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Effectiveness of Monetary Policy Transmission Mechanism Through Interest Rate Channel in Tanzania

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Abstract

This study investigates the effectiveness of monetary policy transmission through interest rates in Tanzania using quarterly data from 2002 to 2022. The study specifically examines how fluctuations in the monetary policy rate (measured by the repo rate) influence the overnight and 7-day interbank rates, as well as short-term and long-term lending and deposit rates, and consequently, the general price level and the overall economy.

In pursuit of these objectives, the empirical analysis employs Autoregressive Distributed Lag (ARDL) to analyze the degree of interest rate pass-through and the Structural Vector Autoregressive (SVAR) model to scrutinize the efficacy of monetary policy transmission mechanism to the overall economy and prices through the interest rate channel.

The study finds a complete pass-through of monetary policy rates to interbank market interest rates, with the 7-day interbank rate showing greater responsiveness to changes in policy rates than the overnight interbank rate. The pass-through to short-term deposit rates is statistically significant but low in the short run, with a higher degree than in previous studies indicating improvement in transmission. Furthermore, there is an incomplete pass-through of the policy rate to both short-term and long-term lending rates. In addition, the study finds that the transmission of monetary policy from policy rate to output and prices is weak.

The study provides four key policy implications. First, the 7-day interbank rate could potentially serve as an operational target in the conduct of monetary policy. Second, the observed improvement in the transmission process could serve as a basis for supporting the adoption of an interest rate-based monetary policy framework in Tanzania. However, there are still limitations to this framework, and efforts should be made to address them. Third, to improve lending rates sensitivity in Tanzania, efforts should be made to address challenges related to bank-specific, industry-specific, and macroeconomic factors. Finally, efforts should be made to improve financial inclusion, financial market competition, and transparency of the Bank of Tanzania's monetary policy operations to improve monetary policy transmission.

1.0 Introduction

A comprehensive understanding of monetary policy and its transmission mechanisms is crucial for maintaining price stability and enhancing economic performance (Gali, 2015). This is because the dynamic structure of the economy, characterized by technological advancements, financial sector evolution, and evolving institutional landscapes, play a significant role in shaping the impact of monetary policy (Gregor and Melecký, 2018; Kessy, Nyella, and O'Connel, 2017). Additionally, expectations regarding future policies and modifications to institutional balance sheets also contribute to the overall effectiveness of monetary policy (Gali, 2015; Gregor and Melecký, 2018). Therefore, to make informed decisions that will have the desired impact on the economy, policymakers are encouraged to have a deep understanding of monetary policy and the effectiveness of its transmission mechanisms.

In the context of Tanzania, monetary policy has evolved in response to changes in economic conditions. During the era of socialism and self-reliance (1967-1985), the Bank of Tanzania-BOT assumed a developmental role coupled with the use of direct tools to manage the economy (Ndulu, 1998). Economic reforms beginning in 1986 to date ushered in a new era of a free market economy where indirect monetary tools were employed (Ndulu, 1998; Bank of Tanzania, 2016(a)). Since the adoption of market-based monetary policy operations in 1995, the Bank of Tanzania employed the quantity-based monetary policy framework aiming at maintaining domestic price stability conducive to a balanced and sustained growth of the national economy (BOT Act 2006, (Ndulu, 1998)). Under this framework, the intermediate target is the extended broad money supply (M3), while the operational variable is Reserve Money (M0) comprising currency in circulation outside the BOT, and banks' deposits at the Bank of Tanzania (Bank of Tanzania, 2016(a)). The Quantity-based monetary policy, alongside other structural policies, has helped to control inflation and as a result, the country has been experiencing remarkable economic growth and is currently among the fastest-growing economies in Sub-Saharan Africa (Kessy, Nyella, and O'Connel, 2017).

Despite the success, the quantity-based monetary policy framework in Tanzania has faced several limitations, including the unstable money velocity and money multiplier associated with development in digital financial services, the failure to capture shocks to money supply and demand, and less transparency compared to an interest rate-based framework (Kessy, Nyella, and O'Connel, 2017). To address these limitations, the Bank of Tanzania initiated the transition to an interest rate-based monetary policy framework in 2016 (Bank of Tanzania, 2016(b)). The new framework, which uses interest rates as an operating target rather than reserve money, is relatively more transparent and easier to communicate with the public and does not depend on the stability of money demand (Mishkin, 1999). This framework has also worked well in other countries, and all EAC countries have agreed to adopt the framework as specified in the EAC Monetary Union Protocol (Morales, 2014).

The transition to an interest rate targeting framework requires a precise understanding of the strength of the interest rate channel via which monetary policy shocks are conveyed to the overall economy (Mukherjee and Bhattacharya, 2011). This understanding is necessary not only for the monetary policy to have the desired results but also for the type of reforms which are needed during the implementation of the framework (Mishkin, 1999). Despite its relevance, the interest rate transmission process and its effectiveness are not extensively studied in Tanzania. Empirical studies in this area are few and have yielded different results. Thus, a fresh assessment of the effectiveness of the interest rate channel in Tanzanian monetary policy transmission is of paramount importance to fill this knowledge gap.

The current study builds from the earlier study by Mbowe (2015) to investigate the effectiveness of monetary policy transmission via interest rates in Tanzania. More precisely, the study has three specific objectives: first, to explore the pass-through from policy rate to interbank market rates in Tanzania; second, to assess the pass-through from policy rate to deposit- and lending-interest rates; and third, to assess the transmission of the policy rate to prices and output.

The findings of the study are useful because they offer policy insights and contribute to the literature on the efficacy of monetary policy transmission mechanisms via interest rates. They shed light on Tanzania's performance with respect to interest rate pass-through compared to other countries and suggest ways to enhance it. The findings are also critical to the effective implementation of monetary policy as it allows for the selection of appropriate policy instruments and targets and their timely implementation (Ganev, Molnar, Rybinski, and Wozniak, 2002).

The rest of the study is structured as follows: Section 2 presents an overview of the structure and development of the financial sector in Tanzania; Section 3 covers literature reviews; Section 4 describes the methodology; and Sections 5 and 6 cover a discussion of the findings and policy implications, respectively.

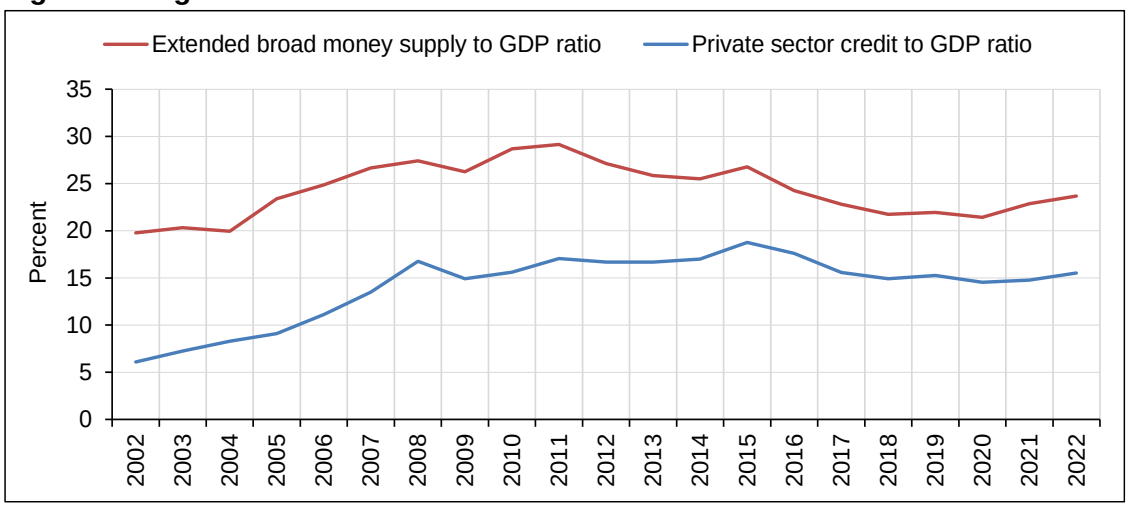
2.0 An Overview of Structure and Development of the Financial Sector in Tanzania

The financial sector in Tanzania has undergone significant changes over the years, particularly following the implementation of market-based financial sector reforms in 1991. These reforms have contributed to the growth and development of the sector, which in December 2022 comprised 45 institutions, including commercial banks, microfinance banks, community banks, and development banks. The banking sector has a strong customer base and a widespread branch network, and the 10 largest banks dominate the industry, accounting for over 70 percent of total assets, deposits, and loans. The liberalisation of the banking industry and foreign exchange regulations and foreign exchange auctions have played a crucial role in enhancing the efficiency of the financial services supply in a competitive environment. Additionally, measures such as the elimination of maximum lending rates, the introduction of Treasury bill

auctions, and the repeal of the Bank of Tanzania Act (1965) have helped to promote an environment where financial pricing can be determined freely. The Capital Market and Securities Act was also enacted, establishing a stock market and providing measures to create a market for mobilising and distributing savings for medium and long-term investments (Bank of Tanzania, 2016(a)).

Despite the historically low degree of financial intermediation in Tanzania, there has been a slight increase in recent years. As described in **Figure 1**, money supply (M3) as a share of GDP grew slightly from 21.7 percent on average between 2002 and 2006 to 22.3 percent on average between 2018 and 2022. This increase is indicative of the effectiveness of the market-based financial sector reforms that have been implemented in Tanzania. Despite the challenges that remain, this progress is a positive development for the country's economic growth and development.

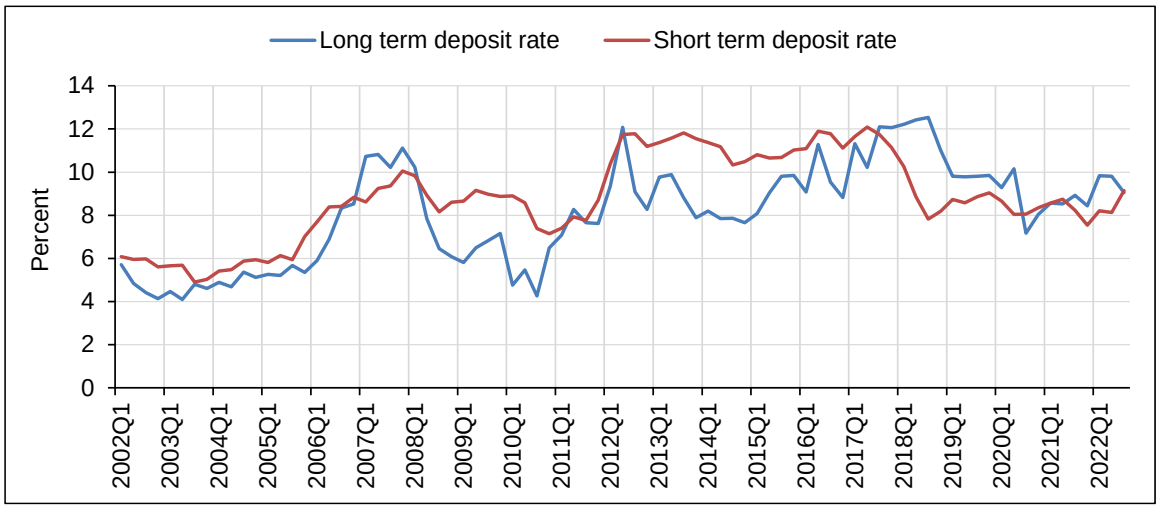
Figure 1: Degree of Financial Intermediation



