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The Impact of Financial Development on Inflation in Tanzania: Empirical Evidence from the VECM Approach

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ABSTRACT

This study examines the impact of financial development on inflation in Tanzania using time series data from 1980 to 2020. By employing the VECM analysis method, the study contributes to the existing literature on the relationship between financial development and inflation. The findings reveal that financial development has a significant long-run impact on inflation in Tanzania, resulting in a reduction in inflation in the country. However, in the short run, the impact of financial development on inflation is not statistically significant. Therefore, the study recommends that the government implement appropriate regulatory policies and supervise financial institutions to promote financial sector stability. Further, to promote financial sector stability, greater financial inclusion, higher investment, and economic growth, the government should improve financial market infrastructure, expand the coverage of financial institutions, and increase access to credit. Additionally, fostering the development of more efficient payment systems, particularly electronic payment systems, can mitigate expenses and potential risks associated with cash transactions. Moreover, promoting financial inclusion can reduce the need for cash and enhance the efficacy of monetary policy, serving as a preventive measure against inflationary pressures and unnecessary credit growth.

INTRODUCTION

Inflation plays a pivotal role in the economic well-being of a country as it influences the purchasing power of both individuals and businesses, thereby affecting consumption, investment, and overall economic growth. In addition to that, Friedman's (1977) theory on inflation uncertainty argues that when inflation rates are volatile and unpredictable, it becomes challenging for economic agents to anticipate future price movements, leading to an increase in uncertainty. This, in turn, leads to distortions in the information content of prices as they fail to reflect the underlying economic fundamentals accurately. As a result, resource allocation becomes inefficient as market participants make suboptimal decisions based on distorted price signals. On the other hand, central banks typically aim to achieve economic stability and growth by maintaining a low and steady inflation rate. In Tanzania, for instance, the inflation rate needs to be maintained at around 3% to 5% per year, in line with the convergence criteria of the East African Community (EAC) and the Southern African Development Community (SADC) (BoT, 2023). These organisations have set a maximum inflation threshold of 8% per year for attaining economic stability and growth.

In the contemporary era, inflation has emerged as a significant impediment to global economic growth. This persistent challenge retards economic growth (Atigala *et al.*, 2022), diminishes the purchasing power of currency, and causes individuals to face difficulties in obtaining basic necessities. One pivotal aspect of promoting a flourishing and sustainable economy involves obtaining a comprehensive understanding of

inflation and implementing effective control measures. The financial system is commonly acknowledged as a principal contributor to inflation, and the development of a well-functioning financial system is deemed crucial for attaining low and stable inflation rates (Ehigiamusoe & Samsurijan, 2021). In that sense, financial development occupies a crucial position in curtailing inflation, and countries worldwide have adopted policies to foster financial stability and strengthen their financial systems in pursuit of this objective (Eichengreen *et al.*, 2016).

The financial system in developing countries is still in the process of growing, prompting policymakers to implement regulatory frameworks and reforms that encourage private sector involvement while maintaining financial stability (Puatwoe & Piabuo, 2017). Tanzania is following this global trend by initiating several reforms to improve its financial sector, promote financial inclusion, and mitigate macroeconomic risks such as inflation. The development of the financial sector and inflation have a noteworthy influence on Tanzania's economic growth and progress. During the 1970s and 1980s, Tanzania's high inflation rates adversely affected economic growth and development, leading to lower investment and productivity (Kasidi & Mwakanemela, 2013). However, the growth and development of the financial sector in the 1990s allowed the country to attract more investment and foster more significant private sector growth. The emergence of microfinance institutions and insurance companies provides better access to finance for small and medium-sized businesses in Tanzania (Brown *et al.*, 2015). This, in turn, has contributed to economic growth and development, increased employment opportunities,

