The Relative Effectiveness of Monetary Policy Transmission Channels in Tanzania: Empirical Lesson for Post COVID-19 Recovery

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Abstract

This study examines the relative efficacy of monetary policy transmission channels in Tanzania. The study applied co-integration and error correction modeling approach to analyze the short-run and long-run comparative effects of five monetary policy transmission mechanisms on economic growth. The study found that growth-effects of monetary policy depends on transmission channels used. The results show that interest rate channel and stock price channel are not effective in Tanzania. The results further show that though the bank credit channel is working, it is weak. Moreover, the results reveal that exchange rate and expected inflation are the dominant transmission channels of monetary policy in Tanzania. Thus, to enhance interest rate, stock price, and bank credit channels concerted efforts are required to increase financial inclusion in Tanzania. The central bank, commercial banks, financial markets, and other players should continue increasing access and range of financial services; revising lending procedures to private sector; and devise strategies to encourage more economic agents, preferably the domestic investors, to participate in the stock exchange market. In addition, there is a need for the central bank to closely continue monitoring inflation and exchange rates as the dominant monetary policy transmission mechanisms.

Key Words: Monetary policy; Transmission channel; Short-run; Long-run; Economic growth; Tanzania

JEL Classification Codes: C13, E52

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1.0 Introduction

In the last two decades, central banks virtually in the entire world have moved away from monetary policy framework targeting monetary aggregates to inflation-targeting or interest rate-targeting framework. Since 1995, the Bank of Tanzania (BOT) implements a monetary policy framework that is directed towards attaining low inflation conducive to balanced and sustainable economic growth (BOT Act, 2006). In the current framework, the BOT targets monetary aggregates (extended broad money-M3) as a nominal anchor in attaining monetary policy objectives. However, the Bank is currently contemplating to move into the inflation-targeting framework as part of commitment to the implementation of the East Africa Monetary Union (EAMU) Protocol (BOT, 2018). This movement is motivated by changes in the structure of the economy (Mishra et al., 2012; Ma and Lin, 2016). For instance, there have been enormous developments in the financial sector in Tanzania, including developments in payments systems and introduction of new financial instruments. All these have enhanced the financial inclusion that involves increase in access and usage of financial services (FSDT, 2017). These financial sector developments are expected to be sustained and ultimately alter efficacy of monetary policy transmission mechanism in Tanzania (Bashangi *et al,* 2019).

There is plethora empirical works from developed and emerging economies on monetary policy transmission (Tahir, 2012). But these studies do not provide relevant policy to Tanzania because monetary policy transmission is expected to differ between developed and developing countries due to varied structural and institutional features. Thus, to understand the effectiveness of monetary policy transmission channels, each country needs be examined separately. Despite the importance of knowledge on channels of monetary policy transmission, most of the empirical studies so far in Tanzania have paid little attention to this topic (Aikaeli, 2007; Mbowe, 2008; Minja and Magina, 2009; Montiel et al., 2012; and Davoodi et al., 2013). All these studies traced the effects of monetary policy on real sector variables of inflation and economic activity while providing some general inferences regarding monetary policy transmission. Specifically, they do not identify the channels of monetary policy transmission, which are effective. The notable efforts by Montiel *et al*. (2012) and Mkai and Aikaeli (2020) focused on three channels of interest rate, exchange rate, and credit; and ignored two channels of asset price and peoples' expectations. This study seeks to bridge this gap by extending the analysis to capture the relative efficacy of all five channels.

Understanding the relative effectiveness of monetary policy transmission channels is important for a number of reasons. First, such information is important to policy makers and analysts in choosing an anchor for monetary policy. Second, a thorough understanding of monetary policy channels is necessary if policy is going to have the desired outcome (Tahir, 2012). Third, a good understanding of the monetary policy channels working in a particular country provides information about the type of the reforms that are required. Mukherjee and Bhattacharya (2011) noted that for a successful implementation of monetary policy it is cardinal for monetary authorities to have a sound understanding of the channels through which monetary measures are transmitted to the real sector. In addition, the decision by the East African central banks to adopt the Monetary Union (EAMU) by 2024, make it relevant to undertake continuous assessment on the effectiveness of the monetary policy transmission mechanism in respective countries. This paper is, therefore, an attempt to establish the most relevant and effective channels of monetary policy transmission in Tanzania.

The remainder of this paper is organized as follows: section 2 is literature review; section 3 deals with methodology; section 4 presents results; and section 5 provides conclusion and policy implications.

