increased from USD 5.044 billion in 2018 to USD 5.2 billion in 2019. The record rise of Tanzania's forex reserves has sparked optimism among local economists over the country's economic prospects. Tanzania's foreign reserves reached a historical high, sailing well above the regional benchmarks thanks to export diversifications, notably rice and edible vegetables. The increase in export earnings from these items helped cushion the

revenue deficit generated from tourism, which was heavily impacted by the COVID-19 pandemic.

The theoretical underpinnings of this study are based on self-insurance theory, precautionary theory, mercantilist theory, and macroeconomic stabilization theory. These theories explain foreign exchange reserves as they impact economic growth. Wijnbergen (1990), who pioneered work on self-insurance theory, claims precautionary is the primary motivation behind self-insurance. Countries holding significant reserves can use them to stabilize their currencies, intervene in the foreign exchange market, and meet external obligations during economic stress. By accumulating foreign exchange reserves, a country aims to reduce its vulnerability to these risks and enhance its ability to weather economic challenges. In addition, adequate foreign exchange reserves can help stabilize a country's currency by providing confidence to investors and markets. This stability contributes to overall economic stability and facilitates international trade and investment. Mendoza (2004) equally investigated a possible self-insurance motivation for increased reserve-holding in 65 developing countries after the Asian financial crisis. Empirical verification of the hypothesis that a self-insurance framework is a reasonable explanation for the recent increase in reserve accumulation provided evidence that several countries could be self-insured. The recent accumulation of reserves in developing countries has thus been broadly interpreted as self-insurance precipitated by the high level of global economic and financial instability and the absence of an adequate international system for crisis management.

The mercantilist theory posits that many countries accumulate foreign reserves to manage effective exchange rates and maintain low exchange rates to promote trade and international competitiveness (Durdu *et al*., 2009). On the other hand, Yeyati (2008) also noted that one reason for the recent surge in the stock of foreign reserves in developing countries is to prevent genuine exchange rate appreciation as a result of capital inflows, either due to the 'mercantilist' objective of preserving competitiveness or to avoid a potential overvaluation that may eventually create downside risks.

The precautionary theory is related to the precautionary motives for holding money, which involve reserving money to meet unforeseen contingencies. When applied to the concept of foreign reserves, it stresses the traditional use of reserves as savings for potential times of crises, especially balance of payments crises. This reason can also be seen as a need for insurance against future crises precipitated by the financial crisis in the 1990s and early 2000s (Winjhold and Sondergaard, 2007; Fukuda and Kon, 2008). Nonetheless, in developing countries, some still claim that the foreign exchange bulwark is derived from the need to deal with "sudden stops" of capital inflows. Initially, the creation of the IMF was viewed as a response to the need for countries to accumulate reserves. If a specific country is suffering from a balance of payments crisis, it would be able to borrow from the IMF, as this would be a pool of resources, and so the need to accumulate reserves would be lowered.

Considering the significance of the accumulation of foreign exchange reserves in the economic development of countries in Sub-Saharan Africa, various pieces of literature have assessed the impact of foreign exchange reserves on economic growth. In the context of time series analyses, Akinboyo *et al*. (2016) investigated the long-run and causal relationship between external reserves and economic growth in Nigeria for the period 2000Q1-2013Q2. The empirical findings indicate the presence of a cointegrating relationship between the two with a structural break in 2009Q4 and, specifically, a percent rise in reserves leading to a 0.15% increase in economic growth. The results also suggest a unidirectional causality from external reserves to economic growth. Sula and Oguzoglu (2021) employed a dynamic panel data model to examine the impact of international reserves on economic growth for 120 developing and developed economies

from 1981 to 2010. They find that reserves have a significant positive effect on economic growth. Moreover, Kruskovic and Maricic (2015) investigate the Granger causality effect of foreign exchange reserve accumulation on economic growth in emerging economies. The results from Granger causality imply a unidirectional causality from foreign exchange reserves to economic growth. Moreover, Kashif *et al*. (2017) employed data on India from 1985Q1-2014Q4 to examine the linear and nonlinear causal relationship between the accumulation of international reserves and economic growth. The empirical findings suggest bidirectional linear and nonlinear causality between the two.

Ojiako (2020) examines the two-way relationship between foreign exchange reserve accumulation and Nigeria's economic growth performance from 1981-2018. The empirical evidence suggests a cointegrating relationship between the variables, and the Granger causality test results imply a unidirectional causality running from GDP to international reserves. In one of the recent studies, Kaphle (2021) analyses the effect of foreign exchange reserves on Nepal's economic growth from 1975-2018. The study's findings indicate a cointegrating relationship between the variables and imply that foreign exchange reserves have contributed to Nepal's economic growth during the study period. Ifurueze (2014) examined the relationship between external reserves and economic growth in developing countries, focusing mainly on Nigeria from 1970 to 2009. The result showed a significant relationship between economic growth and external reserves.