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and poverty reduction. The development of the financial sector has contributed positively to Tanzania's economic growth and development over the past 50 years. However, additional progress is still needed to address remaining challenges, such as improving financial literacy, enhancing access to finance for women and youth, and addressing underdeveloped infrastructure in rural areas. The Tanzanian government has implemented several reforms aimed at enhancing the financial sector and reducing macroeconomic uncertainties, including establishing microfinance institutions, introducing new banking regulations, and developing capital markets (Yona & Inanga, 2014; Balele *et al.*, 2018). These efforts have led to significant improvements in financial development in Tanzania, with an increased use of digital payment solutions to reduce liquidity issues and avoid cash dependency. Moreover, the reforms have improved the regulatory environment, created a robust banking system, and enhanced access to financial services countrywide. Despite recent reforms and developments in the financial sector, significant hurdles remain, including achieving a balance between financial development and inflation rates. This is due to the theoretical perspective of the quantity theory of money that financial development can lead to inflationary pressures (Rousseau & Tarazi, 2002) via the expansion of credit and loans, among other causes, in the economy. To gain deeper insights into the relationship between financial development and inflation, this study examines the impact of financial development on inflation in Tanzania. The study contributes to academic literature and may inform policy decisions aimed at stabilising the economy. The scope of this study is limited to using time series analysis to quantify the relationship between financial development and inflation. The present paper is organised as follows: Section 2 presents a comprehensive review of the relevant literature. Section 3 elucidates the employed methodologies. Section 4 comprises the findings and subsequent discussion. Finally, the last section furnishes conclusive remarks and recommendations.

LITERATURE REVIEW

This study conducted an empirical review to examine the relationship between financial development and inflation in different countries. The following empirical studies were analysed:

Ahmed (2021) investigated the impact of inflation on the financial sector's performance in Jordan from 1993 to 2018. The study used the autoregressive distributed lag (ARDL) analysis model and found a negative short- and long-term impact of inflation on the financial sector. The study concluded that inflation can hinder economic growth and development by adversely affecting the financial sector.

Ahmed and Elsayed (2023) studied the relationship between financial development and inflation in Egypt from 1980 to 2018. The study employed various econometric techniques, such as Johansen's test for

co-integration, the error correction model, Granger's causality test, the Toda-Yamamoto causality test, and the dynamic ordinary least squares model. It was found that financial development did not significantly reduce inflation. Additionally, inflation was identified as an obstacle to the country's financial development. The study also found a unidirectional and long-term equilibrium relationship between financial development and inflation, where inflation had a negative effect on financial development. The results further suggested that the inflation rate, economic growth, exchange rate, and trade openness jointly influenced financial development in both the short and long term. Therefore, past values of these variables could be used to predict current and future values of financial development.

Kim and Lin (2010) investigated the dynamic relationship between inflation and financial development in an empirical study. The study examined the long-term link between inflation and financial development for 27 selected nations from 1970 to 2006 using the ARDL model. In order to determine the causal relationship between the two variables, the Granger causality test and variance decomposition analysis were used. According to the findings, financial development had a detrimental long-term impact on inflation. Inflation, on the other hand, had a positive influence on financial development, demonstrating that inflation promotes the development of the financial sector. Furthermore, the study found that financial development caused inflation rather than the other way around. The studies also revealed that different countries' levels of economic and financial development had an impact on the relationship between inflation and financial development. Ismail and Masih (2019) examined the relationship between inflation and financial development in Sudan utilising the ARDL and nonlinear ARDL algorithms. Long-term equilibrium between inflation and financial development was found to be symmetrical, whereas the short-term relationship was asymmetrical. The study highlighted the importance of this relationship in macroeconomic stabilisation policies. Kagochi (2019) investigated the relationship between inflation and the performance of the financial sector in sub-Saharan African countries. The study analysed panel data and revealed that inflation does not contribute to the development of the region's financial sector. It emphasised the significance of inflation management and the creation of strong economic institutions in order to improve financial development. Ozturk and Karagoz (2012) explored the relationship between inflation and Turkish financial development. The study discovered that inflation has a negative impact on financial development and emphasised the detrimental consequences of high inflation on economic growth. Based on the contradictory results of these studies, additional research was required to comprehend the relationship between financial development and inflation in Tanzania. This study's materials and methods section describes the methodologies used for examining the impact.

MATERIALS AND METHODS

This study examined the impact of financial development on inflation in Tanzania using a time series analysis covering the period between 1980 and 2020. STATA software package version 13 was used in the data analysis. This section outlines the methodology employed in the study.

Data sources and Measurement of Variables

The study employs data from the World Bank and the IMF International Financial Statistics publications, spanning the period between 1980 and 2020. The choice of this period is due to data availability, particularly the lack of time series data for the financial development

index before 1980. The economic variables examined in this study include the financial development index and the inflation rate. The financial development index is a composite index developed by the World Bank that is nuanced and accounts for information on the depth, efficiency, and accessibility of financial institutions and markets for a particular country (Sahay *et al.*, 2015). On the other hand, the inflation rate dataset was retrieved from the International Monetary Fund (IMF). The selection of the variables is based on their theoretical and empirical relevance to measure both financial development and inflation in the study's context. Further information about data sources and measurements is presented in Table 1.