Source: Bank of Tanzania

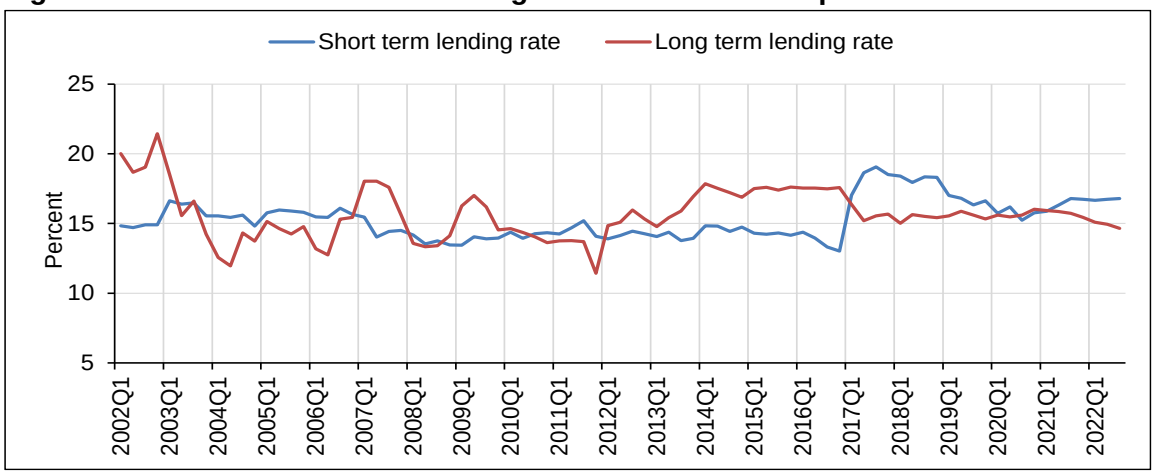
The financial sector reforms have had significant implications on the monetary policy transmission mechanism in Tanzania. Before the reforms, the Bank of Tanzania utilized direct instruments to implement monetary policy. However, following the repeal of the Bank of Tanzania Act (1965) and the introduction of the Bank of Tanzania Act (1995), the central bank now implements monetary policy using indirect instruments, with price stability as its primary objective. The elimination of direct interest rate controls and the introduction of market interest rates as a benchmark have helped to promote an environment where monetary policy can be implemented more effectively. However, despite the changes, interest rates on commercial bank loans and deposits have exhibited a large degree of stickiness which may limit the effectiveness of the interest rate channel in monetary policy transmission. Interest rates on commercial bank loans and deposits have remained relatively high, even as inflation fell to an average rate of 5.0 percent (2013-2020) from 23.4 percent from 1991 to 1998 (see **Figures 2**, **3** and **4**).

Figure 2: Commercial Banks Deposit Interest Rate Developments



Source: Bank of Tanzania

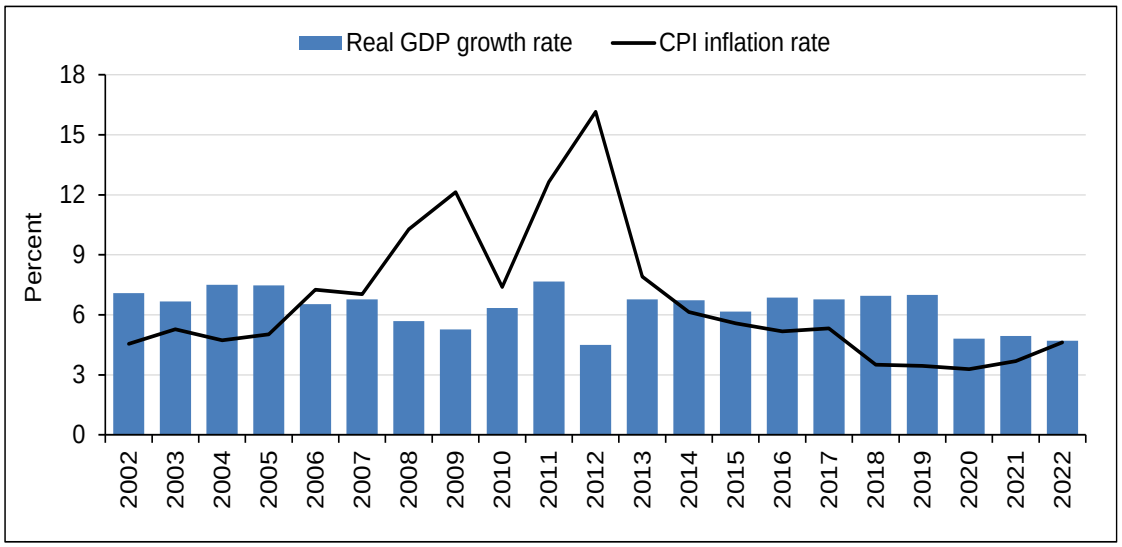
Figure 3: Commercial Banks' Lending Interest Rate Developments



Source: Bank of Tanzania

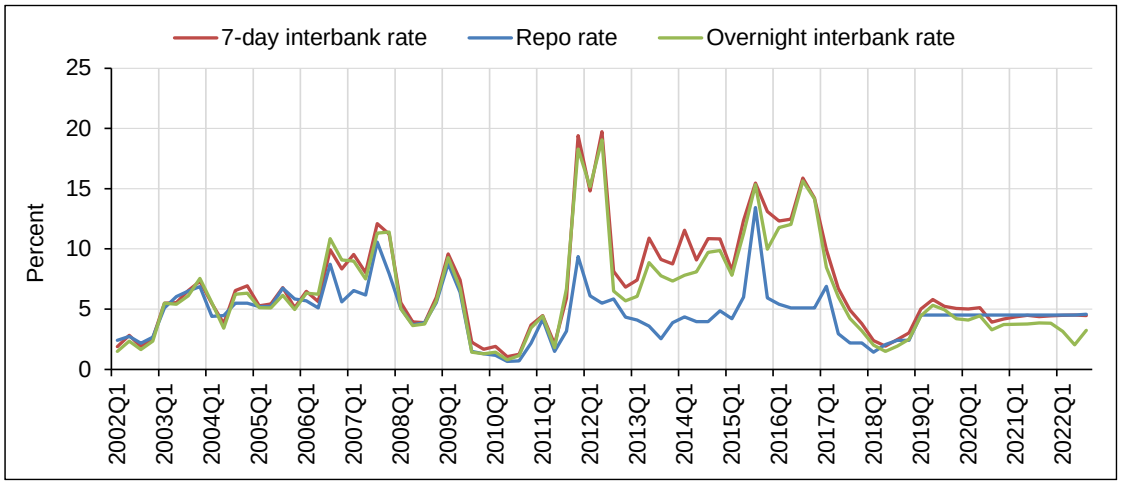
Moreover, the interbank rates at which commercial banks in the country lend to and borrow from each other have also exhibited substantial volatility especially before 2016 driven mainly by seasonal changes in liquidity conditions in the market. However, beginning in 2016 the central bank started implementing policies that encourage greater stability in interbank rates (see **Figure 5**). By promoting greater stability in interbank rates, the central bank has helped to ensure that monetary policy is effectively transmitted throughout the banking system.

Figure 4: Real GDP Growth and Inflation Development



Source: National bureau of statistics

Figure 5: Interest Rate Developments in the Money Market



Source: Bank of Tanzania

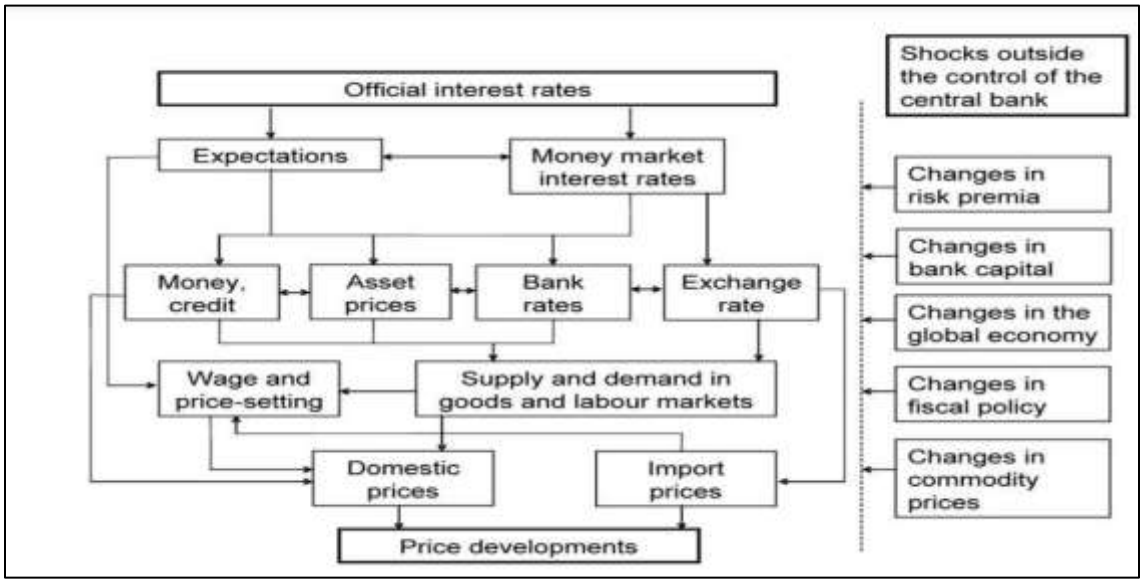
Therefore, the structure and development of the financial sector in Tanzania have played a crucial role in enhancing the efficiency of the financial services supply and promoting an environment where monetary policy can be implemented more effectively. However, there is still room for improvement, particularly in terms of increasing the degree of financial intermediation and inclusion as well as fostering competition to address the market interest rate stickiness.

3.0 Literature Review

3.1 Theoretical Foundation

Monetary Transmission Mechanism (MTM) refers to how monetary policy actions by monetary authority affect aggregate demand and prices in the economy through its influence on investment and consumption decisions of households, firms, and financial intermediaries (Mishkin F, 1995). The influence of monetary policy on the real economy (through changes in interest rates or money supply) is assumed to hold only in the short run under the neoclassical view of nominal price stickiness and long-run money neutrality (Mishkin F, 1995; Taylor, 1995). The central bank can affect the output and the overall price level through several transmission channels, which include the interest rate channel, the credit channel, the portfolio/assets price channel, the exchange rate channel, and the expectations channel (Mishkin F. S., 1996) as depicted by **figure 6**.

Figure 6: Monetary Policy Transmission Mechanism from Interest Rate to Inflation



Source: (Westaway, 2004)

The interest rate transmission channel has been a prevalent topic in economics literature for a significant period and is one of the fundamental models in the Keynesian perspective. Theoretically, monetary policy measures are transmitted through alterations in official interest rates, which affect expectations and conditions in financial markets and the banking system, ultimately impacting economic activities and price trends (Bernanke and Blinder, 1992). More specifically, according to Erdoğan and Yıldırım (2010), the monetary policy transmission via the interest rate channel is divided into two parts.

As shown in Figure 6, the first part is the interest rate pass-through, which defines how money market interest rates react to changes in the monetary policy (official) rate, as well as how these

changes impact bank deposits and lending rates (Erdoğan and Yıldırım, 2010). The theory behind the interest rate pass-through posits that the central bank can impact long-term real interest rates by manipulating short-term real interest rates. Firstly, because of price stickiness, changes in the monetary policy rate have a major impact on short-term real interest rates. In addition, according to Mishkin, 1996, the real market rates are explained by the rational expectation hypothesis of the term structure of interest rate theory. The rational expectation theory of the term structure suggests that the long-term interest rate is a forecasted average of future short-term interest rates. This implies that a reduction in the real short-term interest rate results in a decline in the real long-term interest rate (Mishkin, 1996). Thus, the pass-through is said to be effective when the monetary policy rate can influence the market rates.