The rationale for conducting this study focuses on the notion that most developing economies rely on foreign reserves, which play a crucial role in stabilizing and supporting various aspects of the economy. A stable exchange rate helps maintain the competitiveness of a country's exports in the global market. This is vital for developing countries heavily reliant on exports to drive economic growth. Developing countries often face vulnerabilities like commodity price fluctuations or sudden capital outflows. Reserves provide a cushion, allowing the economy to absorb shocks without resorting to drastic measures that could impede growth (Sugiharti *et al*., 2020).

Many developing nations, including Tanzania, are experiencing pressure to balance their expenditures as price shocks occasioned by global economic crises cripple their current accounts, which measure how much the country spends or saves on its foreign exchange. The Bank of Tanzania (BoT) reports that the deficit doubled in 2022. It reached $3.8 billion compared with $1.8 billion in the corresponding period in 2021. The deficit was caused by shocks emanating from high commodity prices, tight financial conditions, and global challenges aggravated by the Russia-Ukraine conflict (BoT, 2022).

The Bank of Tanzania has put various efforts into foreign exchange regulations, including allowing the bank to receive loans from abroad as inward capital account transactions. Restrictions on maintaining foreign bank accounts without the approval of the Governor of the BoT, restrictions on outward capital account transactions, and outward direct investments (BoT, 2022). Despite the efforts, there is still a lack of clarity since there has been less effort to examine the relationship between foreign exchange and the economic growth in the country.

Although there is a clear relationship between external reserve holdings and economic growth from a theoretical standpoint, the empirical literature on the interrelationship between the two is limited. It can also be argued that there is no consensus in the literature regarding the direction of the effect of external reserves on economic growth. Furthermore, empirical evidence on the direction of causality between the two is also mostly inconclusive and contradictory due to the mixed findings. Previous studies (Were and Mollel, 2020; Yabu and Kimolo, 2020; Lenzi, 2017; Rutasitara, 2004) have been carried out to examine the significance of exchange rate dynamics on Tanzania's

economy. However, most of these studies are concentrated on the exchange rate fluctuations in the economy. Furthermore, there has been less effort to examine the long-run effects of foreign exchange reserves on economic growth and the causal relationship between foreign exchange reserves and economic growth in the country.

Therefore, it is essential to thoroughly examine and understand the nature and extent of the relationship between foreign exchange reserves and economic growth in Tanzania. The study aims to determine whether an increase in the foreign exchange reserve leads to increased economic growth in Tanzania and, if so, to what extent. The particular findings of the study are expected to contribute by adding value to the body of literature that will be crucial to both BoT and monetarist policymakers by setting their monetarist policies that contribute to a stable investment climate and attract Foreign Direct Investment (FDI).

2. Materials and Methods

2.1. Data sources

The data used in this study ranged from 1990 to 2021. The data on foreign exchange reserves and economic growth proxied GDP were obtained from World Development Indicators (WDI). On the other hand, the control variables, namely Foreign Direct Investment (FDI), were sourced from UNCTAD, while the exchange rate and external debt were sourced from the Bank of Tanzania (BoT).

2.2. Methods

The study aims to investigate the causal relationship between foreign exchange reserves and economic growth in Tanzania. The study employed the Wald-Granger causality test to examine the causal relationship between the variables. In addition, the Johansen cointegration test was adopted to examine the long-run equilibrium between the variables. VECM to ECM was also applied to estimate the short-run and long-run effects of foreign exchange reserves on economic growth to fulfil the stationarity requirement and cointegration between variables in the study.

2.2.1 Variables and Model

2.2.1.1 Variable Measurement

To investigate the Granger causality between foreign exchange reserves and economic growth, the study used economic growth proxied as GDP as the dependent variable. Meanwhile, independent variables were foreign exchange reserves and Foreign Direct Investment (FDI). The exchange rate and external debt acted as control variables. FDI is expressed as a ratio to Gross Domestic Product (GDP). FDI flows record the value of cross-border transactions related to direct investment during a given period, usually a quarter or a year. Based on the theory and empirical literature, the expected sign of the estimated coefficient of FDI with economic growth is positive (Musabeh and Zouaoui, 2020). On the other hand, foreign exchange reserves are defined as all foreign assets controlled by the monetary authority and can be used at any time to pay the balance of payments balance and in the context of monetary policy stability by intervening in foreign exchange reserves and for other purposes (Tambunan, 2001). The strengthening of the exchange rate, coupled with a stable economic condition, causes an increase in foreign exchange reserves. It is due to the encouragement of investors interested in investing in the state financial market, which will generate benefits or gains in the current account balance, thereby increasing foreign exchange reserves. (Reny and Agustina, 2014). An exchange rate is a relative price of one currency expressed in terms of another currency (or group of currencies). There are many ways to measure an exchange rate. The most common way is to measure a bilateral exchange rate. A bilateral exchange rate refers to the value of one currency relative to another. Bilateral exchange rates are typically quoted against the US dollar (USD), the most traded currency globally. The expected sign of the coefficient is ambiguous: Although a positive sign of this variable is generally expected, a negative coefficient is

not implausible (Khondker *et al*., 2012). Lastly, external debt is expressed as a ratio to gross domestic. The most common indicator of external debt is gross external debt, which measures the total debt a country owes to foreign creditors, i.e., it considers only the liabilities of that country. Debtors can be the government, corporations, or citizens of that country. Data on external debt are gathered through the World Bank's Debtor Reporting System (DRS). High levels of external debt in an economy pose great challenges because a large proportion of exports are devoted to servicing these debts instead of being put into domestic investment, thus reducing economic growth prospects. The empirical literature on the relationship between external debt and others concludes otherwise. Sulaiman and Azeez (2012) and Hansen (2001) found a positive impact of external debt on economic growth, while Safdari and Mehirizi (2014), Babu (2014), Alam and Taib (2012) and Malik (2010), recorded a negative impact of external debt on economic growth.