2.0 Literature Review

2.1 Theoretical Review

Monetary policy changes are transmitted to real sector variables through interest rate channel, credit channel, exchange rate channel, asset price channel, and the expectations channel. The traditional interest rate channel indicates that monetary expansion leads to a fall in real interest rates, which in turn lowers the cost of capital, causing an increase in investment spending, thereby leading to an increase in aggregate demand and hence a rise in output. Thus, an expansionary monetary policy, which lowers the short-term nominal interest rate, also lowers the short-term real interest rate leading to a fall in the real long-term interest rate. These lower real long-term interest rates then lead to increase in business fixed investment, residential housing investment, inventory investment, and consumer durable expenditure, all of which produce the rise in aggregate demand and output (Mishkin, 2004). The fact that it is real interest rate that affects investment spending suggests that monetary expansion is also effective through raising expected inflation, which in turns lowers real interest rate, even when nominal interest rate is driven to zero by the monetary authority.

The credit channel explains the impact of monetary policy via the effects of informational asymmetry between the lender and the borrower (Mishkin, 1996). The credit view proposes two channels of transmission: bank lending and balance sheets. The bank-lending channel operates through the quantity of loans supplied by banks to households and firms (Dabla-Norris and Floerkemeier, 2006). Monetary expansion increases liquidity in the banking system enabling banks to supply more loans for investment and consumption resulting in increased aggregate demand and consequently economic activity. The effectiveness of this channel depends on presence of banks because banks determine who is creditworthy, how much to lend to each borrower, and under what terms. The balance sheet channel is based on the effects of monetary policy on the net worth of firms (Simatele, 2004). Expansionary monetary policy enhances net worth of firms, which in turn reduces moral hazards and adverse selection, thereby improving chances of the firms to access loans leading to increased consumer spending and investment, and consequently economic activity.

The exchange rate channel influences economic activity through net exports, especially in open economy with flexible exchange rate regime. Monetary expansion leads to fall in domestic interest rates relative to foreign inducing capital outflows leading to a depreciation of local currency making exports cheaper resulting in increased net exports and consequently aggregate demand and output. Likewise, when domestic real interest rates fall, the value of domestic deposits relative to other currency deposits falls, and domestic currency depreciates. This depreciation makes domestic goods cheaper than foreign goods, thereby causing a rise in net exports and hence output (Mishkin, 1995). Also, depreciation effect of monetary expansion raise domestic price of imported goods, leading to inflation through exchange rate pass-through (Butkiewieez et al., 2009). But this channel is affected by exchange rate regime, sensitivity of interest rates, size and openness of the economy, capital mobility, and expenditure switching between domestic and imported goods (Tahir, 2012).

The asset price channel affects economic activity through prices of bonds, stocks and real estates. This channel operates through Tobin's (1969) Q-theory of investment and Modigliani (1963) life cycle theory of consumption. The Tobin's Q measures the ratio of the stock market value of a firm to the replacement cost of physical capital. Expansionary monetary policy increases the demand for stocks, raising stock prices and thereby boost market value of firms relative to the replacement cost of capital. This will result in increased investment and therefore output. On the other hand, the basic premise of Modigliani life cycle model is that consumers smooth out their consumption over time. Therefore, what determine consumption spending is the lifetime resources of consumers and not just today's income. (Mishkin, 1996). Given an important component of consumers' lifetime resources is their financial wealth such as common stocks. Then, monetary expansion increases stock prices, which in turn increases the value of financial wealth, thereby increasing the lifetime resources of consumers, resulting in higher consumption and hence output. Tahir (2012) noted that participation of households in the capital market; generation of funds by firms through issuance of shares; and the level of development of the stock market determine the efficacy of asset price channel.

There is an agreement amongst economists that expectations affect economic activity, but they differ on how these expectations are generated; Keynesian believe on adaptive expectations while Monetarist argue for rational expectations. Keynes comments that behavior of each firm in deciding its daily output will be determined by its short-term expectations. The expectations as to cost of output on various possible scales and expectations as to sale proceeds of this output; though, in the case of additions to capital equipment and even of sales to distributors, these short-term expectations depend on long-term expectations of other parties" (Chileshe and Akanbi, 2017). Built-in inflation, for example, is induced by adaptive expectations; in which people form their expectations about what will happen in the future based on what has happened in the past. It reflects events in the past, and so might be seen as hangover inflation. Monetarists believe that rational expectations affect what happens to the economy in the future. For instance, if producers believe that price will be higher in the future, they will make rational decision to slow production until price rises. This decision weaken supply while demand stays the same, thus likely to cause inflation (Shiffrin, 1996).