The second part is the effect of changes in nominal interest rates on the real economy (Erdoğan and Yıldırım, 2010). This is the interest rate channel of the monetary transmission mechanism, which is based on Keynesian liquidity preference theory that examines how monetary policy actions impact the real economy. The Interest rate channel is frequently regarded as the hallmark of the "Money View" (Mishkin F. S., 1996).

Based on the theory, if the money supply in an economy exceeds demand, the real interest rate decreases because of the Keynesian sticky pricing assumption. Falling interest rates are expected to result in cheaper loans and increased borrowing, which is expected to boost investment and consumer spending (Kuttner and Mosser, 2002). The latter is expected to increase aggregate demand in the economy, putting upward pressure on inflation. The converse is expected to occur if the money supply is reduced (Mishkin F. S., 1996). This process is illustrated in the following schematic where *MS* denotes money supply, *r* denotes real interest rates, *C* denotes consumption, *Inv* denotes Investment, *AD* denotes Aggregate demand and π denotes inflation:

$$MS \uparrow \gg r \downarrow \gg C \uparrow (Inv \uparrow) \gg AD \uparrow \gg \pi \uparrow$$

$$MS \downarrow \gg r \uparrow \gg C \downarrow (Inv \downarrow) \gg AD \downarrow \gg \pi \downarrow$$

Therefore, in the context of interest rate targeting monetary policy framework, the central bank's actions are expected to cause changes in short-term money market interest rates, such as interbank market rates, and subsequently affect retail rates for loans and deposits (Mishkin, 1999). A faster and more symmetric interest rate pass-through is not only crucial in explaining the effectiveness of the monetary policy transmission mechanism, but may also help to create a more functional, competitive, and efficient financial system (Taylor, 1995, Bernanke and Blinder, 1992).

3.2 Some Empirical Considerations

Several key messages can be drawn from the empirical review of the literature regarding the effectiveness of monetary policy transmission mechanisms across countries and over time.

First, the empirical literature shows that the monetary policy transmission mechanism is complex and context-dependent, with no one-size-fits-all model that can be applied across countries and periods. The effectiveness of monetary policy transmission mechanisms varies across countries, and this is largely attributed to differences in economic structures, financial systems, policy frameworks, and institutional arrangements.

Several studies have identified that interest rates are a reliable indicator of monetary policy actions and a useful measure for policy changes in developed countries. For example, Bernanke and Blinder (1992) suggest that changes in the interest rate on Federal funds have a significant impact on explaining future movements of underlying macroeconomic variables such as lending rates, deposit rates, and other macroeconomic variables in the US. A similar conclusion is also reached by Gregor and Melecky (2018) for the Czech Republic, Grigoli and Mota (2015) who find a full pass-through to deposit and lending rates in the case of the Dominican economy, Egert, B., et al (2007) for Czech Rep and Spain, Mojon (2000), Muller-Spahn (2008) for the case of Germany as well as Gambacorta (2004) for Italy.

Conversely, the transmission of monetary policy changes from the policy rate to commercial bank interest rates and the overall economy is incomplete and weak in most developing and emerging market economies. This is confirmed by Tai et al. (2012) who find that the rate of transmission from money market rates to deposit and lending rates was moderate and sluggish across economies in Asia. A similar conclusion is reached by Dube and Zhou (2014) for the case of South Africa, Kigabo and Mwenese (2016) and Davoodi et al (2013) for East Africa as a region, Ngoma and Chanda (2022) for the case of Zambia, Sande and Apaa Okello (2013) for Uganda, Misati et al. (2011) for Kenya, Kigabo (2018) for Rwanda as well as Mbowe (2015) and Bashagi et al (2019) the case of Tanzania. Indeed, several factors have been identified as contributing to the incomplete pass-through, including weak market structure, limited bank competition, limited financial development, and volatile exchange rate movements.

In addition, the literature suggests that the choice of variable to represent monetary policy stance for estimating the interest rate pass-through and transmission varies across studies. For example, Misati et al. (2011) and Mbowe (2015) used changes in the 91-day Treasury bills rate as a proxy for monetary policy rate changes for Kenya and Tanzania respectively, while Ngoma and Chanda (2022) used Zambia's interbank rate and Kigabo and Mwenese (2016) used Rwanda's repo rate. On the other hand, Bashagi et al (2019) used average reserve money as an operating target in estimating monetary policy transmission in Tanzania. Importantly, the choice of policy rate and variable to represent monetary policy stance may depend on the

specific country's monetary policy framework and operating procedures. Nevertheless, the literature generally agrees that a more comprehensive understanding of the interest rate transmission process and its effectiveness is necessary to make informed decisions on the choice of monetary policy variable.

In the same vein, the literature review has shown that studies have employed various estimation techniques to assess the pass-through of monetary policy rates to lending rates and examine the impact of changes in monetary policy on key macroeconomic variables. These techniques include ARDL, VECM, SUR, and BVAR. Structural VAR has been widely used to analyze the transmission of monetary policy to output and prices.

Table 1 summarizes selected empirical literature on deposit rate pass-through and **Table 2** summarizes selected empirical literature on lending rate pass-through from selected literature across different economies:

Table 1: Selected Literature on the Pass-through from Policy Rate to Deposit Rates

Zone	Country	Study	Method	Immediate pass-through (%)	Long run	Speed of Adjustment	Reference Rate
Advanced Economies	Czech Rep	Egert, B., et al (2007)	ARDL & DOLS	0.74**	0.79**	na	Policy rate
	Germany	Mojon (2000)	ECM	0.82***	1.00***	na	Interbank rate
	Spain	Egert, B., et al (2007)	ARDL & DOLS	0.91***	0.97**	na	Policy rate
Emerging market economies	China	Tai, P. N.,et al. (2012)	SUR	0.28***	0.38***	na	Interbank rate
	Malaysia	Tai, P. N.,et al. (2012)	SUR	0.74***	0.69***	na	Interbank rate
Developing countries	Kenya	Misati et al. (2011)	ECM	0.07	na	na	91-day Tbill
	Uganda	Sande, D., & Apaa Okello, J. (2013)	ECM	0.57*	na	-0.55*	7-day interbank rate
	Rwanda	Kigabo, T. R., and Mwenese, B. (2016)..	ARDL	0.33*	-0.3*	na	Repo rate
	Zambia	Ngoma, C., & Chanda, C. (2022)	VECM	0.09***	0.62	-0.09***	Interbank rate
	Tanzania	Mbowe, W.E. (2015)	ECM	0.03	-0.15	-0.15***	Overall Tbill rate

Notes: *, **, and *** means statistically significant at 10%, 5% and 1% respectively.
ARDL: Autoregressive Distributed Lag, DOLS: Dynamic Ordinary Least Squares, ECM: Error Correction Model, SUR: Seemingly Unrelated Regression, VECM: Vector Error Correction
Source: Author's Review of Literature

Table 2: Selected Literature on the Pass-through from Policy Rate to Lending Rates

Zone	Country	Study	Method	Immediate pass-through (%)	Long run	Speed of Adjustment	Reference Rate
Advanced Economies	Italy	Gambacorta (2004)	VECM	0.88***	1.01***	na	Policy rate
	Germany	Muller-Spahn (2008)	ECM	0.79***	0.94***	na	Policy rate
	Spain	Egert, B., et al (2007)	ARDL & DOLS	na	0.68***	na	Policy rate
Emerging market economies	China	Tai, P. N.,et al. (2012)	SUR	0.18938***	0.270825***	na	Interbank rate
	Malaysia	Tai, P. N.,et al. (2012)	SUR	0.470218***	0.480312***	na	Interbank rate
	South Africa	Dube, S., & Zhou, Y. (2014)	ARDL	0.85***	0.9***	-0.09***	Repo rate
Developing countries	Kenya	Misati et al. (2011)	ECM	0.14	na	na	91-day Tbill
	Uganda	Sande, D., & Apaa Okello, J. (2013)	ECM	0.43*	na	-0.22*	7-day interbank rate
	Rwanda	Kigabo, T. R., and Mwenese, B. (2016).	ARDL	0.01	-0.19	na	Repo rate
	Zambia	Ngoma, C., & Chanda, C. (2022)	VECM	0.03	0.40	-0.1	Interbank rate
	Tanzania	Mbowe, W.E. (2015)	ECM	0.00	-0.01	-0.25	Overall Tbill rate

Notes: *, ** and *** means statistically significant at 10%, 5% and 1% respectively.
ARDL: Autoregressive Distributed Lag, **DOLS**: Dynamic Ordinary Least Squares, **ECM**: Error Correction Model, **SUR**: Seemingly Unrelated Regression, **VECM**: Vector Error Correction
Source: Author's Review of Literature

Therefore, the empirical analysis of literature on the monetary policy transmission mechanism suggests that the transmission mechanism varies across countries and over time, and there is no one-size-fits-all model that can be applied across countries. In this regard, it is crucial to conduct country-specific studies to determine the strength of the interest rate channel via which monetary policy shocks are transmitted to the economy.

The motivation for the present study in Tanzania also stems from gaps found in previous empirical research. Specifically, Mbowe (2015) found a weak pass-through from policy rates to deposit rates in Tanzania. However, the study used monthly data until 2012, before the introduction of the hybrid monetary policy framework in 2016. Additionally, it did not explicitly analyze the transmission from interest rates to output and prices. Therefore, a new study is needed to fill the gaps by using fresh data and a different methodology. Similarly, Bashagi et al (2019) found weak transmission from monetary policy to output and prices in Tanzania using average reserve money as an operating target. However, this study did not explore the efficacy of interest rates in explaining variations in output and prices. Hence, the current study aims to address these gaps and provide a better understanding of monetary policy transmission in Tanzania.

4.0 Methodology

4.1 Modelling Strategy

To address the study objectives, two modelling strategies are implemented.

i. Interest Rate Pass-through

The interest rate pass-through in Tanzania is examined using a marginal pricing model, which is based on the approach of Borio (1997), De Bondt (2002) and Tieman (2004). The model is simple and intuitive, easy to understand and apply, and provides a straightforward way to assess the effectiveness of monetary policy transmission, while also allowing for the inclusion of additional variables in the analysis. According to the model, a bank sets its interest rate to match the marginal cost of financing. This cost is represented by both a market interest rate and a fixed markup such that

$$i_t^m = \alpha + \beta_1 i_t^p + \varepsilon_t, \quad (1)$$

where i_t^m denotes the endogenously determined retail rate at time *t* that can either be deposit or lending rates, α is the markup or mark-down on the retail rate, β_1 represents the pass-through parameter, i_t^p represents the interest rate which is set by the monetary authority. The pass-through is effectively complete when β_1=1. When β_1 is significantly less than one, then the pass-through is considered incomplete due to market imperfections and the presence of information asymmetric (Tieman, 2004).

Equation (1) portrays a long-term association between these variables and disregards the fact that in developing countries, market rates do not react immediately to changes in the policy rate. In reality, market rates gradually adjust to the new policy rates, this is illustrated by utilising Equation (2) as the long-run relationship, with short-term dynamics being prevalent.

To facilitate a gradual adaptation of market rates to the new policy rates, equation (2) is considered as the long-term relationship that also accommodates short-term changes. This applies to error correction models that are associated with the concept of cointegration.

$$\Delta i_t^m = \gamma_1 + \gamma_2 \Delta i_{t-1}^m + \gamma_4 (i_{t-1}^m - \beta_1 i_{t-1}^p - \alpha) + \nu_t \quad (2)$$

where Δ represents the first difference operator, γ_2 is the measure of short-run pass-through, β_1 is the degree of long-run pass-through. The coefficient γ_4 in an Error Correction Model denotes the pace at which short-run dynamics adjust to the long-run equilibrium condition and

is expected to bear a negative sign. A larger value of this coefficient indicates a faster market response to the policy rate. (Tieman, 2004).