Table 1: Description of the Variables of the Study

Type of variables	Name of variable	Notation	Scale
Dependent variable	Economic growth	GDP	Ratio
Independent variable	Foreign exchange reserve	PRESERVE	Ratio
Control variables	Foreign direct investment	FDI	Ratio
	Exchange rate	EXR	Ratio
	External debt	EXCERPT	Ratio

Source: Author's creation

2.2.2. Test and Estimation Methods

2.2.2.1. Model Estimation

In estimating parameters regarding the model to examine the Granger causality between foreign exchange reserves and economic growth from 1990 to 2021. The study included economic growth measured by GDP, foreign exchange reserves, Foreign Direct Investment (FDI), and control variables exchange rate and external debt. This led to the formulation of a function of the causal effect of foreign exchange reserves, FDI, exchange rate, and external debt in economic growth by the following form function:

$$RVEGP = f(TRESERVE, FDI, EXR, EXDEBT) \quad \ldots\ldots(1)$$

$$LGDP = \beta_0 + \beta_1 LnTRESERVE + \beta_2 LnFDI + \beta_3 LnEXR + \beta_4 LnEXDEBT + \varepsilon_t \quad \ldots\ldots(2)$$

Where:
LnGDP is a logarithm of Gross Domestic Product
LnTRESERVE is a logarithm of a foreign exchange reserve
LnFDI is a logarithm of Foreign Direct Investment
LnEXR is a logarithm of the Exchange rate
LnEXDEBT is a logarithm of External Debt
LnEXR is a logarithm of the Exchange rate
β_0 is the constant value
ε_t is the error term, and
β_1 to β_4, represents the coefficients of the variables

Where:
GDP is economic growth value
RESERVE is a foreign exchange reserve
FDI is a Foreign Direct Investment
EXR is an exchange rate
EXDEBT is an external debt

The study employed time series analysis of the multivariate regression model using the Vector Error Correction Model (VECM). The equation was linearized by applying natural logarithms of the variables in the model to bring normality among variables as used by Kaphle (2021), Ojia (2020), Kashif *et al*. (020), and Benli (2019).

2.2.3. Stationarity Test (Unit root)

This is used to test the stationarity of the variable. A time series is said to be stationary if its mean and variance (at various lags) remain the same no matter at what point we measure them. The Augmented Dick Fuller test was used to test data stationarity. ADF was used to test the null hypothesis that the data are not stationary (has a unit root) against the alternative hypothesis that the data are stationary (has no unit root). A 5% significance level was used, and the guideline rejected the null hypothesis if the ADF statistic was less than the critical level (0.05) (Priestley, 1969). Table 4 shows that all the variables are non-stationary tested with ADF at level form. However, at first, all the variables become stationary.

2.2.4. Lag order – selection criteria

For the analysis of the time series data, the selection of lag length to be used in the model was done first. In determining the lag to be used in the model, the Akaike Information Criterion (AIC) was used. AIC is superior to other criteria, such as Maximum Likelihood Estimation under study in the case of a small sample of sixty (60) observations and below, in the sense that they minimize the chance of underestimation while maximizing the chance of recovering the actual lag length (Liew, 2004). The lag was chosen for the one with the lowest Akaike Information Criteria (AIC) value, which was used for the co-integration test and Vector Error Correction Modelling (VECM).

2.2.5. Co-integration test

This technique is used to check if there is a long-run equilibrium relationship between non-stationary variables. When two or more variables are non-stationary, predicting that their linear combination will likewise be non-stationary is typical. However, if the linear combination is stationary, the variables will share the same stochastic trends, which cancel out when combined. Therefore, the regression of these variables will be meaningful and not spurious (Jeroen, 2002). The Johansen test tests for co-integrating relationships between non-stationary time series data. The Johansen test allows for more than one cointegrating relationship. It is divided into two tests: trace statistic and the maximum eigenvalue statistic (Kaulu, 2021). The trace statistic specifies that the null hypothesis states no cointegration relationship, whereas the alternative hypothesis states a co-integration relationship. The guideline for testing co-integration is when the trace statistics are more significant than the 5 percent critical value, then reject the null hypothesis; otherwise, do not reject the null hypothesis (Saikkonen and Lütkepohl, 2000). Also, when the maximum Eigen statistics is greater than the 5 percent critical value, reject the null hypothesis; otherwise, fail to reject the null hypothesis. Consider the following hypothesis of maximum rank: The relationship between the foreign exchange reserves, FDI, exchange rate, external debt, and GDP was examined using Johansen's co-integration test. The following is the model for the trace statistics that was used to determine the co-integration among variables:

$$\lambda_{Trace} = -T \sum_{i=r+1}^{n} ln(1 - \lambda_i) \ldots\ldots\ldots\ldots\ldots (3)$$

Where: **T** stands for several sample size, λ_I is the i^{th} most extensive canonical correlations, λ_{Trace} **is** the set of the null, **r** co-integrating rank against the alternative of **n** co-integrating rank, **n** is the number of variables in which **r** = 0, 1, 2 since the number of variables used were three variables.