Table 1: Data sources and measurement of variables

| Variable Name | Description | Measurement | Expected Sign | Source |
|---------------|-----------------------|-----------------------------|---------------|--------------------|
| INFL | Inflation | Inflation rate | - | IMF, (2021) |
| FD | Financial Development | Financial development Index | Negative | World Bank, (2021) |

Source: Study construction, 2023

Analytical Framework

Descriptive Statistics

This study employed the mean and standard deviation to describe financial development based on inflation data. The mean provided insights into the average level of financial development and inflation in the Tanzanian economy, while the standard deviation was useful in describing the variation in financial development and inflation across different years. These statistical measures enabled the identification of patterns, trends, and outliers in the data. Further, their findings informed subsequent analyses and modelling of the relationship between financial development and inflation.

Correlation Analysis

The association between financial development (FD) and inflation (INFL) using the correlation coefficient (r) as a statistical indicator. The coefficient ranges from -1 to 1, with 0 (or values close to 0) indicating no relationship between the two variables. Conversely, coefficients of -1 or 1 indicate an absolute relationship between the two variables. Based on this, the following hypotheses were formulated:

$H_0: r < 0$, The correlation coefficient with a negative value indicates an increase in financial development leads to a decrease in the inflation rate, while a decrease in financial development leads to an increase in the inflation rate.

$H_1: r > 0$, The correlation coefficient indicates a positive relationship, suggesting that an increase in financial development is associated with an increase in the rate of inflation and vice versa.

Estimation Technique

Model Specification

The Ordinary Least Squares (OLS) regression analysis was employed to determine the impact of financial development and inflation on economic growth in Tanzania. The OLS regression analysis helps to estimate

the coefficient of financial development on inflation and determine the statistical significance of the relationship. The functional relationship was derived as in Equation 1 and then transformed into natural logarithms to obtain the log-linear model as specified in Equation 2.

$$INFL_t = f(FD_t) \dots \dots \dots (1)$$

After applying the logarithmic function to Equation (1), the resulting model was as follows:

$$\ln INFL_t = \alpha_0 + \alpha_1 \ln FD_t + \mu_t \dots \dots \dots (2)$$

Where:

- $INFL_t$: Inflation rate in percentage
- FD_t : Financial development index in percentage
- α_0, α_1 : Coefficients to be estimated
- \ln : Natural logarithm
- μ_t : Error term

Stationarity Test

Before proceeding with data analysis, it was crucial to assess the stationarity of each variable included in the study. Stationarity refers to the property of a time series whose statistical properties remain constant over time. A non-stationary or unit-root time series can have trends, cycles, and other patterns that make it difficult to model accurately. Stationarity is a crucial assumption in time series analysis, and ignoring the presence of a unit root can result in biased or inaccurate estimates. Testing for unit roots is therefore an essential step in time series analysis, as it determines whether a time series is stationary or non-stationary. This decision guides whether the time series needs to be transformed or differenced. A stationary time series is preferred in analysis due to its predictability, as it possesses constant statistical properties over time, such as a consistent mean and variance. In contrast, a non-stationary time series has statistical properties that change over time, making its behaviour less predictable. Additionally, a time series with a unit root has a mean that grows or declines over time, making its behaviour unpredictable too.

This study employed the Augmented Dickey-Fuller (ADF) (1981) and Phillips-Perron (PP) (1988) tests to check for unit roots in each variable. Therefore, it was necessary to apply a unit root test to evaluate stationarity. The null hypothesis assumes the presence of a unit root in the time series sample, which implies that the data mean is non-stationary. Rejecting the null hypothesis suggests that the data mean is either stationary or trend stationary, depending on the model used for the test.

Based on the stationarity test results, if the ADF or PP tests were statistically significant, the null hypothesis of the time series being non-stationary would be rejected, and it would be concluded that the series is stationary. This would indicate that the series has a stable mean and variance over time and could be used for further analysis. On the other hand, if the tests were not statistically significant, the null hypothesis of non-stationarity would fail to be rejected, indicating that the series is non-stationary and has a unit root. In this case, differencing the series becomes necessary to obtain stationarity and make the series suitable for further analysis.