The Autoregressive Distributed Lag (ARDL) estimation technique is employed to estimate the short-run and long-run coefficients by regressing the dependent variable (monetary policy rate) against the explanatory variables. The short-run coefficients are estimated using the first difference of the variables, while the long-run coefficients are computed using the error correction term. The ARDL technique can accommodate variables that are both stationary and non-stationary. Additionally, the technique is relatively easy to implement, making it a popular choice in econometric analysis. The Wald test is then used to determine whether these coefficients are statistically significant. This test determines whether the short-run and long-run coefficients of the monetary policy rate are jointly significantly different from zero. If the test statistic is smaller than the critical value, the null hypothesis that all coefficients are zero is rejected, indicating that the coefficients of the interest rate pass-through are statistically significant.

ii. Transmission to Output and Prices

The Structural Vector Autoregressive Model (SVAR) is utilized to examine the monetary transmission mechanism through the interest rate channel to the overall economy and prices during the study period. The VAR modelling was originally used by Sims (1980) and later extended as SVARs to help improve the model parameter estimates, eliminate the dimensionality problem, and improve out-of-sample forecasting (Miranda-Agrippino and Ricco, 2018). The reason for selecting the SVAR model for the study is also due to its widespread usage in the literature even in the context of Tanzania. The Tanzanian economy can thus be described by the following general SVAR model:

$$A_0 Y_t = A_1(L) Y_{t-1} + B\varepsilon_t \ , \tag{3}$$

where the Y_t is $n \times 1$ represents a vector of endogenous macroeconomic variables; A_0 and B represent $(n \times n)$ a vector of parameters of the model; $A_1(L) = \sum_{i=1}^{n} A_{1i} L^i$ represent the matrix of a polynomial in the lag operator, and ε_t denotes a $(n \times 1)$ vector of structural disturbances. A reduced form VAR of the structural model in eq (3) can be obtained by multiplying equation (3) by A_0^{-1}, which generates equation (4),

$$Y_t = C(L) Y_{t-1} + u_t \, , \tag{4}$$

where $C(L) = A_0^{-1}A_1(L)$; $u_t\ \varepsilon_t$ denote a vector of reduced form residual, namely $A_0^{-1}B\varepsilon_t$, The SVAR system has the following relationships in condensed representation:

$$A_0 u_t = B\varepsilon_t . \tag{5}$$

Equation (5) is known as the AB model where A_0 is $(n \times n)$ represents a matrix of contemporaneous relationships between endogenous variables; B is $(n \times n)$ that linearly relates SVAR residuals to the structural innovations, u_t is a vector of reduced-form residual, presumed to be white noise., and ε_t is a vector of structural shocks.

The Bank of Tanzania's primary monetary policy objectives is represented by the first two variables, the GDP and consumer price index (CPI). The other two domestic variables are the repo rate (*rp_i*), which is used as a measure of policy stance, and the nominal effective exchange rate (neer)-which is the main endogenous variable in the model. Since Tanzania is a small open economy that is affected by global developments, foreign variables are represented by global oil prices (*woil*) and the US Federal funds rate (*i_fed*).

In this regard, a six-variable SVAR model can be specified as follows:

$$Y_t\left(woil, i_{fed}, gdp, cpi, rp_i, neer\right). \tag{6}$$

The standard SVAR model is represented as

$$A_0 \begin{bmatrix} u_{woil} \\ u_{i\_fed} \\ u_{gdp} \\ u_{cpi} \\ u_{rp\_i} \\ u_{neer} \end{bmatrix} = B \begin{bmatrix} \varepsilon_{woil} \\ \varepsilon_{i\_fed} \\ \varepsilon_{gdp} \\ \varepsilon_{cpi} \\ \varepsilon_{rp\_i} \\ \varepsilon_{neer} \end{bmatrix}. \tag{7}$$

The identification scheme of the contemporaneous matrix (A_0) is represented in matrix form as

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ \alpha_{21} & 1 & 0 & 0 & 0 & 0 \\ \alpha_{31} & 0 & 1 & 0 & 0 & 0 \\ \alpha_{41} & 0 & \alpha_{43} & 1 & 0 & 0 \\ 0 & 0 & \alpha_{53} & \alpha_{54} & 1 & \alpha_{56} \\ \alpha_{61} & \alpha_{62} & \alpha_{63} & \alpha_{64} & \alpha_{65} & 1 \end{bmatrix} \begin{bmatrix} u_{woil} \\ u_{i\_fed} \\ u_{gdp} \\ u_{cpi} \\ u_{rp\_i} \\ u_{neer} \end{bmatrix} \begin{bmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & b_{66} \end{bmatrix} \begin{bmatrix} \varepsilon_{woil} \\ \varepsilon_{i\_fed} \\ \varepsilon_{gdp} \\ \varepsilon_{cpi} \\ \varepsilon_{rp\_i} \\ \varepsilon_{neer} \end{bmatrix} \tag{8}$$

The first identification relates to foreign variables; here, the global oil prices are assumed to be completely exogenous, i.e., international oil prices are simultaneously influenced by factors that are not included in the designated model. In the second identification, changes in the price of oil throughout the world are assumed to immediately affect US monetary policy (the Fed's fund rate). In the third identification, the output equation is contemporaneously impacted by the price of oil but is assumed to react slowly to other price and financial signals (such as the interest rate and exchange rate). In the fourth identification, the price equation is assumed to be contemporaneously affected by GDP and inflationary pressure coming from the international oil price. The monetary policy response function, the sixth identification in this model, is changed to adhere to the Taylor rule, which states that the policy interest rate (rp_i) responds contemporaneously to domestic prices (cpi), output (gdp), and exchange rates (neer). As a result, all model variables, except for the foreign variables, have an immediate impact on monetary policy. The nominal exchange rate is depicted in the final row and is thought to be the most endogenous variable in the model-impacted contemporaneously by all SVAR system variables.

The impulse response function and forecast error variance decomposition are used as tools of analysis in this study. From the AB SVAR model that is estimated by ordinary least squares, the impulse response function (IRF) allows us to study the monetary policy transmission mechanism by showing the effects of the VAR system on monetary policy shocks or impulses. While keeping all other variables and shocks constant, the IRFs demonstrate the effects of a one-unit or one-standard-deviation shock to an endogenous variable on all the other endogenous variables in a VAR system (Sims (1980). The IRFs from the VAR are usually presented in conjunction with a confidence interval band. The bottom band is created at the 10th percentile of 1000 bootstrap simulations, while the upper band is created at the 90th percentile for the VAR. While the impulse response functions concentrate on analyzing the effect of a shock of a specific variable on the other variables in a VAR model, the forecast error variance decomposition offers insights into the comparative significance of each shock that hits the VAR system in describing the variability of each variable in the model at various time horizons (Sims (1980).

4.2 Data Definition, Sources and Preliminary Tests

To estimate the models described in section 4(b), the study employs quarterly data from the first quarter of 2002 to the third quarter of 2022 since GDP is available only at a quarterly and annual frequency. The period is chosen based on two facts. First, published quarterly data on disaggregated interest rate structure of Tanzania start from 2002 onwards. Second, the period captures well the era of monetary targeting framework and a hybrid interest rate smoothing that started in 2016 to date.

i. Choice of Policy Rate

As described in the literature review section, various proxies of policy rate (reference rate) have been employed to investigate the transmission mechanism when there is no active policy rate. For example, Misati et al. (2011) employed the 91-day Treasury bill rate for Kenya, whereas Mbowe (2015) used the overall Treasury bill rate for Tanzania. Ngoma and Chanda (2022) used Zambia's interbank rate, whereas Kigabo and Mwenese (2016) used Rwanda's repo rate. In this study, the repo rate is used as a proxy for the policy rate. The repo rate is used as a proxy for the policy rate because it is the rate at which the Bank of Tanzania lends money to commercial banks, and changes in the repo rate are typically transmitted to other money market rates and deposit and lending rates. Therefore, the repo rate is a useful indicator of monetary policy actions and their impact on the economy through the interest rate channel.

ii. Definition and Sources of Data

Table 3: List of Variables

Abbreviation	Variable	Units	Where applicable	Source
RP_I	Repo rate	Percent	All sections	BOT
OI_IBCM	Overnight IBCM rate	Percent	Interest rate pass-through section	BOT
SI_IBCM	7-day IBCM rate	Percent	Interest rate pass-through section	BOT
STI_DR	Short-term deposit rate	Percent	Interest rate pass-through section	BOT
LTI_DR	Long-term deposit rate	Percent	Interest rate pass-through section	BOT
STI_LR	Short-term lending rate	Percent	Interest rate pass-through section	BOT
LTI_LR	Long-term lending rate	Percent	Interest rate pass-through section	BOT
TBILL_91_DAYS	91-day Treasury bills rate	Percent	Sensitivity analysis	BOT
WOIL	World oil price	USD per barrel	Transmission to output and price	World Bank
I_FED	Fed funds rate	Percent	Transmission to output and price	IMF
GDP	Gross domestic product	Billions of TZS	Transmission to output and price	NBS
CPI	Consumer Price Index	Index	Transmission to output and price	NBS
NEER	Nominal Effective Exchange rate	Index	Transmission to output and price	BOT

iii. Preliminary Tests

a) Diagnostic Test for Normality and Break Points

Diagnostic tests were performed for all variables to determine normality and possible breaks in the data to ensure that variables have good statistical properties, failure of which could lead to spurious regression results. **Table 4** below shows the results of the normality test and structural brakes for all variables. As depicted in **Table 4**, the P-value of the Jarque-Bera statistics indicated that 9 out of the 13 variables were normally distributed. Further investigation revealed that three variables i.e log of CPI, short-term lending rate, nominal effective exchange rate, and Fed's fund rate that were not normally distributed contained breaks which were detected by the Bai-Perron test (Bai and Perron, 1998; Perron, 2006).

