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AN EMPIRICAL ASSESSMENT OF THE SYSTEMATIC RELATIONSHIP BETWEEN INTEREST RATE AND EXPECTED INFLATION IN TANZANIA

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Abstract

The theorization of the Fischer effect considers expected inflation as the driver of short-term interest rates. However, empirical data does not show a clear support of this theory implying that there are other drivers of interest rates beyond inflation expectations. This paper considers existence of a systematic relationship between the short-term interest rate and expected inflation, specifically investigating whether expected inflation has impact on short term interest rates, other factors held constant. In achieving this objective, econometric methods are applied on Tanzanian data obtained from the Bank of Tanzania. Using OLS and correlation coefficient analyses, the findings indicate existence of a systematic positive relationship between the nominal short-term interest rate and expected inflation, albeit weak with short term interest rates responding to expected inflation. These findings imply that the short-term interest rate, particularly the overnight interbank cash market rate is a potential policy rate for the Bank of Tanzania monetary policy. The findings provide empirical evidence that the intermittent unsystematic relationship between the short-term nominal interest rate and expected inflation are temporary phenomena along the path of nominal interest rate. This justifies the central bank's transition from the monetary targeting framework to the interest rate-based framework. The study distinguishes itself from the existing literature by initially taking account of the causality between expected inflation and short-term nominal interest rate before estimation of the effect of expected inflation on short term interest rate.

Keywords: Fisher hypothesis; Fisher equation; Bank of Tanzania.

INTRODUCTION

Liberalization of interest rate in 1991 among other financial sector reforms, constitutes the 1990s package of financial sector reforms in Tanzania. The interest rate reforms entailed a switch from a controlled interest rate policy that had existed until 1991 to the prevailing market-determined interest rate policy. During the controlled economic regime, interest rates were determined administratively by the government. The financial market was not supportive to economic growth because of its small size, comprised of a few government-owned commercial banks, two pension funds, one insurance company, and one hire purchase company. Given that interest rates were exogenously determined, there was no systematic relationship among interest rate, inflation, and money supply growth.

With the current market-determined interest rate policy, real interest rates respond to movements in expected inflation. This implies that inflation is among the drivers of the real cost of funds. In market economies, movements in inflation and interest rates imply an opportunity for central banks to influence macroeconomic variables. Lending rates are determined by several factors including the cost of funds, risk profile of customers, profit margins, Treasury bill rates, and quality of collaterals.

Since liberalization of interest rates in 1990s Tanzania, interest rates have been determined by market forces and hence have moved in similar patterns with inflation albeit with lags. During this period, interest rates on average have responded to movements in inflation (Figure 1).