2.2 Empirical Review

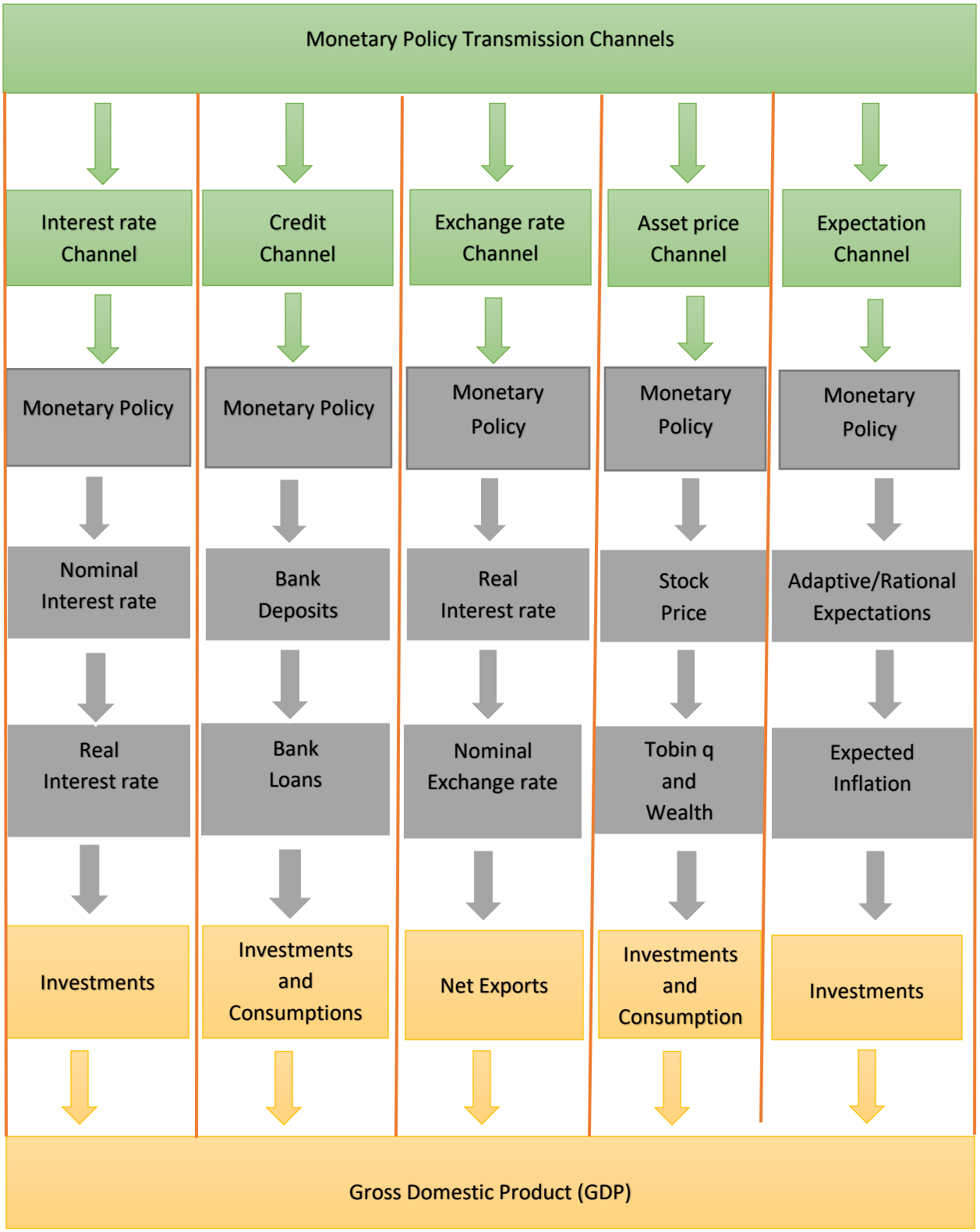
Although empirical studies on effects of monetary policy have been going on for decades, studies focusing on monetary policy transmission channel emerged in 1990s. Studies in developed economies indicate that all the transmission channels of monetary policy are working. In the USA, Bernanke and Blinder (1992) finds that credit and interest rate channels are working while Ramey (1993) finds that money channel is more important than credit or interest channels. In addition, Bernanke and Gertler (1995) finds evidence for the interest channel while Bernanke and Kuttner (2004), Christino et al. (1999, 2001), and DA'mico and Farka (2011) finds evidence for interest rate and asset price channels. Studies in advanced small open economies also find evidence for the exchange rate channel. Camerero and Ordonez (1999) for Spain finds that the interest and exchange rate channels are working while Bjonland and Halvosen (2010) find similar results for OECD countries; UK, Norway, Canada, Australia, and Sweden. Berkelmans (2005) for Australia finds evidence of exchange rate and credit channels while De Fiore (1998) obtains similar results for Israel.