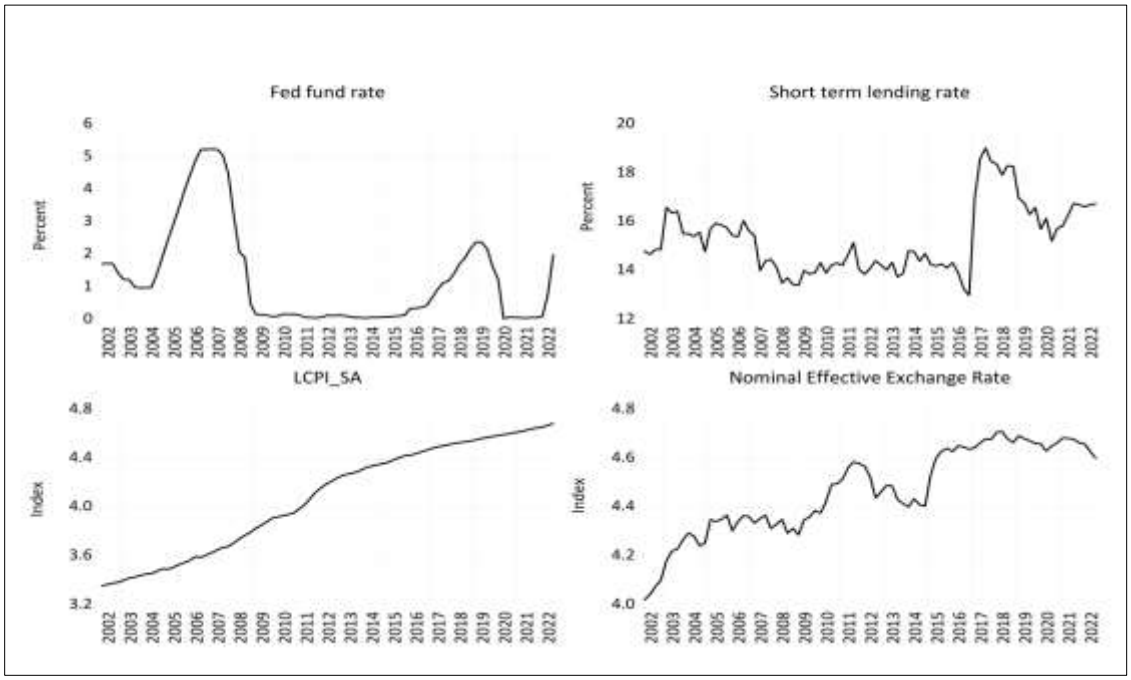
Table 4: Results for Normality and Structural breaks test

	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability (P-value)	Structural break?	Break period
LTI_LR	1.33	0.20	2.24	2.27	0.32		
RP_I	1.21	-0.39	2.46	2.44	0.29		
STI_DR	2.00	-0.12	2.08	3.09	0.21		
LTI_DR	2.33	-0.02	2.02	3.29	0.19		
OI_IBCM	2.53	0.49	2.46	3.41	0.18		
TBILL_91_DAYS	3.87	0.29	1.69	7.02	0.03		
LWOIL	0.43	-0.43	2.44	3.55	0.17		
LGDP_SA	0.39	-0.03	1.81	5.07	0.08		
SI_IBCM	3.23	0.67	2.64	5.97	0.05		
LNEER	0.18	-0.39	2.28	3.85	0.15	YES	2015Q2
LCPI_SA	0.44	-0.23	1.53	8.10	0.02	YES	2012Q4
STI_LR	1.40	0.82	3.01	9.08	0.01	YES	2017Q2
I_FED	1.54	1.39	3.93	29.47	0.00	YES	2008Q1

Note: Jarque-Bera: HO: The variable is normal, If the probability value p ≥ 0,05, then the assumption of normality is fulfilled; (ii) If probability p < 0,05, then the assumption of normality is not fulfilled.
Source: Author's computations in E-views

The observed break for the fed funds rate in 2008Q1 is associated with the onset of the global financial crisis while that of CPI in 2012Q4 is attributed to the beginning of a low inflation regime. Regarding the short-term lending rate, the break in 2017Q2 indicates a heightened risk premium linked to the increase in non-performing loans and other underlying factors while the break of the nominal effective exchange rate in 2015Q2 is attributed to high depreciation in the nominal exchange rate during the period, as shown in **Figure 7**. The abnormalities were corrected by introducing dummies in regressions that involved variables with structural brakes. Figure 7 illustrates variables with Structural Breaks.

Figure 7: Variables with Structural Breaks



Source: Author's computations in E-views

b) Stationarity Test for Variables

Standard unit root tests were used to test for stationarity of the variables[1], except for the feds funds rate, short-term lending rate, log of nominal effective exchange rate and log of CPI, where unit root with break test was used. All tests brought almost similar results, with most of the variables being stationary after first differencing, i.e., integrated of order one I(1). Some variables, however, were stationary at levels I(0), these include the 7-day and overnight IBCM rate, short-term and long-term lending interest rates, and repo rate, as per ADF and PP test. On the other hand, the KPSS test results indicated world oil price, treasury bond and treasury bill rate to be stationary at levels. **Table 5** shows the results of the stationarity test for all variables.

Table 5: Results of the Stationarity Tests

	ADF			PP			KPSS		
	Levels	**1st Difference**	**I(d)**	**Levels**	**1st Difference**	**I(d)**	**Levels**	**1st Difference**	**I(d)**
lgdp_sa	-1.521179	-7.119204	I(1)	-2.111446	-17.8131	I(1)	1.262534	0.296678***	I(1)
lwoil	-2.562231	-7.62441***	I(1)	-2.623201*	-7.529684***	I(1)	0.324478***	0.141938***	I(0)
oi_ibcm	-3.072405**	-5.555765***	I(0)	-3.072405**	-9.547878***	I(0)	0.257302***	0.192428***	I(0)
si_ibcm	-3.58626***	-6.155888***	I(0)	-3.60330***	-8.132279***	I(0)	0.172055***	0.130988***	I(0)
tbill_91_days	-1.703518	-8.603680***	I(1)	-2.202712	-8.317939***	I(1)	0.371815***	0.196571	I(0)
lti_lr	-0.872146	-6.241322***	I(1)	-3.039781**	-8.187456***	I(0)	0.221634	0.126092	I(0)
lti_dr	-2.309821	-10.26194***	I(1)	-2.210691	-10.26194***	I(1)	0.775221	0.047879**	I(1)
sti_dr	-2.147679	-5.996497***	I(1)	-1.774177	-5.801392***	I(1)	0.586341	0.128412***	I(1)
rp_i	-3.352364*	-6.648545***	I(0)	-3.374072**	-6.65078***	I(0)	0.185043***	0.142391***	I(0)
lcpi_sa	-3.844476	-5.49358***	I(1)						
sti_lr	-4.757818	-10.44606***	I(1)						
i*fed	-1.283393	-7.689221***	I(1)						
lneer	-4.366829*	-8.219049***	I(1)						

Note: *, ** and *** means statistically significant at 10%, 5% and 1% respectively.
Source: Author's computations in E-views

The results of the stationarity tests guided us on the model to be used for the estimation of the pass-through equations. Thus, due to the presence of I(0) and I(1) interest rate series, the empirical models for the interest rate pass-through are estimated by the Autoregressive Distributed Lag (ARDL) method to determine short-run and the long-run relationships among the variables[2].

[1] Standard unit root test includes, Augmented Dickey-Fuller(ADF), Phillip-Peron(PP) and Kwiatkowski-Phillips-Schmidt-Shin test (KPSS) statistic

[2] Cointegration was performed using the Johansen Cointegration Test and Bounds test for cointegration proposed by Pesaran, Shin and Smith (2001).

5.0 Empirical Analysis

5.1 Interest rate Pass-through

i. Pass-through from Policy Rate to Interbank Market Interest Rates

The first step in the interest rate pass-through process is the transmission of the policy rate to the money market (interbank) rates. As stated in section 4 (a) (i), since the policy rate and interbank market interest rates were all stationary in levels i.e. I (0), only short-run coefficients were estimated by the ARDL technique. The robustness of the results of the estimated ARDL model was confirmed by stability test using CUSUM of square test in addition to conventional residual diagnostic tests[3].

According to the findings as presented in **Table 6**, the interest rate pass-through from monetary policy rates to interbank market interest rates is extremely high and statistically significant. This finding is similar to that of Mbowe (2015) in the case of Tanzania. The short-run elasticities have positive signs as predicted. The results further show that the 7-day interbank rate is highly sensitive to changes in policy rates compared with an overnight interbank rate, exhibiting even an overshooting pass-through of 1.08 and 1.37 with the policy rate. The coefficient of error correction term although carrying the expected sign is statistically insignificant for both interbank rates implying no long-run (level) or counteracting relationship with the policy rate.

Given the fact that the pass-through of the policy rate to the interbank rate is the first step in the entire monetary policy pass-through process to retail short and long-term commercial bank interest rates, the outcome of the complete pass-through of the repo rate to the interbank rates is a very interesting piece of information[4]. Moreover, the overshooting pass-through of the 7-day interbank rate suggests that the 7-day interbank rate could be considered an operational target during the implementation of monetary policy.

[3] Residual diagnostic tests include Breusch-Godfrey serial correlation LM test, heteroscedasticity test (ARCH test), Jarque-Bera for normality and Ramsey Reset specification tests.

[4] The wald test statistic confirm that the short-run coefficients of 0.96 and 1.17 for the overnight and 7-day interbank rates are not statistically different from 1.

Table 6: Pass-through to Interbank Market Interest Rates

	Dependent variable: Overnight IBCM rate Independent variable: policy rate (repo rate)	**Dependent variable: 7-day IBCM rate Independent variable: policy rate (repo rate)**	
Estimation method	**ARDL**	**ARDL**	
	ARDL 1	**ARDL 2**	**ARDL 3**
Lag length selection criteria (information criteria)	SC	SC	AIC
Leads/lags (ARDL)	1	1	3
***F*-Test Statistics**	46.82357***	30.77337***	14.70157***
Constant	0.052176	5.520089	14.06709**
Short-run coefficient	0.955577***	1.080522***	1.373419***
Error correction term (ECT)	-0.084948	-0.163514	-0.182276
Autocorrelation (*p*-value)	0.931	0.0881	0.9013
Normality (*p*-value)	0.002353	0.04384	0.0002
Heteroscedasticity (p-value)	0.6289	0.1893	0.8706

Note: *, ** and *** means statistically significant at 10%, 5% and 1% respectively.
Source: Author's computations in E-views

ii. Pass-through to Short and Long Term Deposit Rates

The second step involves the interest rate pass-through from the money market-interbank rate to deposit and lending rates based on marginal cost financing theory as explained by Borio (1997), De Bondt (2002) and Tieman (2004). When the interbank rate changes, banks adjust their cost of funds, which in turn affects their deposit and lending rates. The ADF, PP and KPSS stationarity test indicated the policy rate to be I(0) while short-term and long-term deposit rates were I(I), thus, the cointegration test for the said variables was performed using the Bounds test for cointegration proposed by Pesaran, Shin and Smith (2001). The results of the cointegration test prompted us to apply the ARDL model to estimate both the short and long-run coefficients as proposed by Keele and De Boef, 2004.

The SIC (Schwarz Information Criterion) and AIC (Akaike Information Criterion) criteria are used to compare statistical models based on ideal lag structure. The model with the lowest value of either criterion is chosen, which indicates the best balance between model complexity and explanatory power. The stability of the results of the estimated ARDL model was confirmed by the CUSUM test and the CUSUM of the square test. On the other hand, residual diagnostic tests were performed using Breusch-Godfrey serial correlation LM test, heteroscedasticity test (ARCH test) and Jarque-Bera for normality test.

For the case of pass-through to short-term deposit rate, an ARDL regression model 1 in **Table 7** indicates that one percentage point change in the policy rate leads to a change in short-term deposit rates by 0.14 percentage points. Thus, the study found evidence of a short-run incomplete pass-through of the policy rate to short-term deposit rates, which was confirmed by the Wald test. The null hypothesis of the test was that the coefficient of pass-through (0.14) is statistically different from one. In this case, the null hypothesis was not rejected. In the long run, the coefficient of the pass-through from IBCM to the short-term deposit rate is 0.58 and

statistically significant. This indicates that a one percentage point change in the 7-day IBCM rate translates to a change in short-term deposit rates by 0.58 percentage points in the long run. Despite being incomplete, the degree of pass-through to short-term deposit rates found in the current study (14.3 percent) is relatively higher than the 1.0 to 3.0 percent estimated by Mbowe (2015) suggesting an improvement in the transmission process. This finding could potentially support the adoption of an interest rate-based monetary policy framework in Tanzania as it suggests that the interest rate channel could be an effective tool for conveying monetary policy shocks to the overall economy. However, it is important to acknowledge that the existing framework still has limitations that need to be addressed to ensure the long-term effectiveness of monetary policy.

For the case of pass-through to long-term deposit rate, all pass-through coefficients from Policy rate and IBCM rate to long-term deposit rate were statistically insignificant. The coefficient of error correction term (ECT) which measures the speed of the pass-through to deposit rates from policy rates was negative as expected and statistically significant for all regressions for both short and long-term deposit rates.