2.2.6. Granger Causality Test

It is a technique for determining whether a one-time series is helpful in forecasting another (Farook & Kannan, 2016). In the Granger sense, x is a cause of y if it is helpful in forecasting y. In this framework, "useful" means that x can increase the accuracy of the prediction of y concerning a forecast, considering only past values of y (Granger, 1969). There are three different types of situations in which a Granger-causality test can be applied. Firstly, in a simple Granger-causality test, two variables and their lags exist. Secondly, in a multivariate Granger-causality test more than two variables are included because it is supposed that more than one variable can influence the results. Finally,

Granger-causality can also be tested in a VAR framework; in this case, the multivariate model is extended in order to test for the simultaneity of all included variables (Foresti, 2006). This study employed the Wald-Granger causality test to establish the causal relationship between variables. To test the null hypothesis that X does not Granger-cause Y, the test statistic is given by:

$$F = \frac{(RSS_R - RSS_{UR})/m}{(RSS_{UR})/(n-k)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

Where: RSS_R is restricted residual sum of squares, RSS_{UR} is the unrestricted residual sum of square, m is the number of lagged X terms, and K is the number of parameters estimated in the unrestricted regression.

2.2.7. Vector Error Correction Model (VECM)

The Vector Error Correction Model (VECM) is a system of the vector of two or more variables which are exogenous. Still, it is applicable when the variables are integrated in the same order I (1) and also when the variables are co-integrated, which means that the long-run relationship exists among them. The error term was incorporated into the short-run coefficients. It is treated as the equilibrium error (Damodar, 2004); normally the error term is used to tie the short run behaviours to their long run equilibrium.

Since cointegration between variables has been found, the VECM was established to study the short-run and long-run properties of the variables. This model helps to illustrate how deviations from equilibrium in the long-run model are adjusted for in the short run (Kaulu, 2021)

$$\Delta \mathbf{lnGDP_t} = \alpha + \sum_{i=1}^{k-1} \boldsymbol{\beta_i} \Delta \mathbf{lnGDP_{t-i}} + \sum_{j=1}^{k-1} \boldsymbol{\phi}_j \Delta \mathrm{lnTRESERVE}_{t-j} + \sum_{m=1}^{k-1} \varphi_m \Delta \mathrm{lnFDI}_{t-m} + \sum_{n=1}^{k-1} \psi_n \Delta \mathrm{lnEXR}_{t-n} + \sum_{b=1}^{k-1} \varphi_b \Delta \mathrm{lnEXDEBT}_{t-b} + \lambda_i \, \mathrm{ECT}_{t-i} + \varepsilon_{it}$$

$$\Delta \mathbf{lnTRESERVE_t} = \alpha + \sum_{i=1}^{k-1} \beta_i \Delta \mathrm{lnGDP}_{t-i} + \sum_{j=1}^{k-1} \boldsymbol{\phi_j} \Delta \mathbf{lnTRESERVE_{t-j}} + \sum_{m=1}^{k-1} \varphi_m \Delta \mathrm{lnFDI}_{t-m} + \sum_{n=1}^{k-1} \psi_n \Delta \mathrm{lnEXR}_{t-n} + \sum_{b=1}^{k-1} \varphi_b \Delta \mathrm{lnEXDEBT}_{t-b} + \lambda_i \, \mathrm{ECT}_{t-i} + \varepsilon_{it}$$

$$\Delta \mathbf{lnFDI_t} = \alpha + \sum_{i=1}^{k-1} \beta_i \Delta \mathrm{lnGDP}_{t-i} + \sum_{j=1}^{k-1} \boldsymbol{\phi}_j \Delta \mathrm{lnTRESERVE}_{t-j} + \sum_{m=1}^{k-1} \boldsymbol{\varphi_m} \Delta \mathbf{lnEXCFDI_{t-m}} + \sum_{n=1}^{k-1} \psi_n \Delta \mathrm{lnEXR}_{t-n} + \sum_{b=1}^{k-1} \varphi_b \Delta \mathrm{lnEXDEBT}_{t-b} + \lambda_i \, \mathrm{ECT}_{t-i} + \varepsilon_{it}$$