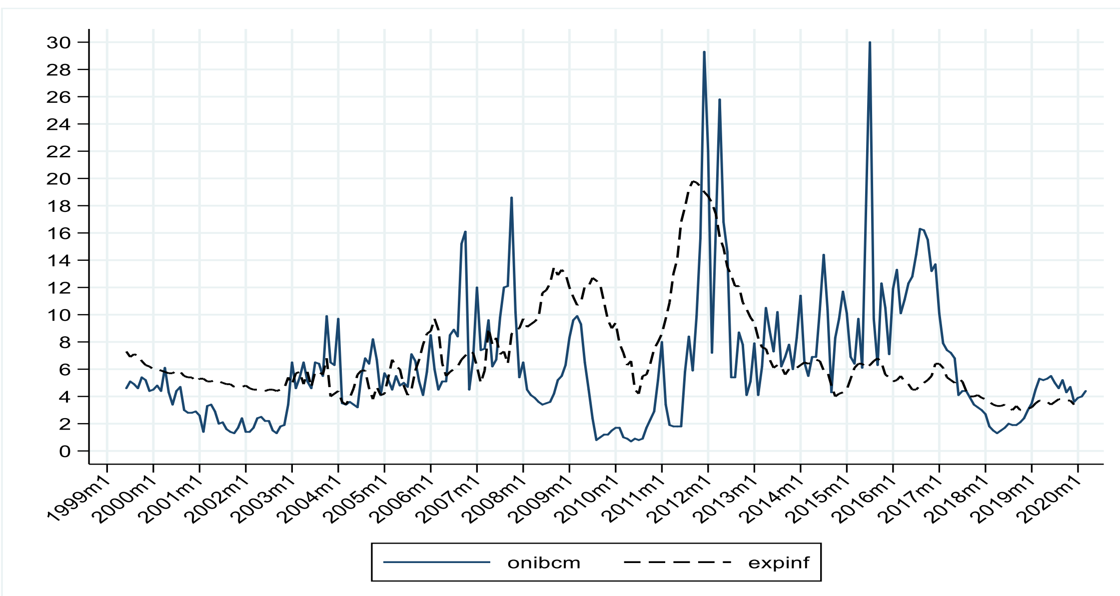

FIG 1. INTEREST RATE AND EXPECTED INFLATION DYNAMICS

For the past two decades, expected inflation and short-term interest rates, particularly the overnight interbank cash market rate have moved dynamically with expected inflation leading or predicting the nominal short-term interest rate. Comparing the movements, interest rate depicted volatilities with marked spikes at some intervals, particularly around 2011 and around 2015. As the closest measure of cost of funds, the overnight interbank cash market rate portrays volatilities, reflecting market liquidity dynamics in the economy.

We test whether there is a systematic relationship between the short-term nominal interest rate and expected inflation. Specifically, we test the hypotheses:

- Expected increase in inflation leads to increase in short-term nominal interest rate.
- There is a positive partial relationship between expected inflation and the short-term nominal interest rate.
- Expected inflation and the short-term nominal interest rate have a long-run relationship.

In terms of contributions, this study provides empirical evidence on whether the intermittent unsystematic relationship between short-term nominal interest rate and inflation temporary phenomena along the path of nominal interest rates. The study also sheds some light on whether the Bank of Tanzania is ready to modernize its monetary policy framework, the process which constitutes switching from monetary targeting framework to the price-based framework, in which central bank policy rate is the instrument of monetary policy.

LITERATURE REVIEW

Theoretical literature review

The starting point in this study is the Fisher hypothesis (1930), which suggests a one-for-one adjustment of the nominal interest rate to changes in expected inflation. In a simple mathematical form, this can be written as

$$r_t = i_t - \pi^e \tag{1}$$

where r_t is the real interest rate in the current period, i_t is the nominal interest rate in the current period and π^e is expected inflation in period t+k. The one-for-one movement between the nominal interest rate and expected inflation is a stricter condition such that it is not supported by empirical data because it implies that the real interest rate is fixed. This is not feasible because real interest rate is also influenced by other factors such as investment returns and agents' preference. The one-for-one condition does not hold; instead, a less than the one-for-one relationship between expected inflation and interest rate is not only theoretically relevant but also supported by empirical evidence according to literature (Fisher, 1930; Mishkin, 1992). This outcome allows comparison between the Fisher hypothesis with the theory of rational expectations and efficient market hypothesis given that the two imply that nominal interest rate movements reflect movements in expected inflation. While the weak form of the Fisher hypothesis corresponds to the weak form of efficient market hypothesis, the strict form of the Fisher hypothesis corresponds to the strong form of the efficient market hypothesis. However, the strict form of the Fisher hypothesis and strong form of efficient market hypothesis are rarely supported by empirical evidence in the literature. This requires relaxing the Fisher (1930) condition of one-for-one relation between the nominal interest rate and inflation rate by imposing a condition that expected inflation have impact on short-term nominal interest rate. That is, nominal interest rate movements reflect expected inflation, that is, $\frac{\delta i_t}{\delta \pi^e} = \frac{\delta i_t}{\delta \pi_t} > 0$.

The above condition can be broken down into two parts: First, the impact of expected inflation on interest rate is positive but less than unit (i.e. $0 < \frac{\delta i_t}{\delta \pi^e} < 1$) (e.g. Fisher, 1930; Mundel, 1963; Tobin, 1965). Second, the impact of expected inflation on interest rate is greater than unit (i.e. $\frac{\delta i_t}{\delta \pi^e} > 1$), consistent with the Darby-Feldstein effect (Darby, 1975; Feldstein, 1976) who suggest a modified Fisher equation that includes a tax parameter, which is also corroborated by Crowder and Hoffman (1996). However, Carmichael and Stebbing (1983) and Choudhry (1997) find a negative relationship between expected inflation and interest rate or the inverted Fisher effect.