Table 7: Pass-through to Deposit Rates

	Dependent variable: short term-deposit rate **Independent variable: policy rate (repo rate)**	**Dependent variable: short-term deposit rate** **Independent variable: 7-day IBCM rate**	**Dependent variable: long-term deposit rate** **Independent variable: policy rate (repo rate)**	**Dependent variable: long-term deposit rate** **Independent variable: 7-day IBCM rate**
Estimation method	**ARDL**	**ARDL**	**ARDL**	**ARDL**
Lag length selection criteria (information criteria)	SC&AIC	SC	SC&AIC	SC&AIC
Leads/lags (ARDL)	1	1	1	1
F-Test Statistics	546.3969***	121.0526***	109.2293***	104.5350***
Constant	-0.399481	2.759196	0.795586	3.309139
Long-run coefficient	6.114288	0.581341***	0.609677	0.880108
Short-run coefficient	0.142890***	0.02811	0.090354	0.058551
Error correction term (ECT)	-0.23370***	-0.245818***	-0.148200***	-0.096475***
Autocorrelation (*p*-value)	0.3177	0.064	0.5599	0.3084
Normality (*p*-value)	0.623169	0.4819	0.7347	0.790037
Heteroscedasticity (p-value)	0.2265	0.7355	0.1494	0.0871

Note: *, ** and *** means statistically significant at 10%, 5% and 1% respectively.
Source: Author's computations in E-views

iii. Pass-through to Short and Long-Term Lending Rates

As pointed out earlier, the short-term and long-term lending rates were integrated of order 1 and found to contain a structural break during the second quarter of 2017 associated with increased risk premiums due to a rise in non-performing loans and other structural factors. Thus, the short-run ARDL model was specified to also include the dummy variable to capture the non-normality of the data.

As presented in **Table 8**, except for the short-run coefficient of pass-through from the 7-day IBCM rate to the long-term lending rate, all other coefficients are statistically insignificant. The short-run coefficient of the pass-through from the 7-day IBCM rate to the long-term lending rate is 0.13 and statistically significant, indicating that one percentage point change in the 7-day IBCM rate translates into a change in long-term lending rates by 0.13 percentage points in the short run.

Similarly, coefficients of the long-run relationship were all statistically insignificant implying a missing link between policy interest rate, interbank rate and lending rates in the long run Tanzania.

The magnitudes of the error correction terms indicate a slow pace of adjustment of retail lending rates to their long-run equilibrium.

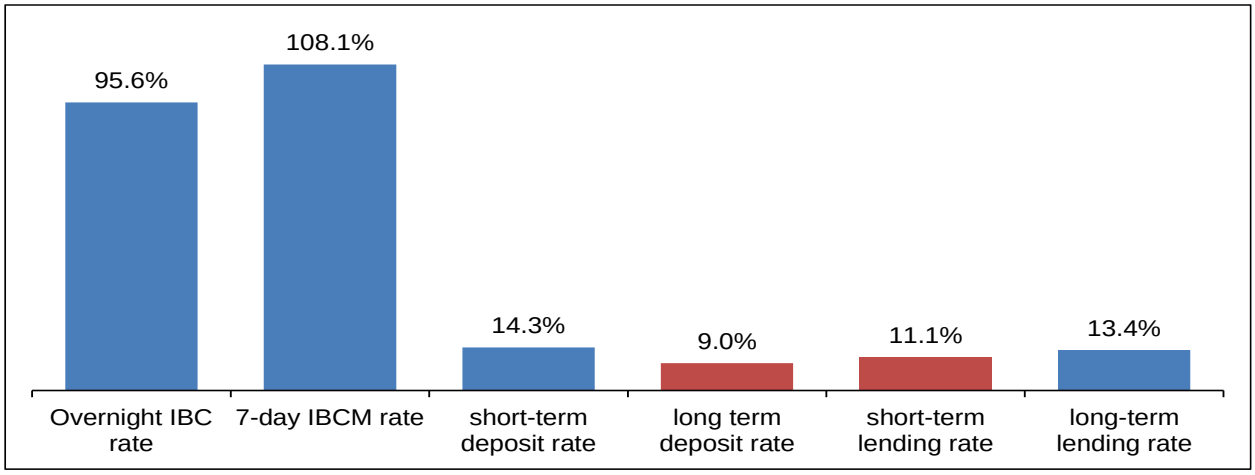
Table 8: Pass-through to Lending Rates

	Dependent variable: short term-lending rate **Independent variable: policy rate (repo rate)**	**Dependent variable: short-term lending rate** **Independent variable: 7-day IBCM rate**	**Dependent variable: long-term lending rate** **Independent variable: policy rate (repo rate)**	**Dependent variable: long-term lending rate** **Independent variable: 7-day IBCM rate**
Estimation method	**ARDL**	**ARDL**	**ARDL**	**ARDL**
Lag length selection criteria (information criteria)	AIC	SC&AIC	SC	SC
Leads/lags (ARDL)	2	1	2	1
F-Test Statistics	25.71249***	89.91926***	25.30576***	19.61247***
Constant	17.11230***	17.24618***	15.41361**	12.04096**
Long-run coefficient	-0.18892	-0.290119	-0.911919	0.178328
Short-run coefficient	0.110936	0.021913	0.084383	0.134061**
Error correction term (ECT)	-0.20809	-0.094406*	-0.115522**	-0.393277***
Autocorrelation (*p*-value)	0.3939	0.1136	0.3243	0.0775
Normality (*p*-value)	0.8713	0.000143	0.4784	0.8626
Heteroscedasticity (p-value)	0.4362	0.0275	0.0326	0.0461

Note: *, ** and *** means statistically significant at 10%, 5% and 1% respectively.
Source: Author's computations in E-views

The degree of short-run interest rate pass-through across the wholesale, as well as retail money markets in Tanzania based on the current study, can be further summarized in **Figure 8**.

Figure 8: Short-run Pass-through of the Policy Rate to IBCM, Deposit and Lending Rates



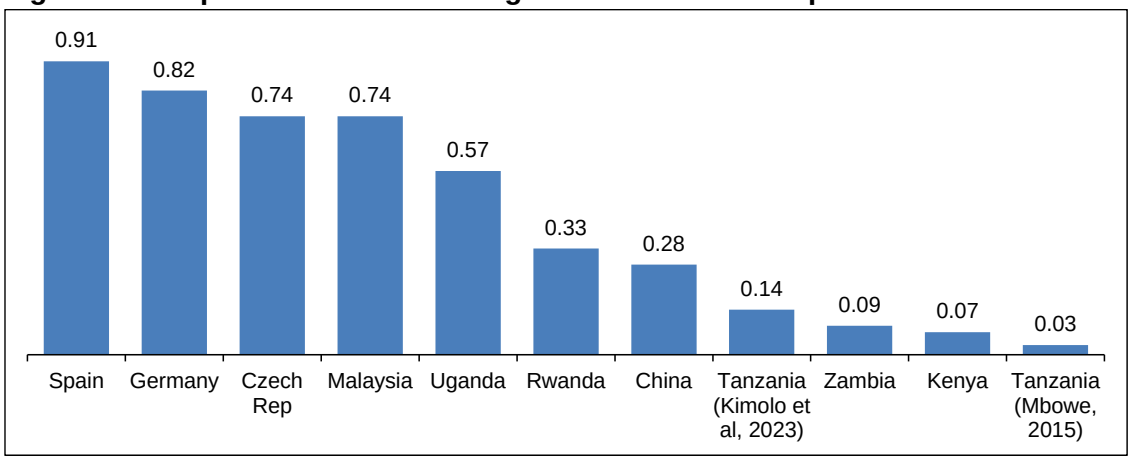
Note: Blue colour means statistically significant while red colour means statistically insignificant.
Source: Author's computations

i. Comparison of Passthrough coefficients with other countries

a. Comparison of Passthrough to Deposit Rate

Our results on the pass-through of policy rates to deposit rates confirm previous findings in the empirical literature that pass-through coefficients are typically very low in developing countries, but much higher for advanced economies, this is illustrated by **Figure 9**.

Figure 9: Comparison of Pass-through Coefficients for Deposit Rate

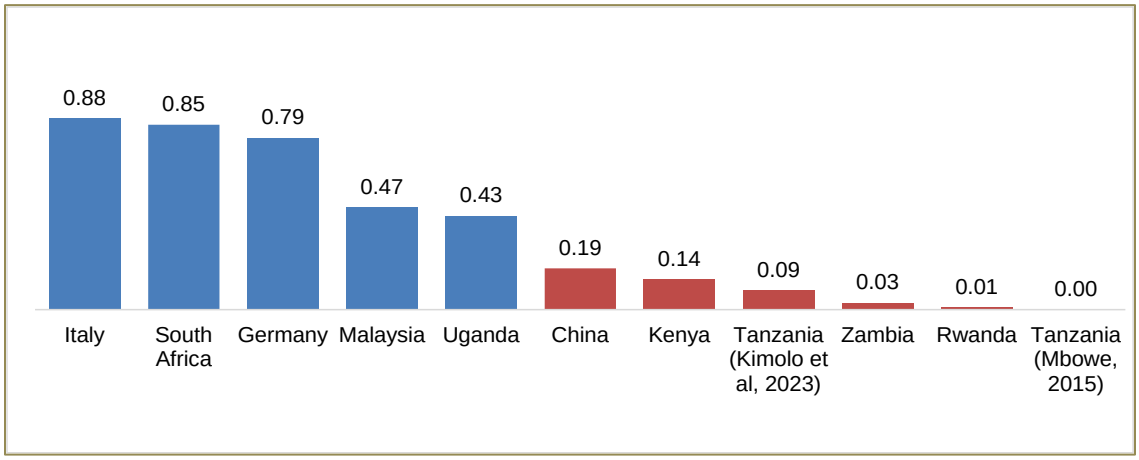


Note: Blue colour means statistically significant while red colour means statistically insignificant.
Source: Author's literature review by Egert, B., et al (2007) for Czech Rep, Mojon (2000) for Germany, Egert, B., et al (2007) for Spain, Tai, P. N., et al. (2012) for China; Tai, P. N., et al. (2012) for Malaysia; Misati et al. (2011) for Kenya; Sande, D., & Apaa Okello, J. (2013) for Uganda; Kigabo, T. R., and Mwenese, B. (2016) for Rwanda; Ngoma, C., & Chanda, C. (2022) for Zambia; and Mbowe, W.E. (2015) for Tanzania

b. Comparison of Pass-through to Lending Rates

Likewise, our results for the pass-through of policy rates to lending rates confirm previous findings in the literature missing link in developing countries, but the pass-through (as given by pass-through coefficients) is much higher for advanced economies, this in illustrated by **Figure 10**.

Figure 10: Comparison of Pass-through Coefficients for Lending Rates



Notes: Blue colour means statistically significant while red colour means statistically insignificant.
***Source*:** Author's literature review by Gambacorta (2004) for Italy; Muller-Spahn (2008) for Germany; Egert, B., et al (2007) for Spain; Tai, P. N., et al. (2012) for China; Tai, P. N., et al. (2012) for Malaysia; Dube, S., & Zhou, Y. (2014) for South Africa; Misati et al. (2011) for Kenya; Sande, D., & Apaa Okello, J. (2013) for Uganda; Kigabo, T. R., and Mwenese, B. (2016) for Rwanda; Ngoma, C., & Chanda, C. (2022) for Zambia; Mbowe, W.E. (2015) for Tanzania

ii. Sensitivity Analysis

A sensitivity analysis was conducted to assess the robustness of the results of a study by using the 91-day treasury bills rate as a proxy for the policy rate instead of the repo rate. A similar result of significant pass-through to IBCM was found (see **Table 9**). However, in terms of the magnitude, the pass-through from the repo rate to IBCM appears to be much stronger compared to the pass-through from treasury bills to IBCM rates.