Just like in emerging markets, in Sub-Saharan African (SSA) there are copious empirical works on this matter, but the results show that the effective channels are variable across the countries. For instance, Simantele (2004) for Zambia, Isiohoro (2012) for Nigeria, Mangani (2012) for Malawi, Ngalawa and Viegi (2011) for Malawi found evidence that the dominant channel of monetary transmission is exchange rate channel whereas Lungu (2012) for Southern African countries and Boughrara (2008) for Morocco and Tunisia found evidence of the bank-lending channel. Chileshe and Akanbi (2017), however, found evidence that both exchange rate and credit channels are effective in Zambia. In addition, Apanisile and Okinlo(2020) for Nigeria found that while the credit channel was the best path in promoting output level, people's expectations had the strongest ability to stabilize prices. While some studies have established interest rate as the most effective channel of monetary policy (Cheng, 2008), others - notably by Al-Mashat and Billmeir (2007) for Egypt and Kovanen (2011) for Ghana found that interest rate is a weak and ineffective transmission channel. This outcome implies that it is difficult to establish effective channel of monetary policy transmission for a set of countries together unless country-specific studies are done.

Similarly, in East Africa region, the scanty empirical evidence is inconclusive on the effective channels of the monetary policy transmission. For instance, Buigut (2010) found that bank lending is the most effective channel of monetary policy transmission in Kenya. Mkai and Aikaeli (2020) found that credit is effective in Kenya while exchange rate is the dominant transmission channel in Tanzania and Uganda. However, Mugume (2011) found that all the three channels of monetary policy transmission (interest rate, exchange rate, and credit) are ineffective in Uganda. Minja and Magina (2009) found that Treasury bills, in both volume and yield, had a significant crowding out effect on bank lending in Tanzania. Mbowe (2008) noted that there were positive shocks on reserve money and broad money that accelerated inflation and output, while shocks to interest rates reduced inflation and output in Tanzania. Aikaeli (2007) found that the impact of money supply on inflation is not a sort of one time-strike but a persistent shock in Tanzania. Montiel *et al.* (2012) concludes that both exchange rate and bank lending channels were weak and that monetary policy effect on the real output was neither statistically significant nor economically meaningful in Tanzania

Unlike empirical works done elsewhere, most of the studies in Tanzania admits that there is policy transmission, but they do not clearly establish the specific monetary policy transmission channels. The little evidence provided by Montiel *et al*. (2012) and Mkai and Aikaeli (2020) focused on three channels of interest rate, exchange rate, and credit; and ignored two channels of asset price and peoples' expectations, which may yield different policy suggestions. This study, therefore, seeks to bridge this gap in literature by extending the analysis to capture the relative effectiveness of all five monetary policy transmission channels. Moreover, almost all previous studies on monetary policy transmission mechanisms are characterized by estimation of Recursive Vector Autoregressive Models (VAR) and Granger causality tests using high frequency data with varying number of endogenous variables. This study uses Error Correction Modelling approach (ECM) to analyze the relative efficacy of monetary policy transmission channels in Tanzania. The ECM produces forecasts with lower errors than VAR when variables used in the model pass statistical test for co-integration. In addition, this study uses monthly time series data covering post-covid periods. This is important to capture the impacts of COVID-19 on monetary policy transmission mechanisms

Figure 1: Summary of Monetary Policy Transmission Mechanisms



Source: Mishkin (2004) and Mwamkonko (2022)

3.0 Methodology

3.1 Data

The study used monthly time series data covering the post-covid period from January 2020 to September 2022. The post-covid period was purposely considered to ascertain whether the changes in the structure of the economy brought by prevalence of covid-19 have implications on the effectiveness of monetary policy transmission mechanisms in Tanzania. The time series data were sourced from the Bank of Tanzania's (BOT) Monthly Economic Review and Dar es Salaam Stock Exchange market (DSE). Data for economic growth, interest rate, credit to private sector, exchange rate and money supply were taken from BOT while data for the price of stock was obtained from DSE.

3.2 Description of Variables

The study used real gross domestic product (GDP) as the only monetary policy goal. Since GDP is available on annual or quarterly basis, monthly series were generated by Denton interpolation method (see Baum and Renka, 2001). The study used lending rate to determine efficacy of interest rate channel. The lending rate (LIT) is a weighted average monthly lending rate of commercial banks. Also, credit to private sector was used to assess efficacy of the credit channel in the economy. Credit to private sector (CDT) consists of credit extended by the banking system to the private sector. Regarding exchange rate channel, the nominal official exchange rate (FEX), measured as domestic currencies (Tanzania shillings) per unit of foreign currencies (US Dollar) was used. The effectiveness of asset price channel was measured by using Tanzania all share index (POS). This is a market capitalization weighted index, which includes all stocks listed on the DSE. The study used expected inflation to determine the effectiveness of people's expectations channel. The expected inflation rate (INF) was calculated as a difference between growth rate of money supply and growth rate of the economy keeping velocity constant, as in classical quantity theory of money.