Cointegration Test

Cointegration analysis is a statistical test used to examine the long-run relationship between two or more time series variables. In examining the impact of financial development on inflation in Tanzania, this analysis helps determine if there is a stable long-run relationship between these two variables. Various cointegration tests, such as Engle-Granger (1987), Johansen (1988), and Pesaran *et al.* (2001), are used in the literature to confirm the potential presence of a long-run equilibrium relationship between variables.

This study adopted the Johansen cointegration test, which is used to examine the cointegration among time series variables and is based on the Vector Error Correction Model (VECM). The VECM framework analyses the short-run and long-run dynamics of cointegrating variables. The Johansen test was chosen due to its ability to detect multiple cointegrating relationships between variables, which was important in capturing the complex relationship between financial development and inflation. The test was represented by Equations 3 and 4, as shown. $\ln INFL_t = \mu_1 + \varphi_{11} \ln INFL_{(t-1)} + \varphi_{12} \ln FD_{(t-1)} + \epsilon_t \dots \dots \dots (3)$ $\ln FD_{2t} = \mu_2 + \varphi_{21} \ln INFL_{(t-1)} + \varphi_{22} \ln FD_{(t-1)} + \epsilon_{2t} \dots \dots \dots (4)$ where:

$INFL_t$ and FD_{2t} are the time series for inflation and financial development, respectively. μ_1 and μ_2 are the intercept terms. φ_{11} , φ_{21} , φ_{12} , and φ_{22} are the coefficients of the lagged terms. ϵ_t and ϵ_{2t} are the error terms.

Based on the Johansen cointegration results, if the trace and/or maximum eigenvalue tests were statistically significant, then the null hypothesis of no cointegration could be rejected, and it could be concluded that there is at least one cointegrating vector among the variables. This would indicate a long-run relationship between

the variables that can be used for further analysis, such as estimating a vector error correction model (VECM) to investigate the short- and long-run dynamics of the system. On the other hand, if the tests were not statistically significant, then the null hypothesis of no cointegration could not be rejected, indicating that the variables are not cointegrated and do not have a long-run relationship.

VECM Estimation

This study used the VECM to examine the impact of financial development on inflation in Tanzania. The model was originally introduced by Granger in 1987 and is useful in analysing the dynamic relationship between time series variables. The VECM analysis restricts long-run relationships through cointegrating relations, while the error correction term represents the deviation from the long-run equilibrium of the variables. The model is particularly suitable for exploring the relationship between variables and accommodating non-stationary time series data that are integrated in the same order. The model takes the form shown in Equation 5.

$$\Delta \ln INFL_t = \alpha_0 + \sum_{i=1}^n \beta_i \Delta \ln INFL_{t-i} + \sum_{i=1}^n \gamma_i \Delta \ln FD_{t-i} + \lambda ECT_{t-1} + \mu_t \dots \dots \dots (5)$$

Where:
 $\Delta \ln INFL_t$ is the first difference of inflation rate at time t.
 $\Delta \ln FD_t$ is the first difference of a financial development index at time t.
 ECT_{t-1} is the error correction term, which captures the speed of adjustment of the system back to equilibrium in the long run.
n is the number of lags included in the model.
 α_0 is the constant term.
 β_i and γ_i are the coefficients of the lagged inflation and financial development variables, respectively.
 λ is the coefficient of the error correction term.
 μ_t is the white noise error term.

This model simultaneously estimates the short-run and long-run effects of financial development on inflation, along with the speed of adjustment to equilibrium in the long run. The error correction term captures the long-run equilibrium relationship between inflation and financial development, ensuring the model is well-behaved and not subject to spurious regression.

The interpretation of the estimated results is based on the theoretical underpinning that the estimated coefficients in a VECM indicate the short-run and long-run relationships between the variables, with positive coefficients suggesting a positive relationship and negative coefficients suggesting a negative relationship. Also, the error correction term reflects the speed of adjustment towards the long-run equilibrium after a shock, with a positive coefficient indicating a quick adjustment and a negative coefficient indicating a slower adjustment.

On the other hand, diagnostic tests were conducted to assess the appropriateness of the model and validate that it precisely captures the underlying data generating process. These tests involved evaluating causality,

autocorrelation, stability, and normality of the residuals, among other tests.