Table 9: Pass-through from 91-day T bill to Interbank Market Interest Rates

Estimation method	Dependent variable: Overnight IBCM Independent variable: 91-day T-bills		Dependent variable: Seven-day IBCM Independent variable: 91-day T-bills)
	ARDL	**ARDL**	**ARDL**
Lag length selection criteria (information criteria)	AIC	SC	AIC&SC
Leads/lags (ARDL)	3	1	3
F-Test Statistics	13.15695***	27.66615***	28.51355***
Constant	2.049069***	2.187968***	2.194472*
Long-run coefficient	0.509614***	0.486347***	0.567899***
Short-run coefficient	0.512458***	0.353082***	0.719183***
Error correction term (ECT)	-0.725906***	-0.621673***	-0.378616***
Autocorrelation (*p*-value)	0.571	0.6396	0.7177
Normality (*p*-value)	0.003723	0.002886	0.000306
Heteroscedasticity (p-value)	0.2298	0.3717	0.1074

Note: *, ** and *** means statistically significant at 10%, 5% and 1% respectively.
Source: Author's computations in E-views

As illustrated by **Table 10**, for the case of pass-through to deposit rates, all short-run and long-run coefficients are not statistically significant.

Table 10: Pass-through from 91-day T bill to Deposit Rates

Estimation method	Dependent variable: Short-term deposit rate Independent variable: 91-day T-bills		Dependent variable: Long-term deposit rate Independent variable: 91-day T-bills)	
	ARDL		**ARDL**	**ARDL**
Lag length selection criteria (information criteria)	AIC	SC	AIC	SC
Leads/lags (ARDL)	3	2	3	1
F-Test Statistics	200.1535***	297.6371***	38.98295***	145.6177***
Constant	5.486208*	5.16342	8.091853***	6.436614***
Long-run coefficient	0.542313	0.602499	0.100245	0.267778
Short-run coefficient	0.001331	0.022818	-0.017944	-0.02085
Error correction term (ECT)	-0.047638**	-0.040799*	-0.10134*	-0.121669**
Autocorrelation (*p*-value)	0.434	0.7953	0.979	0.3981
Normality (*p*-value)	0.664403	0.823342	0.955886	0.467715
Heteroscedasticity (p-value)	0.0541	0.4962	0.7545	0.2687

Note: *, ** and *** means statistically significant at 10%, 5% and 1% respectively.
Source: Author's computations in E-views

Likewise, for the case of pass-through to short-term lending rate, as illustrated by **Table 11**, the short-run coefficients are statistically insignificant while the long-run coefficients though statistically significant bear unexpected signs. Unlike the repo rate, the short-run pass-through from the 91-day t bills rate to the long-term deposit rate appears to be statistically significant.

Table 11: Pass-through from 91-day T bill to Lending Rates

Estimation method	Dependent variable: Short-term lending rate Independent variable: 91 T-bills		Dependent variable: Long-term lending rate Independent variable: 91 T-bills)
	ARDL	**ARDL**	**ARDL**
Lag length selection criteria (information criteria)	AIC	SC	AIC
Leads/lags (ARDL)	3	1	3
F-Test Statistics	37.86032***	92.87222***	29.22499***
Constant	17.11392***	17.14566***	8.436352***
Long-run coefficient	-0.227292**	-0.229358*	0.127396
Short-run coefficient	-0.024135	-0.034486	0.133795**
Error correction term (ECT)	-0.19651***	-0.160489***	-0.227383***
Autocorrelation (*p*-value)	0.6052	0.2688	0.0899
Normality (*p*-value)	0	0	0.5106
Heteroscedasticity (p-value)	0.7962	0.5708	0.7433

Note: *, ** and *** means statistically significant at 10%, 5% and 1% respectively.
Source: Author's computations in E-views

5.2 Monetary Policy Transmission from Policy Rate to Output and Prices

As mentioned earlier, the key to a successful implementation of monetary policy is that the policy should exert a systematic influence on the economy in a forward-looking manner. Similarly, a well-functioning interest rate channel is critical for transmitting monetary policy stance to the economy, including the banking sector. Without a working interest rate channel, the central bank's ability to impact actual activities is constrained.

To analyse monetary policy transmission to output and prices as stated in section 5 (a) (ii) a six variable/dimensional structural VAR (SVAR) is employed. The variables included both foreign variables (world oil price, fed funds rate, and nominal effective exchange rate) and domestic variables (GDP, CPI, policy rate). In the SVAR model, the foreign variables are treated as endogenous, but they stay 'exogenous' in the sense that all domestic variables do not have any effect on foreign variables. As a result, there is only one direction of transmission—from the foreign block to the domestic block, not the other way around (Dungey and Pagan, 2009). Normal VAR is also employed in the current study to check the robustness of the results of structural VAR (SVAR) results.

The choice of the VAR lag length was based on standard lag length selection criteria (Akaike, Shwartz, Hannan-Quinn, Final Prediction Error, etc). A maximum lag length of one was found, which was also sufficient to render empirically well-behaved VAR with good residual diagnostics. The analysis of the transmission of monetary policy is based on the examination of impulse response functions as well as forecast error variance decomposition.

i. Impulse Response Functions

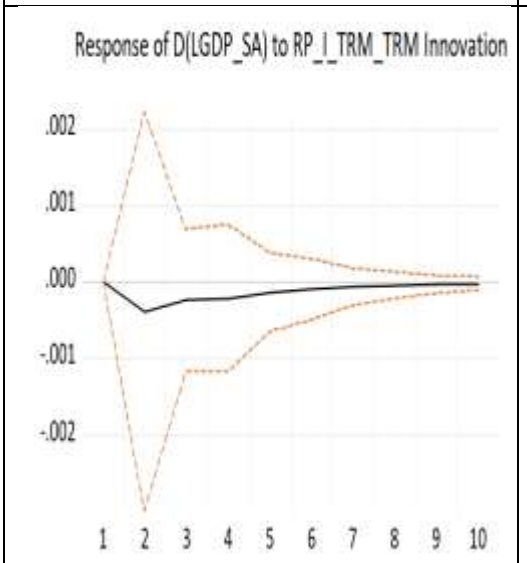
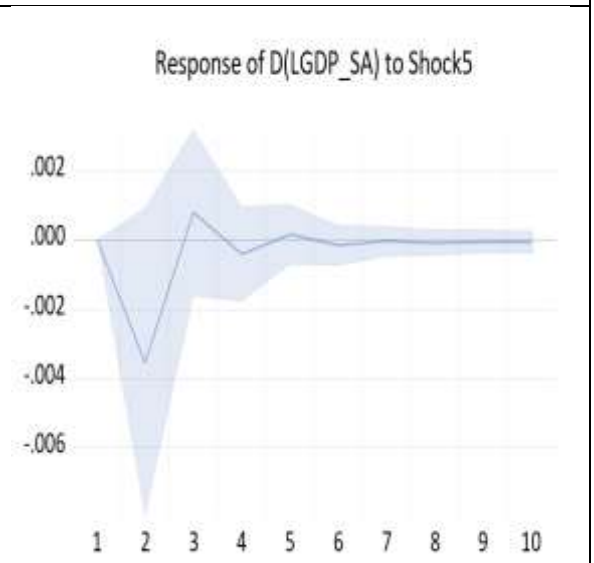
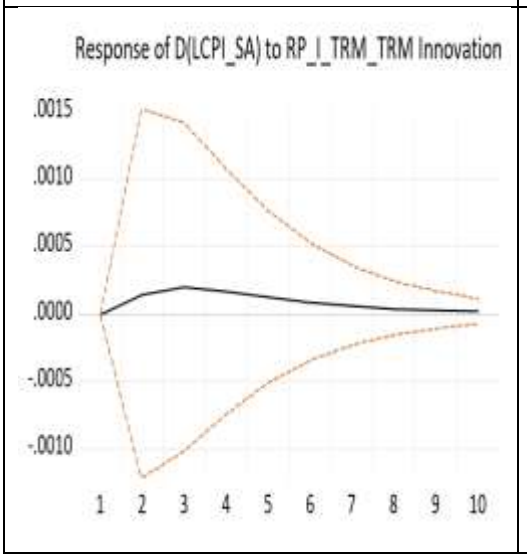
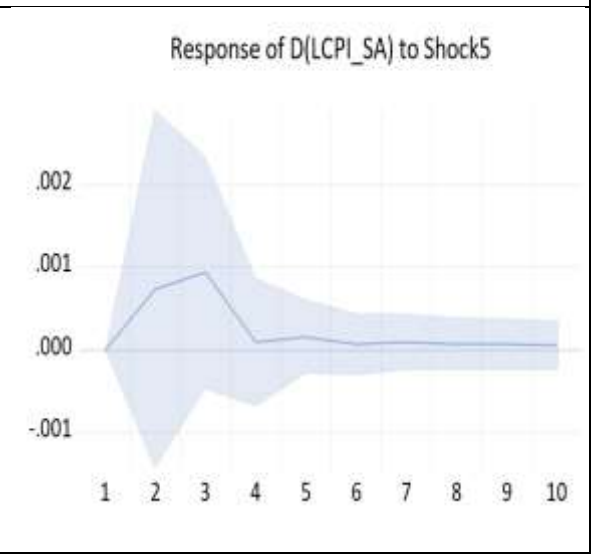
Figure 11 presents impulse response functions from our two basic models. For the case of GDP growth[5], using both models[6], the response of GDP growth (D(LGDP_SA)) to monetary policy shock (RP_I_TRM_TRM) is generally in line with the predictions of economic theory. An increase in interest rate (monetary tightening) has no response since it is not statistically significant. According to Figure 11, a positive shock in the policy rate is observed to cause GDP to fall after 1–2 quarters before gradually coming back to its steady state level at around the 8th quarter.

For the case of inflation (D(LCPI_SA)), both models[7], indicate the existence of a phenomenon known as the "price puzzle". This refers to the initial positive response of inflation to a contractionary monetary policy. Similar findings have been documented in various empirical studies, including the research conducted by Davoodi, Dixit, and Pinter (2013). Despite being observed in many studies, the underlying mechanisms behind the "price puzzle" are not well understood in the literature. Some researchers suggest that the "price puzzle" occurs because a contractionary monetary policy may lead to a temporary reduction in the output of goods and services, which in turn may lead to a temporary increase in prices (see Rusnák, Havranek, and Horváth, 2013). Other researchers suggest that the "price puzzle" occurs because financial markets may initially overreact to a central bank's policy actions, leading to a temporary increase in inflation (see Rusnák, Havranek, and Horváth, 2013). The confidence interval for all impulse responses for inflation includes zero which designates a weak monetary policy transmission mechanism in Tanzania.

A similar conclusion is reached for both unrestricted VAR and structural VAR models, that monetary policy transmission in Tanzania through the interest rate channel is ineffective (weak). A monetary policy shock via interest rate has no statistically significant impact on either inflation or real output growth, these findings are similar to the findings of Buigut (2009), Bashagi et al (2019), Balele et al. (2018), Mbowe (2015), Montiel et al. (2012) and Davoodi et al (2013).

[5] This is due to the fact that the lower bound confidence interval is below zero.
[6] GDP growth also reacts most strongly in the baseline VAR, and most weakly in the SVAR
[7] Inflation reacts most strongly in the baseline VAR, and most weakly in the SVAR

Figure 11: Impulse Response Functions

Normal VAR	Structural VAR
	
	

Source: Author's computations in E-views

ii. Forecast Error Variance Decompositions

Table 12 and **Figure 12** show the variance decomposition of GDP growth and inflation computed at forecast horizons of up to 10 quarters (2 and half years). **Table 12** indicates that the volatility in GDP growth and inflation is predominantly a result of their own innovations. After two quarters, 86 percent and 78 percent of the variance of GDP growth and inflation, respectively are explained by their own shocks. The variance decomposition for both models indicates that all variables are highly idiosyncratic even after 10 quarters.