3.3 Preliminary Tests

3.3.1 Unit Root Test

To examine the properties of time series data, particularly the presence of unit root the study used Phillips-Perron (P-P) non-parametric test. A unit root test overcomes spurious regression, in which estimators and test statistics are misleading (Verbeek, 2004). The P-P test has an extra advantage over standard Dickey-Fuller (DF) test because the DF test results are sensitive to different lag lengths of the dependent variable, therefore, biased towards non-rejection of unit roots when the structural breaks are incorporated in the data set (Indraratna, 2003; Li, 2001). Moreover, the P-P test is adjusted to take into account serial correlations by using Newey-West (1994) covariance matrix.

3.3.2 Co-integration Test

Since co-integration test is sensitive to lag length, Akaike Information Criteria (AIC), Hannan Quin Information Criteria (HQIC) and Schwarz Bayesian Information Criteria (SBIC) were used to establish optimum lag. Choosing too large lag length results into poor and inefficient estimates as it reduces degrees of freedom. Conversely, using too short lag length leads to biased estimates, as unexplained information remains in error term, thus likely to cause serial autocorrelation in the residuals.

Thereafter, to ascertain whether variables are bound together in the long-run, the study used Johansen method. Within Johansen co-integration procedure, both trace ($\lambda trace$) and maximum Eigen-value (λmax) statistics were applied to ensure robustness of the results. The Johansen's co-integration method is superior over the Engle and Granger two-step method (residual-based test) because it enables testing for multiple co-integrating vectors and thus it exploits all the dynamic interactions of the variables included in the regression model, and it gives a room for normalization (Verbeek, 2004).

3.4 Model

The study employed the error correction method to analyze the relative effectiveness of the monetary policy transmission mechanism. The error correction model (ECM) produces forecasts with much lower errors than vector autoregressive model (VAR) when the variables used in the model pass the statistical test for co-integration. Thus, given existence of co-integration, all terms in Error Correction Model (ECM) are stationary; therefore, standard regression techniques with their associated statistical inferences are valid (Green, 2003). To derive ECM, it is convenient to begin by considering the autoregressive distributed lag model (ADL). The ADL model is specified as follows:

$$Y_t = \quad \delta + \alpha Y_{t-1} + \beta_1 X_t + \beta_2 X_{t-1} + \varepsilon t \qquad (1)$$

Where: Y; is real economic growth measured in gross domestic product, X; is a vector representing monetary policy transmission channels such as interest rate channel, credit channel, exchange rate channel, and asset price channel, εt ; is a classical error term. However, if time series are not stationary, estimation of equation (1) can generate spurious results. Therefore, with co-integrated but non-stationary time series data, the best alternative is to estimate error correction model (ECM) of the form:

$$\Delta Y_t = \quad \theta + \beta_1 \Delta X_t + \gamma ECT + \varepsilon t \qquad (2)$$

Where: γ = (α-1); is adjustment coefficient i.e. coefficient on the error correction term. The expected value of adjustment coefficient is negative, which implies that there are dynamic stability in the long-run within error correction model; ECT = ($Yt{-}1$ - $\beta 2Xt{-}1$), is error correction term, the coefficients $\beta 1$ can be interpreted as elasticity, showing the short-run effects of monetary policy transmission channels, and θ is a constant measuring the non-monetary policy transmission effects on economic growth. Therefore, for our case, empirical estimation model is specified as follows:

$$\Delta Y_t = \beta_0 + \beta_1 \Delta LIT_t + \beta_2 \Delta CDT_t + \beta_3 \Delta FEX_t + \beta_4 \Delta POS_t + \beta_5 \Delta INF_t + \varepsilon t \qquad (3)$$

Where: Y is natural log of real gross domestic product; LIN is natural log of lending rate; CDT is natural log of credit to private sector; FEX is natural log of nominal exchange rate; POS is natural log of asset price, i.e. all share index; INF is natural log of expected inflation; and εt is classical error term.

4.0 Results and Discussion

4.1 Unit Root Test

The Phillips - Perron (P-P) test was used to each variable in log - level and log - difference to establish whether there is a unit root. The results displayed in Table 1 reveal that all variables were not stationary at their levels. However, after taking their first differences all variables became stationary. This is evidenced by their test statistics, which are now less than their corresponding critical values at 5% levels of significance. Therefore, the null hypothesis of the presence of a unit root is rejected at 0.05 significance level; suggesting that all variables are integrated of order one 1(1).

Table 1: Phillips – Perron Test Results

	Levels		First Difference		Order of
Variables	Test Statistics	Critical Value	Test Statistics	Critical Value	**Integration**
GDP	-1.979	-2.992	-3.235**	-2.994	1(1)
LIT	-1.688	-2.992	-8.426**	-2.994	1(1)
CDT	-0.062	-2.992	-4.583**	-2.994	1(1)
FEX	-2.057	-2.992	-3.429**	-2.994	1(1)
POS	-1.714	-2.992	-4.397**	-2.994	1(1)
INF	-1.793	-2.992	-5.240**	-2.994	1(1)

Note:

GDP: natural log of real gross domestic product; LIT: natural log of lending interest rate; CDT: natural log of credit to private sector; FEX: natural log of official nominal exchange rate; POS: natural log of price of stock, i.e. all share index; INF: natural log of expected inflation; ** indicates rejection of null hypothesis of non-stationary at 5% significance levels.