The Fisher effect suggests that movements in expected inflation are associated with movements in nominal interest rate with some lags (Figure 1), consistent with the weak form of efficient market hypothesis. Specifically, returns on assets reflect developments in the market, including inflation developments. The Fisher hypothesis implies that central banks must keep inflation low to ensure low nominal interest rates. Keeping inflation low and stable has been one of the goals of many central banks under the price stability and financial stability objectives.

According to the monetary model of exchange rate determination, policy-driven rises in the nominal interest rates decrease real money balances, leading to decrease in inflation and appreciation of currency (Balele, 2013; Chinn, 1999; Edwards, 1983). This implies that the increase in the interest rate and inflation achieved by cutting money supply lead to currency appreciation. For some periods in Tanzania, the pattern among interest rate, inflation, money supply, and exchange rate has moved inconsistently. For instance, towards the end of 2011, inflation was rising, driven by food prices, but there was no justified significant growth in broad money supply. At the same time, the three-month Treasury bill rate was also rising. This puzzle can be associated with the inverted Fisher effect as coined by Carmichael and Stebbing (1983). Contrary to expectations, short-term interest rates from time to time tend to decouple from the fundamentals, particularly delinking from trends in money supply, inflation, and exchange rate. This is also contrary to the liquidity preference theory.

Despite extensive investigation of the Fisher hypothesis (1930), the debate is still inconclusive given that the findings are characterized by mixed views (Shabir, 2010). While some studies support the Fisher hypothesis of monetary policy neutrality, others reject it. Nevertheless, both options contain important economic implications in terms of monetary policy and macroeconomics (Mishkin & Simon, 1995; Shabir, 2010). For instance, evidence in support of the Fisher hypothesis implies that interest rate is endogenous such that a central bank cannot effectively achieve monetary policy goals using interest rate as an instrument of monetary policy. This is consistent with efficient market hypothesis prediction which argues that economic agents take advantage of market information, both private and public because such information is already reflected in the market (Fama, 1975). That means movements in short-term interest rates reflect inflation expectations. This argument is also consistent with the Real Business Cycle hypothesis which assumes that at any point in time along the business cycle, the economy optimizes such that policy interventions may lead to sub-optimal outcome level. On the other hand, the dearth evidence in support of the Fisher hypothesis implies that interest rate is exogenous to central banks such that it can be effectively used to achieve monetary policy goals.

The common empirical finding among the Fisher hypothesis studies is the less than one-for-one relationship between expected inflation and nominal interest rate instead of a one-for-one relation predicted by Fisher (1930). The literature raises several reasons in explaining both the less than one-for-one outcome and the complete breakdown of the Fisher hypothesis as described in the empirical literature review section. Given the objectives of this study, the empirical literature focuses on the strength (i.e. coefficient size) of the relationship between the nominal interest rate and expected inflation, particularly the evidence of the one-for-one and the less than one-for-one outcomes.

Empirical literature

Mundel (1963) and Tobin (1965) describe the less than one-for-one Fisher's (1930) outcome in terms of wealth effect, that is, the Mundel-Tobin effect, arguing that wealth imposes some lags on the relationship between expected inflation and nominal interest rate. Specifically, expected inflation decrease the real interest rate by lowering real money balances, and the consequent decrease in wealth stimulates savings in form of equities and bonds (Mundel, 1963). Further, inflation pressures tend to increase the demand and hence the stock of real assets held in the economy, leading to a decrease in asset returns (Tobin, 1965). In view of this, increase in expected inflation is associated with a less than proportionate increase in interest rate. This is referred to as the Mundel-Tobin effect.

The Darby-Feldstein effect (Darby, 1975; Feldstein, 1976) provides another argument for the less than one-for-one Fisher effect in which the tax structure influences the Fisher relationship. To insulate the borrowers and lenders expected real payments, nominal interest rates need to increase by more than one-for-one with the increase in expected inflation to ensure positive real returns (Darby, 1975). Specifically, for each basis point increase in expected inflation, the nominal interest rate should increase by $\frac{1}{1-\tau}$ basis points, where τ is the tax parameter which ranges between zero and unit. This assumption requires modification of the ordinary Fisher relationship in equation (1) by incorporating a tax parameter τ, yielding:

$$(1-\tau)i_t = r_t + \pi^e \quad (2)$$

where $0 < \tau < 1$

Taking partial derivative of the nominal interest rate with respect to expected inflation and considering the requirement $0 < \tau < 1$, it gives

$$\frac{\delta i_t}{\delta \pi^e} = \frac{1}{1-\tau} > 1$$

which implies that movements in the pre-tax interest rate are driven by fiscal (i.e. tax) decisions embedded in inflation expectations. This implies that the higher the tax rate, the larger the change in the nominal interest rate as a result of the expected higher inflation rate.