$$\Delta \mathbf{lnEXR_t} = \alpha + \sum_{i=1}^{k-1} \beta_i \Delta \mathrm{lnGDP}_{t-i} + \sum_{j=1}^{k-1} \boldsymbol{\phi}_j \Delta \mathrm{lnTRESERVE}_{t-j} + \sum_{m=1}^{k-1} \varphi_m \Delta \mathrm{lnFDI}_{t-m} + \sum_{n=1}^{k-1} \boldsymbol{\psi_n} \Delta \mathbf{lEXR_{t-n}} + \sum_{b=1}^{k-1} \varphi_b \Delta \mathrm{lnEXDEBT}_{t-b} + \lambda_i \, \mathrm{ECT}_{t-i} + \varepsilon_{it}$$

$$\Delta \mathbf{lnEXDEBT_t} = \alpha + \sum_{i=1}^{k-1} \beta_i \Delta \ln GDP_{t-i} + \sum_{j=1}^{k-1} \boldsymbol{\phi}_j \Delta \ln TRESERVE_{t-j} + \sum_{m=1}^{k-1} \varphi_m \Delta \ln FDI_{t-m} + \sum_{n=1}^{k-1} \psi_n \Delta \ln EXRT_{t-n} + \sum_{b=1}^{k-1} \varphi_b \Delta \ln EXDEBT_{t-b} + \lambda_i ECT_{t-i} + \varepsilon_{it}$$

Where:

k -1 = the lag length is reduced by 1.

α, β_j, $\boldsymbol{\phi}$, φ, ω *and* ψ = Short-run dynamic coefficients of the model's adjustment long-run equilibrium.

λ_i = speed of adjustment of the parameter with a negative sign.

ECT_{t-i} = the error correction term is the lagged value of residuals obtained from the co-integration of the dependent variable on the regressors. Contain long-run information derived from long-run co-integrating relationships.

ΔLnGDP = change in economic growth value.

ΔLnTRESERVE = Change in corporate income tax.

ΔLnFDI = Change in excise duty.

ΔLnEXR = Change in exchange rate.

ΔLnEXDEBT= Change in external debt.

ε_{it} = error term. Residuals (stochastic error term).

3. Results and Discussion

This section presents an empirical analysis of the study to examine the causal relationship between foreign exchange reserves and economic growth in Tanzania from 1990 to 2021. The main sections presented are: a descriptive statistics unit root test, cointegration test, estimation of a long-run and short by VECM, estimation of ECM, causality test, and discussion of findings.

3.1. The Summary Statistics of the Variables under Consideration

Table 2 shows the summary statistics of the variables drawn for the study. The deviation of the variables used in the estimation did not show much variation. The descriptive result reveals that the average GDP over the period was about 23.65 million USD with a maximum of 24.94 million USD and a minimum of 22.17 million USD respectively. The average external debt over the period was about 22.99 million USD with a maximum of 24.07 million USD and a minimum of 22.139 million USD. The average foreign direct investment was 19.29 million USD with a maximum of 21.45 million USD and a minimum of 9.21 million USD. The average official exchange rate was 6.91 million USD with a minimum of 5.273 million USD and a maximum of 7.73 million USD. The average total reserves were 21.20 million USD with a maximum of 22.57 million USD and a minimum of 19.07 million USD.

Table 2: The Summary Statistics for the variable of the study

Statistics	GDP	TRESERVE	EXR	FDI	EXDEBT
Mean	23.65563	21.20605	6.917074	19.29454	22.99818
Maximum	24.94043	22.57644	7.739692	21.45912	24.07281
Minimum	22.172	19.07716	5.273286	9.21034	22.13859
Std. dev	.9225311	1.14643	.6850751	2.924583	.5236808

Source: Author's computation STATA17

3.1.2. Correlation Analysis

After analysing the descriptive statistics of the variables in the model, the next step was to check the linear relationship between the variables. The correlation matrix reveals the strength and direction of the relationship. It tries to give information on the direction of the linear relationship between variables. A negative sign indicates an inverse relationship while a positive sign means a direct relationship. Table 3 shows a pairwise correlation between variables included in the model.

Table 3: Correlation Matrix for variables of the model

	LnGDP	LnEXDEBT	LnFDI	LnEXR	LnTRESERVE
LnGDP	1				
LnEXDEBT	0.7579* 0.0000	1			
LnFDI	0.7029 * 0.0000	0.3804 * 0.0317	1		
LnEXR	0.9531 * 0.0000	0.6961 * 0.0000	0.8445 * 0.0000	1	
LnTRESERVE	0.9741 * 0.0000	0.6483 * 0.0000	0.7674 * 0.0000	0.9640 * 0.0000	1

*Level of significance is at 5%: **Source: Author's computation STATA17**

Table 3 above shows the strength and direction of the relationship between variables. The results show a strong positive relationship between the foreign exchange reserve and all other variables included (exchange rate, foreign direct investment, and external debt) at a 0.05 level of significance.

3.2. Stationarity Test (Unit root test)

The study employed Augmented Dickey-Fuller (ADF) to test for stationarity for all the variables. The Augmented Dick Fuller (ADF) test was used to test the stationarity of the data. ADF was used to test the null hypothesis that the data are not stationary against the alternative hypothesis that the data are stationary at a 5% level of significance.