4.2 Optimal Lag length

The study employed the Akaike Information Criteria (AIC), Hannan - Quin Information Criteria (HQIC), and Schwarz Bayesian Information Criteria (SBIC) to establish and select the optimum lag length. The results in Table 2 demonstrate that all AIC, HQIC, and SBIC select three (3) lags. The chosen three (3)-lag order was used for co-integration and error correcting modelling. Given our relatively small sample of series, the selected three (3) lags can preserve degrees of freedom for estimation. The use of appropriate lag is emphasized to ensure robustness of the estimation results.

Table 2: Lag Selection Results

Lag Order	AIC	HQIC	SBIC
0	30.61	30.67	30.85
1	30.22	30.30	30.52
2	30.16	30.25	30.50
3	29.42**	29.53**	29.82**
4	29.45	29.56	29.89

Note:

*** = indicates optimum lag length selected by the respective criterion at 0.05 levels of significance. The decision criteria is that "the smaller the value the better the lag length chosen".

4.3 Co-integration Test

The Johansen co-integration test was performed to determine whether variables have long-run equilibrium. The results in Table 3 reveal that both the $\lambda trace$ and λmax statistics rejected the null hypothesis of no co-integration against the alternative, as evidenced by test statistics, which are greater than the critical values. This suggests that there exists long-run relationship among variables. In addition, Johansen test reveals that there is more than one co-integrating relationships. Specifically, the $\lambda trace$ and λmax statistics show that there are at most two (2) co-integrating vectors.

Table 3: Johansen Co-integration Test Results

Null Hypotheses	Trace Statistics	Critical Value	Max-Eigen Statistics	Critical value
None	205.59	94.15	89.64	39.37
At most 1	115.94	68.52	81.21	33.46
At most 2	34.73**	47.21	18.22**	27.07
At most 3	16.50	29.68	9.89	20.97
At most 4	6.61	15.41	6.47	14.07
At most 5	0.14	3.76	0.14	3.76

Note:

If there are k stochastic variables in the regression equation, there can be are up to "k-1" co-integrating vectors. However, it may not be easily to give all relationships meaningful economic interpretations; ** indicates the accepted null hypothesis at 5% significance levels.

4.4 Error Correction Model Results

The results of ECM in Table 4 show that the speed of adjustment is negative and statistically significant, – 0.3629: suggesting that about 36% of the last period's disequilibrium is corrected for in the next period. This implies that, in the long-run, monetary policy transmission mechanisms matter for economic activity, i.e. the effects of monetary policy on growth depends on transmission channels used. The results also reveal that there are partial adjustments in economic growth over time. This outcome is evident by the statistically significant coefficient of the lagged dependent variable (GDP). This implies that past growth rate of the economy considerably determine the future economic growth, other factors held constant. That is, the high (lower) the current growth rate of the economy the high (lower) the growth rate of the economy in the next period, ceteris Paribus.

The results show that the traditional interest rate transmission channel is not working in Tanzania, as evident by insignificant coefficients of lending rates. This outcome indicates that a fall in interest rates does not substantially increase business fixed investment, residential housing investment, inventory investment, and consumer durable expenditure in Tanzania. This suggests that despite various initiatives deployed by public and private sectors to increase financial inclusion, the country financial system's performance as measured by population coverage and range of services offered has been dismal, even by African standards. For example, the proportion of adults with access to bank services in Tanzania as of 2017 was only 16.7% (NFIF, 2018-2022). In addition, commercial banks are concentrated in urban making monetary policy transmission via interest rate channel limited. The results align Al-Mashat and Billmeir (2007) for Egypt and Kovanen (2011) for Ghana.

The results further reveal that, though the asset price channel seems to be working it is weak and therefore not effective in Tanzania, specifically the stock price channel. This is evident by p-values of the coefficients of price of stock (POS), which is statistically significant only at 10% but not econometrically meaningful at both 5% and 1%. This outcome reflects that expansionary monetary policy increases demand for stocks, leading to increase in stock prices, which in turn fails to enhance investments considerably perhaps because of low participation of majority of Tanzanians in Dar es Salaam stock exchange market. The alternative but plausible interpretation is that expansionary monetary policy increases stock prices, which increases value of financial wealth, which in turn does not significantly result in higher consumption and hence increase in aggregate output; perhaps because Dar es Salaam stock exchange market (DSE) is dominated by foreign investors.