RESULTS AND DISCUSSION

Descriptive Analysis Results

Table 2 shows the descriptive statistics of inflation (INFL) and financial development (FD) over a 41-year period from 1980 to 2020. The statistics describe the distribution of the variables over time. For inflation, the average inflation rate over the period was 16.463%, with a standard deviation of 11.5%. This suggests that inflation was quite volatile over the period, with fluctuations

ranging from a minimum of 3.29% to a maximum of 36.146%. For FD, the mean was 0.110% with a standard deviation of 0.028%, indicating that FD was less volatile than inflation over the period. The minimum FD was 0.048% and the maximum was 0.166%, suggesting that there were periods of both low and high FD over the study period. However, these descriptive statistics provide limited information about the impact and relationship between FD and inflation. Further analysis is required to investigate the relationship between the two variables, inflation and FD, so as to determine the impact of the relationship.

Table 2: Descriptive statistics for Inflation and Financial Development

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|----------|-----|--------|-----------|-------|--------|
| INFL | 41 | 16.463 | 11.5 | 3.29 | 36.146 |
| FD | 41 | 0.110 | 0.028 | 0.048 | 0.166 |

Source: Study findings, 2023

Correlation Results

The study utilised the Pearson correlation coefficient to determine the strength and direction of the linear association between inflation and financial development (Pearson, 1896). The coefficient indicates how closely the two variables are related and in which direction. Pearson's correlation coefficient, denoted as r , takes values between -1 and +1. A value of -1 signifies a perfect negative correlation, where an increase in one variable results in a decrease in the other. Conversely, a value of 1 indicates a perfect positive correlation, where an increase in one variable results in an increase in the other.

A value of 0 indicates no correlation, meaning there is

no relationship between the two variables. The results of this study show that the correlation coefficient between inflation and financial development was 0.7389, indicating a strong positive relationship between the two variables (Table 3). In other words, when financial development increased, inflation tended to increase as well. It is important to note that correlation does not imply causation.

While a strong association existed between financial development and inflation, it did not necessarily mean that financial development caused inflation or vice versa. Hence, further analysis was required to model the nature of the relationship between these two variables.

Table 3: Correlation matrix of Inflation and Financial development

| Variables | Inflation | FD |
|-----------|-----------|-------|
| INFL | 1.000 | |
| FD | 0.7389 | 1.000 |

Source: Study findings, 2023

Unit Root Test Results

The study conducted unit root tests using the ADF and PP approaches to determine the stationarity of the variables under investigation. The coefficients obtained from the tests were compared to critical values at the 1%, 5%, and 10% levels of significance.

The results presented in Table 4 indicate that both variables were non-stationary at their level but stationary

in the first difference. This implies that all variables were integrated in the same order, i.e., I (1).

Therefore, the null hypothesis of non-stationarity was rejected, indicating that both variables were stationary and integrated at order one. In other words, I (1) was the maximum order of integration. This means the variables can be differenced once to achieve stationarity, which is a necessary condition for most time series models.

Table 4: Augmented Dickey-Fuller (ADF) and Phillips-Perron (P-P) tests results

| Test | Variable → | INFL | | | | FD | | | |
|------|------------|-------------|----------|-------------|----------|-------------|----------|-------------|----------|
| | Order → | I (0) | | I (1) | | I (0) | | I (1) | |
| | Item | t-Statistic | p-value* | t-Statistic | p-value* | t-Statistic | p-value* | t-Statistic | p-value* |
| | | | | | | | | | |

| | | | | | | | | | |
|------------|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|
| ADF | Critical values | -2.174 | 0.5044 | -5.216 | 0.0001 | -1.438 | 0.8495 | -4.341 | 0.0027 |
| | 1% | -4.251 | | -4.260 | | -4.251 | | -4.260 | |
| | 5% | -3.544 | | -3.548 | | -3.544 | | -3.548 | |
| | 10% | -3.206 | | -3.209 | | -3.206 | | -3.409 | |
| P-P | Critical values | -2.199 | 0.4903 | -6.445 | 0.000 | -2.016 | 0.5927 | -9.631 | 0.000 |
| | 1% | -4.242 | | -4.251 | | -4.242 | | -4.251 | |
| | 5% | -3.540 | | -3.544 | | -3.540 | | -3.544 | |
| | 10% | -3.204 | | -3.206 | | -3.204 | | -3.206 | |