Table 4: Summary for Unit Root Tests (ADF) at level l (0)

Variables	Test statistic ADF at level	5% Critical Value	p-Value At level	ADF result
GDP	-0.655	-2.986	0.8581	Not stationary
TRESERVE	-1.853	-2.989	0.3545	Not stationary
FDI	0.834	-1.950	0.0000	Not stationary
EXR	-2.042	-2.994	0.2686	Not stationary
EXDEBT	0.079	-2.986	0.9646	Not stationary

*Denotes level of significance is at 5%: Source: Author's computation from STATA 17

The findings in Table 4 above reveal that the computed probability values (P-value) for all study variables were greater than five percent (0.05) level of significance. Thus, the null hypothesis was not rejected, and hence the variables (GDP, foreign reserve, foreign direct investment, external debt, and exchange rate) were not stationary at the level.

Table 5: Summary for Unit Root Tests (ADF) at level l (1)

Variables	Test statistic ADF at level	5% Critical Value	p-Value At level	ADF result
GDP	-3.379	-2.989	0.0117	Stationary
TRESERVE	-4.492	-3.588	0.0016	Stationary
FDI	-5.673	-2.992	0.0000	Stationary
EXR	-3.402	-2.997	0.0109	Stationary
EXDEBT	-3.911	-2.989	0.0020	Stationary

***denotes level of significance is at 5%: Source: Author's computation from STATA 17**

The non-stationary variables were differenced and then re-tested for stationarity. As depicted in (Table 5), the computed probability values became significant (at a five percent level)

after first differencing. This gave justifiable evidence to infer that our study variables were integrated at order one

3.3. Causal Relationship between Foreign Exchange Reserve and (GDP)

The Wald causality test was employed to determine if the exchange rate is a probabilistic cause of economic growth or if the past value of the foreign exchange is a statistical cause of future values of economic growth in Tanzania. The Wald test was used due to its efficiency in the estimation of the causality relationship between the cointegrating data and the significance of the relevant coefficients on the lagged error correction term (Granger, 1969).

Table 6: Wald Granger causality test			
Null Hypothesis		**Chi2**	**p-value at 5%**
LnTRESERVE does not Granger Cause LnGDP		7.30	0.0630
LnGDP does not Granger Cause LnTRESERVE		12.11	0.0070

***Level of significance is at 5%: Source: Computed by the Author**

Table 6 above shows the causality test. This was carried out to establish if the foreign exchange reserve causes economic growth on the one hand and to also know if the economic growth can predict the future value of the foreign exchange reserve. The results from Table 6 show that the foreign exchange reserve does not predict the future value of economic growth since the p-value is greater than the 0.05 level of significance. However, GDP can predict the future value of the foreign exchange reserve at a 0.05 level of significance since the p-value is less than 0.05.

3.4. Lag Selection for the model

In determining the number of lags to be used in the model, the optimal lag is selected using the Vector Autoregressive (VAR) lag order selection criteria. The lag chosen is the one with stars, where Akaike Information Criteria (AIC) has the lowest value among other criteria. The AIC is superior to the Likelihood Ratio test (LR), Final in the case of a small sample of sixty (60) observations and below, in the sense that they minimize the chance of underestimation while maximizing the chance of recovering the true lag length (Liew, 2004).

Table 7: Lag order Selection Criteria Results

Lag	LL	LR	Df	P	FPF	AIC	HQIC	SBIC
0	-12.864				2.5e-06	1.27603	1.3487	1.5139
1	124.33	274.4	25	0.000	8.4e-10	-6.738	-6.302	-5.311
2	151.77	54.87	25	0.001	8.6e-10	-6.912	-6.112	-4.295
3	179.22	54.89	25	0.001	1.3e-09	-7.087	-5.923	-3.281
4	256.19	153.95*	25	0.000	1.3e-10*	-10.799*	-9.2724*	-5.8039*

*** Indicates lag order selected by the criterion: Source: Author's compilation from STATA 17 output**

The results from Table 7 depict the Vector Autoregressive (VAR) Lag order selection criterion. Since the Likelihood Ratio test (RL) and AIC were optimal at lag 4, the study employed lag 4. As tabulated in the summary of VAR selection criteria, lag four was employed for the Johansen co-integration test and VECM estimation.

3.4.1. Co-integration Test

Johansen co-integration uses two statistics for testing the hypothesis, namely trace statistics and maximum statistics. The guideline for testing co-integration is that when the trace statistics are greater than the 5 percent critical value, then reject the null hypothesis; otherwise, do not reject the null hypothesis. Also, when the maximum Eigen statistics is

greater than the 5 percent critical value then reject the null hypothesis; otherwise, fail to reject the null hypothesis. Consider the following hypothesis of maximum rank:
i. Maximum rank zero

H_0: There is no co-integration among variables
H_1: There is a co-integration among variables
If Trace statistics or maximum-Eigen statistics is less than 5% critical value then accept or do not reject H_0.