A closer examination of the results reveal that bank credit is effective transmission channel in Tanzania. This is confirmed by the positive and significant coefficients of credit to private sector. This suggests that monetary expansion, increases bank reserves and bank deposits, which in turn, increases quantity of bank loans available. Because many borrowers depend on bank loans to finance their activities, this increase in loans increases investment and consumer spending, hence output. This outcome partly reflects that the financial institutions, particularly banking sector, is currently doing well. The results, therefore, support Tanzania Banking Sector Report (2021) which shows that Tanzania's banking sector remained resilient in the face of economic shocks associated with the COVID-19 pandemic. Accommodative policy measures helped increase the banking sector's capital adequacy, profitability, and liquidity and created room for increased credit to private sector.

Also, the ECM results demonstrate that the exchange rate transmission channel is strong in Tanzania. This is evident by the coefficients of nominal official exchange rate, which are negative and statistically meaningful. This indicates that expansionary monetary policy reduces the value of the domestic currency (Tanzanian shillings) relative to foreign currencies, making domestic goods cheaper than foreign goods, thereby causing a rise in net exports and hence in aggregate output. These results are similar to many studies on the effects of monetary policy done in developing economies especially those with floating exchange rate and a liberalized capital account. Mkai and Aikaeli (2020), for instance, found that exchange rate is the dominant monetary policy transmission channel in Tanzania and Uganda. This study, however, focused on price stability and pre-covid sample while the current study focused on GDP growth and post-covid sample.

Moreover, the results show that people's expectation is also an important channel in Tanzania; as supported by the coefficients of expected inflation, which are positive and statistically significant. This outcome suggests that monetary expansion raise expected price level and hence expected inflation, thereby lowering real interest rate even when nominal interest rate is fixed at zero, and stimulate investment leading to high output. Alternatively, monetary expansion leads to rise in general price level, rising real net worth, which lowers adverse selection and moral hazard problems, leading to a rise in investment and hence output. This outcome supplements previous findings by Apanisile and Osinubi (2020) for Nigeria that while the credit channel was the best path in promoting aggregate output, people's expectations had the strongest ability to stabilize prices.

Table 4: Error Correction Model Results

Variables	GDP		
	1	2	Joint (1&2)
GDP	0.1912	0.4808	10.89
	(0.258)	(0.025)**	(0.004)***
LIT	269339	-898948	2.61
	(0.643)	(0.120)	(0.271)
CDT	1085	685	11.02
	(0.003)***	(0.069)*	(0.004)***
FEX	-410551	-285206	30.90
	(0.000)***	(0.009)***	(0.000)***
POS	3880	6553	5.89
	(0.221)	(0.061)*	(0.093)*
INF	362244	391254	25.45
	(0.000)***	(0.000)***	(0.000)***
ECT	-0.3629		
	(0.000)***		
CON	0.5359		
	(1.00)*		

Note:

GDP: natural log of real gross domestic product; LIT: natural log of lending rate; CDT: natural log of credit to private sector; FEX: natural log of nominal exchange rate; POS: natural log of price of stock; INF: natural log of expected inflation; ECT: error correction term; CON: constant. Column 1 to 2 represents coefficient estimates of lagged variables and figures in parentheses are their p-values. ***, ** & * = significant at 1%, 5% & 10% respectively.

4.5 Variance Decomposition

To analyze and forecast the relative importance of monetary policy transmission channels in the post-sample periods, the forecast error variance decomposition was estimated based on ECM results. In various forecasting horizons, variance decomposition for GDP measures the proportions of its total variations due to own shock, and due to some shocks of all monetary policy variables in the model.

The results in Table 5 show that, in the short-run (for instance at three month horizon), innovation to GDP accounts for 71.73 percent variation in GDP (own shock); shock to expected inflation contributes to 11.88 percent fluctuation in GDP; impulse to nominal exchange rate causes 6.08 percent fluctuation in GDP; shock to credit to private sector leads to 4.15 percent fluctuation in GDP; impulse to price of stock, i.e. all share index contributes to 1.34 percent fluctuation in GDP; and shock to lending rate causes 5.25 percent fluctuation in GDP. In the long-run (for example at ten month horizon), the variance decomposition results reveal that shock to GDP accounts for 36.00 percent variation in GDP (own shock); innovation to expected inflation causes 30.51 percent fluctuation in GDP; shock to nominal exchange rate leads to 23.77 percent fluctuation in GDP; shock to credit to private sector causes 2.14 percent fluctuation in GDP; innovation to price of stock causes 1.59 percent fluctuation in GDP; shock to lending rate causes 5.25 percent fluctuation in GDP.