Using the US three-month Treasury bill rate as a proxy for the market interest rate during 1953q1-1978q4, Carmichael and Stebbing (1983) note the complete breakdown of the Fisher hypothesis in terms of an inverted Fisher effect. Their analysis assumes substitutability between money and financial assets and that interest rate on financial assets is invariable over time such that real interest rate and expected inflation move in inverse direction. This can be written as

$$r_t = \bar{\imath} - \pi^e \quad (3)$$

r_t and π^e are as defined in equation (1), $\bar{\imath}$ is the nominal interest rate, invariant to financial assets.

Equation (3) implies an inverse relationship between the real interest rate and expected inflation (i.e. $\frac{\delta i_t}{\delta \pi^e} = -1$). However, this specification is not supported by empirical evidence (e.g. Choudhry, 1997; Moazzami, 1991; Woodward, 1992), instead, the real interest rate is not fixed, rather it is endogenously determined by return on real investment and economic agents' time preference.

Using correlation coefficient, Fisher (1930) examines the relationship between nominal interest rate and expected inflation using US and UK annual data for the period 1890-1927 and 1820-1924, respectively. Their findings show a less than one-for-one relationship between nominal interest rate and expected inflation in the short-run, that is, correlation coefficients of 0.86 and 0.98 for the US and UK, respectively. These findings imply that inflation expectations are slightly less instantaneously reflected in the nominal interest rates in the US compared to the UK. According to Fisher, the one-for-one outcome is on account of money illusion in which money holders enjoy holding money irrespective of the opportunity cost involved in terms of foregone interest income.

Mishkin and Simon (1995) examine the Fisher effect using Australian data and find evidence in support of the long-run Fisher hypothesis but rejects the Fisher hypothesis in the short-run. This implies that, while short-run movements in nominal interest rates reflect movements in monetary policy, the long-run movements in interest rates are driven by inflationary expectations. This outcome is more appealing since it is consistent with short-term interest rate rather than the long-term interest rate as a central bank choice tool of monetary policy.

Using Japanese and US data in the 1990s, Mishkin (1992) provides two important empirical applications of the Fisher hypothesis. The first empirical application is the Japanese case in the 1990s when prolonged recessions were accompanied by deflation when the six-month Treasury bill rate turned slightly negative. The second interesting empirical application is based on the US data which shows rising and falling interest rate (i.e. three-month Treasury bill rate) during the business cycle expansions and recessions, respectively.

ESTIMATION METHODOLOGY

Variables and data sources

Monthly data on short-term interest rates[1], and inflation were obtained from the Bank of Tanzania. The data covers the period from June 1999 to March 2020.

Choosing the representative short-term interest rate

The correlation coefficient test results suggest statistically significant relationship between the overnight interbank cash market rate and expected inflation. However, the results indicate no statistically significant relationship between expected inflation and the remaining short-term interest rates at all conventional significance levels. This finding

[1] These are overnight interbank cash market rate, repo rate, three-month Treasury bills rate, and Lombard rate.

serves as an independent test for the Fisher hypothesis, widely referred to in the literature. Table 1 reports the correlation coefficients between expected inflation and a set of short-term interest rates.

TABLE 1. CORRELATION COEFFICIENTS BETWEEN INFLATION AND SHORT-TERM INTEREST RATES

	exp_inf	$nibcm$	$repo$	$tmtb$	$lombard$
exp_inf	1.0000				
$onibcm$	**0.2738**	1.0000			
	(0.0001)				
$repo$	0.1040	**0.7139**	1.0000		
	(0.1480)	(0.0000)			
$tmtb$	0.0958	**0.5494**	**0.4696**	1.0000	
	(0.1828)	(0.0000)	(0.0000)		
$lombard$	0.0850	**0.9314**	**0.8084**	**0.5841**	1.0000
	(0.2795)	(0.0000)	(0.0000)	(0.0000)	

Notes: In brackets are p-values and bold implies significant at 5% level and below.
exp_inf is expected inflation rate, onibcm is overnight interbank cash market rate
repo is repo rate, tmtb is the three-month Treasury bill rate, and lombard is the Lombard rate.