Table 8: Johansen Co-integration Test

Maximum rank	Parms	LL	Eigenvalue	Trace Statistic	5% critical value
0	80	156.17	.	200.04	68.52
1	89	201.24	0.960	109.91	47.21
2	96	236.88	0.921	38.62	29.68
3	101	252.48	0.671	7.4290*	15.41
4	104	255.48	0.193	1.419	3.76
5	105	256.19	0.049		

Maximum rank	Parms	LL	Eigenvalue	Max Statistic	5% critical value
0	80	156.17	.	90.134	33.46
1	89	201.24	0.960	71.287	27.07
2	96	236.88	0.921	31.194	20.97
3	101	252.48	0.671	6.010	14.07
4	104	255.48	0.193	1.419	3.76
5	105	256.19	0.049		

* Indicates ranks of co-integration equation at 5%. Source: Author's compilation from STATA 17 output

From the Johansen co-integration test results in Table 8, the trace statistics indicate that there are a maximum of three co-integration equations in this model. For maximum rank zero, the null hypothesis is rejected since the trace statistics (200.04) are greater than the critical value (68.52) at the 5 percent level. Implying that the variables of the study are cointegrating.

For one co-integrating equation, the trace statistics (109.91) are greater than the 5 percent critical value (47.21), therefore the null hypothesis is rejected. For two co-integrating equations, the trace statistics (38.62) is greater than the 5 percent critical value (29.68), therefore the null hypothesis is not rejected. For two co-integrating equations, the trace statistics (7.4290*) are less than 5 percent critical value (15.41), therefore the null hypothesis is not rejected.

Also, for three cointegrating equations, the trace statistics (1.419) are less than 5 percent critical value (3.76), therefore, the study fails to reject the null hypothesis of at most two cointegrating equations. Thus, the study accepts the alternative hypothesis that there are three cointegrating equations in the model. Hence, knowing that there is cointegration among the variables under study confirms the presence of a long-run causal relationship among the variables. Therefore, it gives the room to determine the long-run effect by using VECM.

3.5. Vector Error Correction Model

The cointegration test shows that the variables are cointegrating. This implies the existence of dynamic inter-relationship between variables.

Table 9: Vector Error Correction model

Equation	R-squared	Chi^2	p> Chi^2
D_LnGDP_{t-1}	0.816	8.669	0.0001
$D\_LnTRESERVE_{t-1}$	0.890	89.527	0.0000
$D\_ LnFDI_{t-1}$	0.938	166.47	0.000
$D\_ LnEXDEBT_{t-1}$	0.460	9.3771	0.927
$D\_ LnEXR_{t-1}$	0.887	86.894	0.000

*Level of significance is at 5%

Source: Author's compilation from STATA 17 output

Note: D means difference and stationarity

Overall, the output from Table 9 above indicated that the equations for the variables GDP, External Debt (EXDEBT), and Official Exchange Rate (EXR) are not significant, as indicated by the p-value. The variables Total Reserve (TRESERVE) and Foreign Direct Investment (FDI) seem to be significant by their p-value.

3.5.1. The Long Run Effect

Table 10 shows the coefficients of long-run equilibrium. It investigated five variables namely, gross domestic product, external debt, official exchange rate, foreign direct investment, and total reserves.

Table 10: The long-run effect of the VECM model

Variables	Coefficient	Std. Error	Z-statistic	P-Value
D_LnGDP	1			
D_LnTRESERVE	.423	.080	5.28	0.000
D_LnFDI	-.564	.028	-19.91	0.000
D_LnEXDEBT	-.448	.049	-9.04	0.000
D_LnEXR	-1.221	.182	-6.68	0.000
Constant	-2.730			

*Level of significance is at 5%

Source: Author's computation STATA 17

Table 10 above revealed that, in the long run, the total reserve is statistically significant at a 5% level since the p-value is less than 0.05, which shows a positive effect on GDP. On the other hand, external debt and foreign direct investment are statistically significant at a 5 percent level but they have a negative impact on GDP.

3.6. Discussion of Key Findings

This section discusses the findings of this study. The discussion is based on the objectives of the study.

3.6.1. Causal relationship between foreign exchange reserve and economic growth

The study results from the Wald Granger causality test reveal that the foreign exchange reserve does not predict the future value of economic growth since the p-value is greater than 0.05 level of significance. However, GDP predicts the future value of the foreign exchange reserve at the 0.05 level of significance since the p-value is less than the 0.05. This indicates the presence of unidirectional causality from GDP to the foreign exchange reserve. That is foreign exchange reserve is not useful in predicting economic growth (GDP) and economic growth (GDP) is useful in predicting foreign exchange reserve.

The above results (Table 6) were supported with empirical works by Ojiako (2020) who examines the two-way relationship between foreign exchange reserve accumulation and

economic growth performance in Nigeria for the period 1981-2018. Moreover, Jena and Sethi (2021) and Vasani *et al*. (2019 found similar results. In particular, Benli (2019) found a unidirectional causality running from external reserve accumulation to economic growth in Chile, Mexico, Morocco, Philippines, and Thailand, whereas the results indicate bidirectional causality between the two for Brazil. On the contrary, Kashif *et al*. (2020) found bidirectional linear causality in India by employing the Granger causality test developed by Hiemstra and Jones. In light of these results, the study suggests that reserve accumulation can be implemented in an economy provided that excess reserves are invested in alternative sources such as economic infrastructure projects and regional infrastructure development. While Kaphle (2021) found no causal relationship between foreign exchange reserves and GDP in Nepal. The growth in GDP is unable to promote foreign exchange earnings in the country. Finally, Kashif (2016) examined the linear and nonlinear relationship between international reserves and economic growth in Algeria. The study found that there is bidirectional causality between international reserves and economic growth with respect to linear causality but a unidirectional causality exists running from economic growth to international reserves with respect to nonlinear causality.