The results shows that expected inflation and exchange rate have more contribution to economic activity than other transmission channels in the short-run and long-run. This implies that people's expectations and exchange rate are dominant transmission channels of monetary policy in Tanzania. The results demonstrate that credit to private sector contributes to economic activity. However, it appears that contribution of credit to private sector to GDP diminishes overtime, i.e. the short-run effect is more than long-run effect. This reflects that credit channel is working but not as effective as expectation and exchange rate channels. On the other hand, the results reveal that lending rate and price of stock cannot significantly contribute to economic activity, neither in the short-run nor in the long-run. This is evident by short-run and long-run coefficients of lending rate, which are nearly the same, i.e. 5.25 and 5.98 respectively. Likewise, short-run and long-run coefficients of price of stock, which are nearly the same, i.e. 1.34 and 1.59 respectively. This suggests that monetary policy in Tanzania is not effectively transmitted through interest rate and asset price channels. In overall, variance decomposition results confirm the error correction model results.

Table 5: Variance Decomposition Results

PERIOD	GDP	INF	FEX	CDT	POS	LIT
1	100	0.00	0.00	0.00	0.00	0.00
2	85.57	3.59	3.38	5.34	0.42	1.67
3	71.73	11.88	6.08	4.15	1.34	5.25
4	58.08	22.54	6.30	3.74	1.27	8.06
5	48.08	35.52	5.53	2.84	1.02	7.02
6	45.61	37.98	5.90	2.70	0.97	6.81
7	45.06	36.30	8.37	2.83	0.92	6.49
8	41.20	35.49	13.26	2.59	0.98	6.45
9	38.33	32.82	19.24	2.33	0.99	6.26
10	36.00	30.51	23.77	2.14	1.59	5.98

Note:

GDP: natural log of real gross domestic product; LIT: natural log of lending rate; CDT: natural log of credit to private sector; FEX: natural log of nominal foreign exchange rate; POS: natural log of price of stock, i.e. all share index; and INF: natural log of expected inflation.

4.6 Diagnostic Tests

The Lagrange Multiplier (LM) test was employed to ascertain the presence of the residual autocorrelation. The LM test was used instead of the popular Durbin Watson (DW) test because the DW test is biased towards accepting the null hypothesis of no autocorrelation when the regressors include lagged dependent variable in the model (Mukherjee at al. 1998). The results in Table 6 show that there is no serial autocorrelation at chosen lag order. In addition, Jarque-Bera (JB) test was employed to establish whether residuals are normally distributed. The assumption of asymptotic normality of distribution and consistency is known to give satisfactory results (Maddala, 1987). The results show that the residuals were normally distributed over the study period.

Table 6: Diagnostic Test Results

LM test				
lags	1		2	
	Ch2	Prob > Ch2	Ch2	Prob > Ch2
	31.07	0.7022	39.52	0.3155
JB test				
	Ch2		Prob > Ch2	
	0.797		0.6712	
	Skewness	- 0.1030	Kurtosis	2.1672

5.0 Conclusion

This study analyzed the relative effectiveness of monetary policy transmission channels in Tanzania. Specifically, we examined the short-run and long-run effects of five monetary policy transmission channels; interest rate, exchange rate, credit or bank lending, asset price, and expectations. The study applied co-integration, error correction model, and forecast error variance decomposition.

The results reveal that there are partial adjustments in economic activity over time; implying that past growth rate of the economy matters for future economic growth, other factors held constant. Also, the study found that growth-effects of monetary policy depends on transmission channels used. The results show that the traditional interest rate transmission channel is not working in Tanzania, i.e. fall in interest rates does not substantially increase investment and consumer durable expenditure. Also, the results reveal that asset price channel; specifically the stock price channel is not effective in Tanzania, though in relative terms, it appears to be better than interest rate channel. The results further show that though bank credit channel is working in Tanzania, it is weak. These results suggest that despite various initiatives deployed by the public and private sectors to increase financial inclusion, the country financial system's performance as measured by population coverage and range of financial services offered has been dismal, even by African standards. Moreover, the results shows that exchange rate and expected inflation have more profound effects on economic activity in Tanzania. This outcome indicates that people's expectations and exchange rates are the dominant transmission channels of monetary policy in Tanzania

The study has two recommendations. First, to enhance interest rate, stock price, and bank credit channels concerted efforts are needed to increase financial inclusion. The central bank and commercial banks should continue increasing access and range of financial services, and revising composition of the credits given to private sector. In addition, the central bank and financial markets, particularly Dar es Salaam Stock Exchange Market (DSE) should devise strategies to encourage more economic agents, preferably the domestic investors, to participate in the stock market. Second, given that expected inflation and exchange rate are important transmission channels, there is a need for the central banks, to continue monitoring inflation and exchange rates. This outcome also suggests the need for Tanzania to shift from monetary aggregates targeting to inflation targeting framework. Full-fledged movement to inflation targeting in Tanzania will produce better monetary policy transmission results than the current monetary targeting framework.

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