*MacKinnon approximate p-value: Source: Study findings, 2023

Note: All variables were logarithmically transformed during the data analysis process

Optimal Lag Selection

Table 5 presents the output of the optimal lag order selection criteria for the VECM analysis. The use of the optimal lag order improves the accuracy and reliability of the VECM model in analysing the relationship between inflation and FD. To determine the optimal lag order (k), various statistical techniques were employed, including the Likelihood Ratio (LR), Forecast Prediction Error (FPE)

Criteria, Akaike Information Criteria (AIC), Hannan Quinn Information Criteria (HQIC), and Schwartz Bayesian Information Criteria (SBIC). The minimum value of the SBIC, as used in Hussain (2009), was used to select the lag order. The results showed that the chosen lag was 1. This means that the model used only one lag of the variables to capture the long-run relationship and adjust to short-run deviations from equilibrium.

Table 5: The Selection-order criteria of the VECM analysis

| Selection-order criteria | | | | | | | | |
|--------------------------|----------|---------|----|-------------------|-----------|------------|------------|------------|
| Sample: 1984 - 2020 | | | | Number of obs= 37 | | | | |
| Lag | LL | LR | df | P | FPE | AIC | HQIC | SBIC |
| 0 | -32.7268 | | | | 0.022402 | 1.87712 | 1.90782 | 1.9642 |
| 1 | 17.2903 | 100.03* | 4 | 0.000 | 0.001863* | -0.610285* | -0.518189* | -0.349055* |
| 2 | 21.2487 | 7.9169 | 4 | 0.095 | 0.001873 | -0.608039 | -0.454546 | -0.172656 |
| 3 | 23.0089 | 3.5204 | 4 | 0.475 | 0.002126 | -0.48697 | -0.27208 | 0.122566 |
| 4 | 25.3093 | 4.6008 | 4 | 0.331 | 0.002356 | -0.395099 | -0.118812 | 0.388591 |

Source: Study findings, 2023

Johansen Cointegration Test

Table 5 presents the results for the Johansen cointegration test. The results identified the trace statistic as being higher than the 5% critical value; hence, the null hypothesis of no cointegrating equation was rejected at the 5% level. Furthermore, it is concluded that a long-run relationship

exists between financial development and inflation. On the other hand, it is shown from Table 6 that there is one cointegrating equation, meaning the variables move together in the long run. Therefore, this gave rise to further investigation of the variables by employing the VECM analysis.

Table 6: Cointegration test results

| Johansen cointegration test | | | | | |
|-----------------------------|-------|--------------------|------------|-----------------|-------------------|
| Sample: 1982 - 2020 | | Number of obs = 39 | | Lags = 2 | |
| Maximum rank | Parms | LL | Eigenvalue | Trace statistic | 5% critical value |
| 0 | 6 | 19.416288 | | 18.9449 | 15.41 |
| 1 | 9 | 22.813408 | 0.15988 | 2.1507* | 3.76 |
| 2 | 10 | 23.888734 | 0.05365 | | |

Source: Study findings, 2023

VECM Results

Table 7 presents VECM results to explain the dynamics between changes in financial development and inflation over time. Specifically, the coefficient of -0.0938 on inflation indicates that the first difference in inflation was negatively influenced and not significantly influenced by its lagged first difference. Similarly, the short-run coefficient of -0.1793 on financial development implies that the first

difference in inflation was negatively influenced and not significantly influenced by the lagged first difference in financial development. This means that the variables do not move together in the short run.

Based on the results in Table 7, the VECM is fitted as in Equation 6.

$$\Delta \ln INFL_t = -0.0009 - 0.0938 \Delta \ln INFL_{(t-1)} - 0.1793 \Delta \ln FD_{(t-1)} - 0.17198 ECT_{(t-1)} \dots \dots \dots (6)$$

Table 7: VECM results

| | Coef. | Std. Err. | z | P> z | [95% Conf. Interval] | |
|----------|------------|-----------|-------|-------|----------------------|------------|
| D_lnINFL | | | | | | |
| _ce1 | | | | | | |
| L1. | -0.1719823 | 0.0735069 | -2.34 | 0.019 | -0.3160532 | -0.0279115 |
| lnINFL | | | | | | |
| LD. | -0.0937603 | 0.1580202 | -0.59 | 0.553 | -0.4034743 | 0.2159537 |
| lnFD | | | | | | |
| LD. | -0.1792766 | 0.3446136 | -0.52 | 0.603 | -0.854707 | 0.4961537 |
| cons | -0.0009263 | 0.050182 | -0.02 | 0.985 | -0.0992812 | 0.0974285 |