Based on the statistically significant correlation between nominal interest rate and expected inflation, the overnight interbank cash market rate is considered to represent short-term interest rates. The correlation between expected inflation and the interbank cash market rate is less than unit (i.e. 0.27). This is consistent with Fisher's (1930) finding of less than one-for-one relationship (Table 1). However, the small size correlation indicates a weak relationship between expected inflation and short-term nominal interest rate. Formal econometric tests are conducted in section 4.0.

The model

This study tests the Fisher hypothesis using econometric tests in addition to the correlation coefficients reported in Table 1. Since there is no data on expected inflation, we assume perfect foresight to allow using future values of inflation as proxy for expected inflation.

The Fisher effect is mainly on the relationship between the nominal interest rate and expected inflation as specified below.

$$1 + i_t = (1 + E_t\{r_{t+k}|\Omega_t\})(1 + E_t\{\pi_{t+k}|\Omega_t\}) \quad (4)$$

where i_t is the nominal interest rate known at time 't,' r_{t+k} is the real return on assets expected by economic agents expect in period 't+k' given expected inflation in period 't+k,' and π_{t+k} is the expected rate of inflation in time 't+k.' For small values of nominal interest rate and expected inflation, equation (4) simplifies to

$$i_t = r_t + \pi_{t+k} \quad (5)$$

If agents' expectations are correct (i.e. perfect foresight), the Fisher equation (5) imposes an implicit assumption that the real interest rate is fixed because the nominal interest rate is driven by expected inflation and hence follows the evolution of expected inflation, as predicted in Fisher hypothesis (1930). Estimation and analysis of the results of equation (5) serve more than one purpose in the literature. While it is used to test for market efficiency (Fama, 1975), it is used in testing the relationship between nominal interest rate and expected inflation under the Fisher hypothesis. The two hypotheses are similar since the strong form of the efficient market hypothesis corresponds to Fisher's (1930) finding of a one-for-one relationship between nominal interest rate and expected inflation.

The limitations of the strong efficient market hypothesis and strict Fisher hypothesis make them weakly testable, especially in developing countries where financial markets are not well developed. To estimate the Fisher hypothesis econometrically, an error term (i.e. $\in_t$) and a constant term (i.e. γ) are tagged in equation (5). We assume the constant term γ to be an estimate of the real interest rate as assumed in the Fisher hypothesis. The same interpretation of the constant term γ applies to the Taylor rule estimates (Clarida et al., 2000; McCallum, 2002).

$$i_t = \gamma + \beta\pi_{t+k} + \mu_t \quad (6)$$

The strict form of the Fisher hypothesis is when the null hypothesis is $\beta = 1$ and the residuals (μ_t) are stationary. If the null hypothesis holds, then full adjustments in the nominal interest rate are determined by expected inflation, which is the one-for-one outcome. The more appealing analysis of the Fisher hypothesis is testing its weak form such that the null hypothesis is positive but less than unit and the residuals are stationary. If this holds, then partial adjustments in the nominal interest rate are said to depend on expected inflation while the remaining adjustments come from other sources such as productivity of capital and investor's time preference. This motivates testing for the nominal interest rate adjustment by imposing the lagged nominal interest rate on the right-hand side of equation (5), which then becomes

$$i_t = \alpha + \rho i_{t-1} + \lambda\pi_{t+k} + \varepsilon_t \quad (7)$$

The central bank is said to conduct monetary policy adjustment if the coefficient on the lagged coefficient (i.e. ρ) lies between zero and unit (i.e. $0 < \rho < 1$).

EMPIRICAL RESULTS

Introduction

In testing the Fisher hypothesis, we conduct a Granger causality Wald test and estimate the model by ordinary least squares (OLS). We include a lagged dependent variable to examine whether monetary policy involves adjustment.