The particular findings appear to impact foreign exchange reserves, suggesting that a growing economy signifies economic expansion and stability. This in turn leads to a boost in investor confidence in a developing economy, attracting foreign investment and potentially leading to an increase in foreign exchange reserves. The higher level of foreign reserves contributes to economic stability by providing relief against external shocks, such as sudden capital outflows or adverse changes in the global economic environment. Meanwhile, policies that promote economic growth and competitiveness in inter-national trade can positively impact the balance of payments and, consequently, foreign exchange reserves. Furthermore, policy consistency is recommended, especially for those that directly influence the relationship between GDP and foreign exchange reserves which is key to the effectiveness of monetary policy tools and the central bank's ability to respond to economic challenges.

3.6.2. Long-run effect of foreign exchange reserve on economic growth.

The results in Table 10 show that there is a significant positive relationship between foreign exchange reserves and economic growth in the long run implying that a unit increase in the foreign exchange reserve results in an increase in economic growth of 0.423 since the p-value is less than the 5 percent level of significance. Therefore, we reject the null hypothesis so there is a long-run impact of the foreign exchange reserve on economic growth.

The above findings (Table 10) are in line with (Ojiako, 2020) examines the two-way relationship between foreign exchange reserve accumulation and economic growth performance in Nigeria for the period 1981-2018. The empirical evidence suggests a cointegrating relationship between the variables. Furthermore, Benli (2019) indicated a long-run relationship between the foreign exchange reserve accumulation and economic growth in emerging economies. In addition, Benli *et al*. (2022) investigated the impact of international reserves on long-run economic growth by employing a sample of 41 developing economies for the period 1970-2019. The empirical findings revealed a significant positive effect of international reserves and deteriorating impact of inflation on the long-run economic growth of the selected sample of countries.

Kaphle, (2021), Kashif *et al*. (2017) and Regmi (2009) employed Wald statistics to confirm that the values of foreign exchange have a positive contribution to the economicy, however, they found that the impact of impact of foreign exchange reserves in developing countries is insignificant. This raised the key question of whether growing foreign exchange earnings in these economies are contributing to their economic growth. On the other hand,

Nathaniel and Oladiran (2018) revealed that the coefficient of foreign exchange reserve accumulation is negative but has an insignificant impact on economic growth. The findings concluded that foreign exchange reserve accumulation does not promote economic growth in Nigeria.

Consequently, the findings above confirm that it is important for the government through the monetary authority, i.e., the BoT to pursue policies and programmes that would ensure the stability of the exchange rate for economic growth. This particular study demonstrates the need for the government and other stakeholders in the economy to create an enabling environment through the proper mix of macroeconomic variables capable of affecting each other positively. It is also important for the country to shift from its over-reliance on imports and pursue agricultural programmes that lead to economic diversification and boost foreign earnings. Contrary, adequate level of foreign exchange reserves allows a country to implement an independent monetary policy. Central banks can adjust interest rates to stimulate or cool down economic activity, fostering sustainable growth. The flexibility in monetary policy afforded by healthy reserves helps in achieving price stability, which is conducive to long-term economic growth.

4. Conclusion and recommendations

The study aims to examine granger causality between foreign exchange reserves and economic growth in Tanzania from 1980 to 2021. The study used time series data on economic growth, foreign exchange reserves, FDI, exchange rate and external debt. The findings reveal a long-run effect of foreign exchange reserves on economic growth. The results from the Wald Granger-Causality Test revealed a unidirectional causal effect from economic growth value to foreign exchange reserve. This implies that the value of economic growth can be used to predict the future value of foreign exchange reserves in Tanzania in the short run as well as in the long run while the foreign exchange reserves cannot be used to predict the economic growth movement.

Due to these findings, it can be concluded that foreign exchange reserves act as an integral catalyst for sustainable development in a country. Improving monetary policies and reserve management strategies would strike a balance between holding reserves and managing external debt. While reserves can be used to service debt and enhance creditworthiness, excessive reliance on reserves for debt servicing may deplete the buffer needed for crisis management. Policymakers need to consider the specific circumstances of the country and continually assess and adapt strategies to promote sustainable economic growth.

The policy implications of the findings are that reserves accumulation programmes will increase Tanzania's forex reserves and complement other policies aimed at enforcing a stable exchange rate, a moderate increase in government funding costs and macro-economic stability in the form of a lower unemployment rate, robust GDP growth and employment growth. These sound macro-economic policy frameworks will reduce the country's vulnerability to multiple shocks. This also addresses the much-needed policy coordination within the new monetary framework, i.e., the interest rate-based framework, which includes the exchange rate stabilisation policy.

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