Source: Study findings, 2023

Speed of Adjustment Results

The adjustment term (-0.1720) presented in Equation 6 indicates the speed of adjustment. It is statistically significant at the 5% level, suggesting that the deviation from long-run equilibrium in the previous year is corrected for within the current year at a convergence rate of 17.20%. This implies that if the variables experience a shock that takes them away from their long-run equilibrium, they will adjust back to their equilibrium values at a speed of approximately 17.20% per year. The error correction term is presented in Equation 7 as follows.

$$ECT_{(t-1)} = [1.000lnINFL_{(t-1)} - 4.0226lnFD_{(t-1)} - 11.2028] \dots \dots \dots (7)$$

Long-Run Test Results

Table 8 evidences that, in the long run, financial development has a positive impact on inflation. The coefficient is statistically significant at the 1% level. It is concluded that financial development has a long-run impact on inflation, ceteris paribus. Further, Table 8 shows an inverse relationship between financial development and inflation. Specifically, a percent increase

in financial development on average is associated with a 4 percent decrease in inflation, ceteris paribus. This study produced results that corroborate the findings of Kim and Lin (2010), who identified that financial development has a negative effect on inflation in Egypt in the long run. Also, the results mirror those of Ismail and Masih (2019), who found a symmetrical relationship between the variables in the long run.

On the other hand, Table 8 is associated with Equation 7 in the context that the ECT shows a one-unit increase in FD leads to a 4.0226-unit decrease in ECT. In other words, an increase in financial development (represented by FDI) leads to a decrease in the deviation from long-run equilibrium (represented by ECT). This suggests that financial development has a significant impact on the adjustment mechanism towards long-run equilibrium in the relationship between financial development and inflation. Additionally, the negative value of the constant term (-11.2028) indicates that the long-run equilibrium value of ECT is negative, suggesting that the adjustment mechanism is towards a negative deviation from the long-run equilibrium.

Table 8: Johansen normalization

| Johansen normalization restriction imposed | | | | | | |
|--------------------------------------------|-----------|-----------|-------|-------|----------------------|-----------|
| beta | Coef. | Std. Err. | z | P> z | [95% Conf. Interval] | |
| _ce1 | | | | | | |
| lnINFL | 1 | . | . | . | . | . |
| lnFD | -4.022605 | 0.9639202 | -4.17 | 0.000 | -5.911854 | -2.133356 |
| _cons | -11.20279 | . | . | . | . | . |

Source: Study findings, 2023

Causality Test Results

Long Run Causality Results

From Table 6, the error correction term is negative (-0.1720) and significant at the 5% level (p = 0.019). This implies that there is a significant long-run causality running from financial development to inflation. Thus, the evidence of financial development reducing inflation in the long run is established for Tanzania. This suggests that there is strong empirical evidence supporting the notion that financial development reduces inflation over the long term.

Short Run Causality Results

Either the Wald test or the Likelihood Ratio test becomes superior to the conventional Granger causality test after conducting a VECM model.

According to Table 9, there was no short-run causality flowing from either side, i.e., neither financial development nor inflation caused the other. Thus, the 5% p-value indicates that there was no short-term causality between the study variables.

Table 9: Wald test results for short-run causality analysis

| Hypothesis | Causal Direction | chi2 | p-value | Implication |
|--------------------|------------------|------|---------|---------------------------|
| lnINFL causes lnFD | lnINFL → lnFD | 0.38 | 0.5361 | No short run relationship |
| lnFD causes lnINFL | lnFD → lnINFL | 0.27 | 0.6029 | |

Source: Study findings, 2023

Diagnostic Tests

Autocorrelation Test

Table 10 displays the results of a Lagrange-multiplier (LM) test conducted to assess the presence of residual autocorrelation for the inflation and FD variables at two different lag orders (lag 1 and lag 2). The chi-squared values obtained for both lag orders were relatively small, and the p-values were greater than 0.05, as shown in Table 10. This indicates that there is no significant autocorrelation at either lag order, and thus we cannot reject the null hypothesis of no significant autocorrelation. Consequently, the absence of a systematic pattern of residual autocorrelation in the model implies that the model’s residuals are independent and random.