Unit roots test

Before conducting the causality test and OLS estimation, we examine the time series characteristics of the data by conducting unit roots test. We employ appropriate lag length values obtained by testing for the optimal number of lags using the Final Prediction Error and the Akaike Information Criteria (Appendix). Visual inspection of Figure 1 suggests that expected inflation involves drift(s) and therefore a drift is added in the Augmented Dickey Fuller test to capture such behavior. The results are reported in Table 2.

TABLE 2. SUMMARY OF UNIT ROOTS TEST RESULTS

	Augmented Dickey-Fuller (ADF) test		
Variable	t-stat	Cr-value (5% level)	p-value
exp_inf	-2.765*	-2.884	0.0634
$onibcm$	-3.071**	-2.884	0.0288
$repo$	-5.258***	-2.884	0.0000
$tmtb$	-3.039**	-2.884	0.0373
$lombard$	-3.076**	-2.886	0.0284

Note: MacKinnon (1996) one-sided p-values
*** significant at 1%, ** significant at **, and * significant 10%.

The unit-roots test results show that all variables are stationary at the conventional significance levels. The unit-roots test findings for all the nominal interest rate categories are consistent with the intuition that interest rates have a zero lower bound which implies that investors are not willing to accept negative nominal returns. Given this, monetary authorities tend to ensure positive and stable interest rates as part of macroeconomic stabilization measures. The same is also consistent with the Taylor rule principle which suggests that a central bank will hike the policy rate by more than unit in response to a unit increase in inflation (Balele, 2013). Stationarity of the variables imply absence of the long run but a dynamic relationship between expected inflation and short-term interest rate.

Granger causality Wald test

The literature on the Fisher effect assumes one-way causality from expected inflation to nominal interest rate. However, there is no consensus on causality between nominal interest rate and expected inflation. For instance, while studies on the Fisher effect investigate the effect of inflation on interest rates (e.g. Fisher, 1930; Darby, 1975; Feldstein, 1996), other studies (e.g. Barsky & Delong, 1991) assess the effect of nominal interest rate on inflation.

A source of uncertainty on causality between nominal interest rate and expected inflation is that most of the Taylor rule and Taylor-type rule studies are inclined to application of the generalized method of moments as a remedy to the endogeneity problem between interest rate and expected inflation (e.g. Balele, 2013; Rotich et al., 2007; Sanchez-Fun, 2002). This uncertainty motivates testing for causality between expected inflation and interest rate to ascertain the direction of movement between the two variables. Granger causality Wald test results are reported in Table 3.

TABLE 3. GRANGER CAUSALITY WALD TEST

Equation	Excluded	chi2	df	Prob>chi2
$onibcm$	exp _inf	5.4234	2	0.066
$onibcm$	All	5.4234	2	0.066
exp_inf	0nibcm	0.3541	2	0.838
exp_inf	All	0.3541	2	0.838

Based on the statistically significant p-values of the Granger causality Wald test results, we reject the null hypothesis that expected inflation does not cause interest rate but cannot reject the null hypothesis that interest rate does not cause expected inflation. This implies a one-way causality from expected inflation to interest rate. This further implies that expected inflation predicts short-term interest rates which is consistent with theory, particularly the Fisher hypothesis.

OLS estimates

TABLE 4. OLS REGRESSION RESULTS

Coefficient	Estimate	p-value
α	0.95**	0.043
ρ	0.72***	0.000
λ	0.11*	0.052
F(2, 242)	156.20	0.000
Adjusted R-squared	0.56	
No. observations	245	

Note: In brackets are p-values

***stationary at 1%; **stationary at 5%; and *stationary at 10% level.

We estimate the modified Fisher equation (7) using OLS by including the lagged dependent variable to examine whether monetary policy involves partial adjustment. Table 4 reports the OLS regression results.

Discussion of the findings

According to the F-statistic, the overall model is statistically significant at the 1% level. The coefficient of the adjustment term is 0.72 and statistically significant at the 1% level with the expected positive sign. This implies that monetary policy does adjustments to smooth short-term fluctuations in nominal interest rate. Inclusion of the lagged dependent variable guarantees absence of serial correlation in the model. The constant term which is interpreted as the real interest rate is 0.95 and is statistically significant at 5% level. The coefficient of the expected inflation is 0.11 and is marginally statistically significant at 10% level with the expected positive sign. This suggests that the response of interest rate to a 1% increase in expected inflation is 0.11%. This finding is consistent with Fisher's (1930) finding of less than the one-for-one relationship between interest rate and expected inflation. In terms of the Taylor rule principle, the observed less than one-for-one relationship between expected inflation and interest rate can be interpreted as monetary policy accommodation.