Furthermore, the findings of the forecast error variance decomposition as indicated in **Table 12** demonstrate that the monetary policy shock has a greater impact on output variation than CPI variation in Tanzania. This can be clarified by the point that in the short term, the Bank of Tanzania takes into consideration the fact that cyclical fluctuations of the economy are expected to trigger upward or downward pressure on prices, thus contributing to the stabilisation of growth. The aim to stabilize economic activity is also related to the reason why the price stability objective is defined in the medium-term context, allowing a gradual response to certain shocks that affect prices.

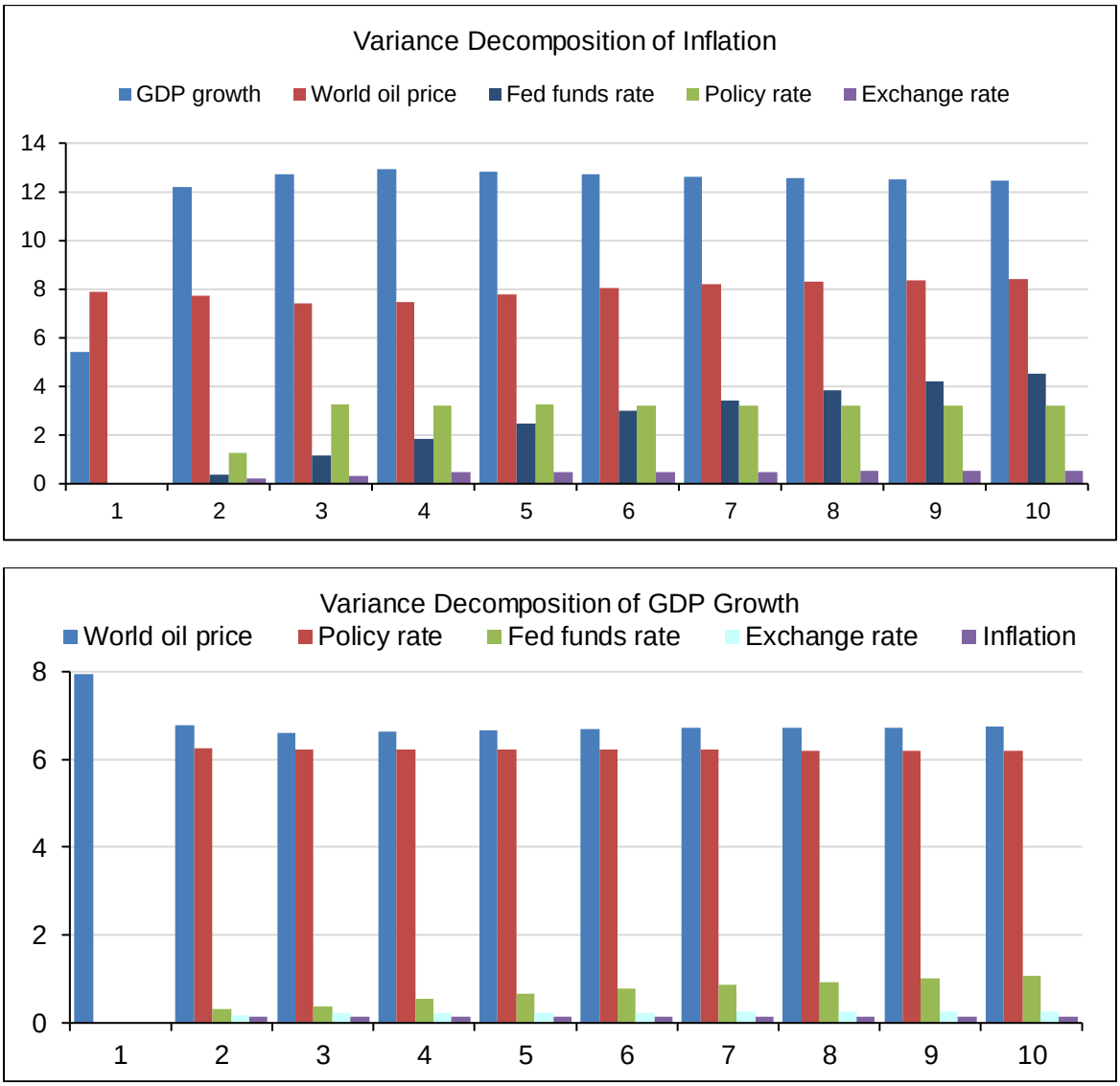
Table 12: Variance Decomposition

Variance Decomposition of Inflation						
Quarter	World oil price	Fed funds rate	GDP growth	Inflation	Policy rate	Exchange rate
1	7.879719	0	5.438445	86.68184	0	0
2	7.717997	3.91E-01	12.17383	78.19484	1.291785	0.230462
3	7.422326	1.184741	12.7051	75.10363	3.249829	0.334374
4	7.460959	1.829974	12.9366	74.05991	3.225006	0.487558
5	7.798099	2.456712	12.82777	73.17022	3.242881	0.504317
6	8.051994	2.975946	12.73068	72.51652	3.223873	0.50099
7	8.21242	3.439251	12.63796	71.98752	3.221276	0.501573
8	8.30406	3.845037	12.57243	71.55461	3.21334	0.510527
9	8.364355	4.207116	12.51385	71.1806	3.206583	0.527491
10	8.40584	4.528768	12.46613	70.8516	3.198601	0.549068

Variance Decomposition of GDP growth						
Quarter	World oil price	Fed funds rate	GDP growth	Inflation	Policy rate	Exchange rate
1	7.954421	0	92.04558	0	0	0
2	6.791641	0.32028	86.33614	0.133749	6.243919	0.174269
3	6.5989	0.38873	86.42527	0.131816	6.215706	0.239574
4	6.623434	0.556206	86.20635	0.141906	6.234293	0.237811
5	6.659146	0.660623	86.07512	0.142924	6.22512	0.237067
6	6.695874	0.76794	85.92751	0.142661	6.224006	0.242006
7	6.710708	0.856905	85.82716	0.142601	6.216328	0.246301
8	6.722436	0.939572	85.73061	0.142445	6.212151	0.252789
9	6.730571	1.012692	85.64839	0.142303	6.206929	0.259113
10	6.737522	1.07888	85.57302	0.142188	6.202557	0.265831

Source: Author's computations in E-views

Figure 12: Variance Decomposition



Source: Author's computations in E-views

6.0 Conclusions and Policy Implications and Areas for Further Work

6.1 Conclusions

This study aimed to investigate the effectiveness of monetary policy transmission through interest rates in Tanzania using quarterly data from 2002 to 2022. The study examined how fluctuations in the monetary policy rate (measured by the repo rate) influence the overnight and 7-day interbank rates, as well as short-term and long-term lending and deposit rates, and consequently, the general price level and the overall economy. The empirical analysis employed a time-series cointegration method called Autoregressive Distributed Lag (ARDL), which involves the determination of short and long-run relationships among variables. In addition, Structural Vector Autoregressive Model (SVAR) was used to scrutinize the monetary

policy transmission mechanism to the overall economy and prices through the interest rate channel.

The study found a complete pass-through of policy rates to interbank market interest rates. Furthermore, the results indicated that the 7-day interbank rate is more responsive to changes in policy rates compared to the overnight interbank rate. Also, the study found that the pass-through of the policy rate to short-term deposit rates is statistically significant but low (incomplete) in the short run. The degree of pass-through is 14.3 percent which is relatively higher than the 1.0 to 3.0 percent estimated by Mbowe (2015), indicating a possible improvement in the transmission process. The study also found a statistically significant long-run pass-through degree of 0.58 from IBCM to the short-term deposit rate. Moreover, concerning the transmission of the policy rate and IBCM rate to lending rates, the study found a statistically significant short-run pass-through coefficient of 0.13 from IBCM to the long-term lending rate. However, for the case of the policy rate, the coefficients are not statistically significant, indicating no interest rate pass-through in Tanzania. The magnitudes of the error correction terms appear to indicate a slow pace of adjustment of retail lending rates to their long-run equilibrium. This finding is similar to finding from previous studies by Buigut (2009), Bashagi et al (2019), Balele et al. (2018), Mbowe (2015), Montiel et al. (2012) and Davoodi et al (2013). In addition, based on an analysis of impulse response functions and forecast error variance decomposition, monetary policy transmission through policy rates to output and prices is generally observed to be weak. Although the overall transmission is weak, the results from the forecast error variance decomposition indicate that the impact of monetary policy shock on output fluctuation in Tanzania is more significant than the fluctuation in the general price level.

6.2 Policy Implications

The empirical findings of this study have four key policy implications. First, the overshooting pass-through identified for the case of the 7-day interbank rate, implies that the rate could serve as an operational target in the conduct of monetary policy.

Second, the current study's findings indicate that there has been an improvement in the transmission process, with the degree of pass-through to short-term deposit rates found to be relatively higher than previously estimated. This observed improvement could serve as a basis for supporting the adoption of an interest rate-based monetary policy framework in Tanzania, as it suggests that the interest rate channel could prove to be an effective tool for conveying monetary policy shocks to the overall economy. However, it is important to note that there are still limitations to the current framework, and efforts should be made to address them to ensure the long-term effectiveness of the monetary policy. The Bank of Tanzania has already taken some important initiatives to improve its monetary policy framework and infrastructure through the development of a forecasting and policy analysis system (FPAS), an online interbank cash market electronic trading platform, a reserve averaging framework and the adoption of the Country Annex of the Global Master Repurchase Agreement (GMRA). Empirical studies have

also shown that the transition to an interest rate targeting framework has helped to improve policy transmission.

Third, the missing link between policy interest rates and lending rates in Tanzania may be explained by bank-specific, industry-specific variables, as well as macroeconomic factors, in line with Mbowe (2020) and other similar studies in the literature. To improve lending rates sensitivity in Tanzania, we propose that efforts be made to address the bank-specific issues such as high provision for non-performing loans and high operating costs; industry-wide factors such as lack of competition in the banking sector as characterised by few dominant players; as well as the macroeconomic factors including exchange rate volatility, high government financing needs which often undermine competition between banks over private customers and inflation.

Fourth, the weak monetary policy passthrough to output and the general price level identified via the interest rate channel implies that in the current monetary policy framework, policy-induced changes in short-term market rates are not fully transmitted to the economy, suggesting that policy rate cuts or increases should be much stronger. The observed insensitivity is not unique to the country as many developing countries also face this issue, see for example Davoodi et al (2013). The weak transmissions to output and prices are linked to structural issues, such as the presence of a large informal economy, which is associated with a larger share of currency in circulation. We propose that efforts be made to improve financial inclusion, financial market competition, and transparency of the Bank of Tanzania's monetary policy operations to improve monetary policy transmission.

6.3 Areas for further work

At least two areas for further research are identified based on the current study. The first is to examine empirically how inflation and GDP subcomponents react to the monetary policy rate. Decomposing GDP and CPI allows policymakers to identify which sectors of the economy and which goods and services are more responsive to monetary policy, which can inform decision-making and help target specific areas of the economy. Second, our empirical analysis is based on a contractionary monetary policy stance (i.e. the impact of an increase in policy rate or policy tightening). By including information related to an expansionary or accommodative monetary policy, a comparative study can be carried out on the symmetric or asymmetric effects of policy rate shocks on market retail rates.

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