Table 10: Lagrange-multiplier test results

| lag | chi2 | df | Prob > chi2 |
|-----|--------|----|-------------|
| 1 | 2.9413 | 4 | 0.5677 |
| 2 | 5.3919 | 4 | 0.24939 |

Source: Study findings, 2023

Normality Test

Table 11 presents the results of the Jarque-Bera test, which was conducted to assess whether the residuals of the model follow a normal distribution. For the equation D_lnINFL, the test statistic is 0.086 with 2 degrees of freedom, and the p-value is 0.95804. Based on these results, we cannot reject the null hypothesis of normality for the residuals of this equation at any reasonable level of significance. This indicates that the errors are normally distributed, and we can rely on the inferential statistics. In other words, the model’s residuals do not exhibit any significant deviation from normality, and the model’s assumptions about the normal distribution of the errors are not violated.

Table 11: Jarque-Bera normality test

| Equation | chi2 | df | Prob > chi2 |
|----------|--------|----|-------------|
| D_lnINFL | 0.086 | 2 | 0.95804 |
| D_lnFD | 41.100 | 2 | 0.00000 |
| ALL | 41.186 | 4 | 0.00000 |

Source: Study findings, 2023

Stability Test

Table 12 shows the stability and variability tests of the VECM model, which are crucial for accurate estimation of the long-run equilibrium relationship between the variables. The eigenvalues of the model represent its variability, while the modulus of the eigenvalues represents its stability, as established by Chen (2022). A modulus less than 1 suggests stability, while a modulus greater than 1 indicates instability.

Table 12: Stability test results

| Eigenvalue stability condition | |
|--------------------------------|----------|
| Eigenvalue | Modulus |
| 1 | 1 |
| 0.8372416 | 0.837242 |
| -0.4611006 | 0.461101 |
| -0.1298797 | 0.129880 |

Source: Study findings, 2023

The unit modulus in Table 12 indicates that the VECM model is well-specified and stable for estimating the long-run equilibrium relationship between the variables. Further, this implies that it is appropriate for estimating the long-run equilibrium relationship between the variables. This suggests that the VECM model was relevant in examining the dynamic interaction between inflation and FD and analysing the effects of shocks on these variables in the short and long run.

CONCLUSION

This study examines the impact of financial development on inflation in Tanzania. The study utilised time-series data from 1980 to 2020. The financial development index was used as a proxy for financial development, which includes the depth, efficiency, and accessibility of financial institutions and markets in the country. The inflation rate was used as a proxy for inflation. These data were sourced from the World Bank and IMF databases. The study employed the VECM analysis technique. Based on the study’s findings, it was observed that financial development has a significant long-run impact on inflation in Tanzania. Furthermore, the study showed that financial development results in a reduction in inflation in the country. This implies that financial development is a reliable strategy for controlling inflation.

Based on these findings, the following recommendations are made:

In order to ensure stability within the financial sector, it is imperative that the government implement suitable regulatory policies and exercise oversight over financial institutions. This encompasses the tasks of upholding a suitable inflation rate, proficiently administering exchange rates, and guaranteeing the financial system’s ability to withstand unexpected disturbances. Furthermore, it is recommended that the government enhance the infrastructure of the financial market and promote the utilisation of financial services. Enhancing the scope of financial institutions and augmenting credit accessibility can result in strengthened financial inclusion, elevated investment, and economic growth.

In order to reduce costs and minimise potential hazards

linked to cash transactions, it is recommended that the government promote and enhance the advancement of more effective payment mechanisms, specifically those that are electronic in nature. The aforementioned systems possess the capability to mitigate the dependence on tangible currency, thereby aiding in the reduction of inflationary forces.

The promotion of financial inclusion is imperative for the purpose of reducing dependence on cash and improving the effectiveness of monetary policy. This has the potential to enhance financial access for a greater segment of the general public. Incorporating a substantial segment of the populace into the financial system may function as a preventative strategy against inflationary forces and unwarranted credit expansion.

Authors Contributions

DU was in charge of designing the study, and BNN and DU both contributed to data collection, analysis, interpretation, and manuscript writing. Both authors thoroughly reviewed and endorsed the final version of the manuscript.

Conflict of Interest

The authors have no conflicts of interest.

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