The one-way causality from expected inflation to short-term interest rate justifies testing for the Fisher hypothesis. This is the novel aspect of this study as it distinguishes it from the prevailing literature, where most of the studies test the Fisher hypothesis directly without empirical evidence on causality between the two variables. These findings, in addition to the correlation coefficient and OLS regression results are consistent with each other and hence provide evidence that the observed finding on the relationship between expected inflation and short-term nominal interest rate is robust.

CONCLUSION AND POLICY IMPLICATIONS

The study examined the seemingly unsystematic relationship between inflation and nominal interest rate by testing the Fisher hypothesis. The Fisher hypothesis predicts a one-for-one relationship between nominal interest rate and expected inflation. The reviewed literature provides empirical evidence of less than one-for-one relationship between expected inflation and interest rate which is evidence of the weak form of the Fisher hypothesis versus the Fisher's (1930) prediction of one-for-one relationship between expected inflation and interest rate. Specifically, the study examined the one-for-one relationship between inflation and nominal interest rate. The main hypothesis is that the weak form of the Fisher hypothesis (i.e. less than one-for-one) holds despite intermittent unsystematic relationship between inflation and nominal interest rate. The study went beyond the empirical evidence in the literature by testing causality between expected inflation and short-term nominal interest rate to ascertain causality between the two variables. Finally, a modified Fisher equation which incorporates an adjustment term as estimated to investigate whether monetary policy involves interest rate adjustment.

The correlation coefficient and OLS estimates show small coefficients (less than unit), implying not only less than a one-for-one relationship but also a weak response of short-term interest rate to expected inflation. This is consistent with the observed weak relationship between expected inflation and short-term nominal interest rate from correlation coefficient estimates. The finding of stationary short-term nominal interest rate and expected inflation rate provides evidence of a dynamic relationship between short-term interest rate and expected inflation but no long run relationship between the two variables. Causality test results show evidence of a one-way causality from expected inflation to short-term nominal interest rate. This allows to conclude that expected inflation predicts short-term interest rate. The economic intuition behind this outcome is that inflation expectations are reflected in the cost of funds.

The statistically significant adjustment term provides evidence for monetary policy adjustment which are intended by the central bank to smooth short-term fluctuations in interest rates. Interest rate smoothing reduces uncertainty to borrowers/investors especially in lending, which in turn motivates economic growth by creating a favorable investment climate. According to the Taylor rule principle, the Bank of Tanzania has been conducting monetary policy accommodation as indicated by not only the less than one-for-one but also a weak relationship between expected inflation and interest rate. This implies that the Bank of Tanzania reactions to inflationary shocks have been less aggressive to fully offset the increase in expected inflationary pressures. These findings corroborate the empirical evidence in the literature.

In terms of policy implications, the observed weak Fisher hypothesis implies that short-term interest rate movements do not perfectly reflect inflation expectations. These findings provide evidence that the overnight interbank cash market rate is a potential operating target under the interest rate-based monetary policy framework. The less than one-for-one finding provides justification and comfort for the Bank of Tanzania to switch from the prevailing monetary targeting regime to the interest rate-based regime as a means of solving the imminent challenge of ineffective monetary policy due to unstable money demand. Instability in money demand is the result of the substantial progress in financial inclusion particularly mobile money services in the country. However, there should be continued measures to strengthen the monetary policy transmission through the interest rate channel.

The finding that inflation predicts short-term interest rates implies that inflation stabilization is important in stabilizing interest rates. Stable interest rates imply confidence on investment decisions and hence a good environment for investors. All these contribute to economic growth. Therefore, the Bank of Tanzania has a crucial role on economic growth and macroeconomic stability through stable interest rates in achieving its primary objective of price stability.

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APPENDIX

LAG SECTION-ORDER CRITERIA

Variable	Information Criteria AIC	FPE	No. lags (conclusion)
exp_inf	3	3	3
$onibcm$	4	4	4
$repo$	1	1	1
$lombard$	4	4	4