Testing for Fisher's Hypothesis in Eswatini

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Abstract

This paper set out to investigate the Fisher effect in Eswatini. It used the Autoregressive Distributed Lag (ARDL) approach using quarterly data from 2000Q1 to 2020Q1. The results revealed the presence of a partial Fisher effect in both the short-run and the long-run, indicating that nominal interest rates (Treasury bill rate) do not fully adjust for expected inflation. In the long-run, a 1 per cent increase in inflation would increase interest rates by 0.21 per cent (P<0.10). The weak significance could be explained by the country's membership to the Common Monetary Area (CMA) in which the country's interest rate relatively tracks that of South Africa which is the anchor economy. In the short-run a 1 per cent increase in inflation would increase interest rates by 0.09 per cent (p<0.05) whiles 1 per cent in inflation lagged once would increase interest rates by 0.10 (p<0.05). The results further revealed that about 20 per cent of the deviation from the long-run path is corrected every quarter (P<0.01).

Keywords: *ARDL, Fisher Effect, Inflation, Treasury Bill Rate, Eswatini*

1. Introduction

The relationship between interest rate and inflation has attracted considerable global economic research interest with findings from the existing empirical literature differing on the findings. Known as the Fisher hypothesis, the theory suggests that

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there is a positive relationship between interest rates and expected inflation. According to this hypothesis, nominal interest rates have two components: real interest rate and the expected rate of inflation (Fisher, 1930). In his assertion, Fisher (1930) suggests that a change in the expected inflation does not affect the real interest rate but induces the same change in the nominal interest rate in the long-run. This therefore suggests that there is a one-to-one link between the two macroeconomic variables.

Testing for the existence of the Fisher hypothesis is common course in monetary economics and of critical importance to monetary policy decision makers. This is done in order to test for the effectiveness of monetary policy as nominal interest rates play a crucial role towards inflation adjustment and the determination of savings and investment behavior of economic agents. This behavior by extension not only also matter for the effectiveness of monetary policy but for the overall growth of the economy. As a result, the interrogation of the Fisher hypothesis is becoming more intense as central banks continue to pin their monetary policy against specified targets of inflation.

While the Fisher hypothesis holds true for most countries, it has been criticized for the lack of an adequate method of inflationary expectations measurement (Cooray 2003). On that note, a number of approaches have been used to measure inflationary expectations in the economy. One of these methods as proposed by Fisher (1930) is the use of distributed lag of past values of inflation rates. Another approach is based on the rational expectation procedure by Muth (1961) and Fama's (1982) efficient market hypothesis. The rational expectation procedure assumes that future inflation rate equals the expected rate of inflation, while efficient market

hypothesis suggests that agents use all available information to predict inflationary expectations.

This paper seeks to empirically test the validity of the Fisher hypothesis in Eswatini by testing whether a long-run relationship between the monetary policy rate and inflation exists. The results of this study are expected to provide useful understanding to the country's monetary authorities about the relationship between inflation rate and interest rate as they would know if they have been responding aggressively or not to inflation developments.

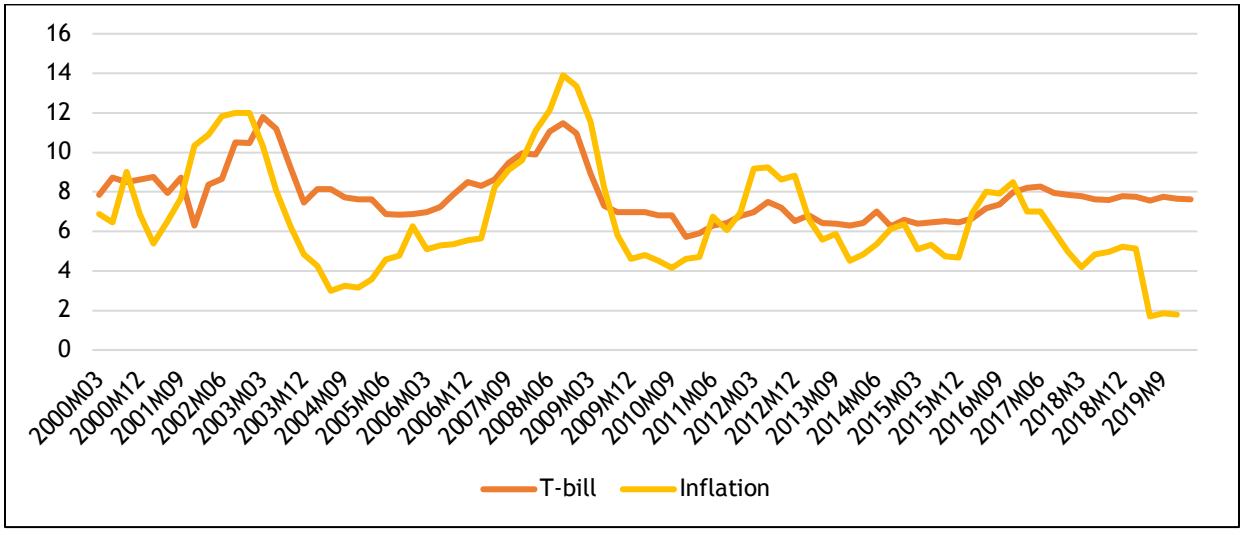
The rest of the paper is organized as follows; Section 2 presents stylized facts about monetary policy in Eswatini whiles section 3 presents the theoretical and empirical literature on the Fisher effect. The methodology of the study is presented in Section 4 whiles the results and discussion are presented in section 5 and Section 6 presents the conclusion and recommendations.

2. Stylized Facts about Eswatini's Monetary Policy

Eswatini's monetary policy subscribes to its membership to the Common Monetary Area (CMA) comprising South Africa, Lesotho and Namibia. Under the CMA, South Africa is the anchor economy and the South African Rand circulates as a legal tender in the other three member states convertible on a one-to-one basis. The Rand on the other hand is freely floating and therefore purely determined by market forces. Given the fixed exchange rate setting, the discount rate (policy rate) in Eswatini closely tracks the South African repo rate, albeit with some small deviation, as South Africa is the anchor economy. In line with the trilemma, Eswatini therefore has limited monetary policy independence with free capital flows and a hard peg. The trilemma theory states that a country cannot pursue an independent monetary policy, free

flow of capital and a fixed exchange rate all at the same time but can only have two options at a time.

Figure 1: Eswatini Inflation and Treasury Bill Rates



Source: Central Bank of Eswatini

Figure 1 depicts quarterly trends of Eswatini's treasury bill rate and the inflation rate from the first quarter of 2000 to the first quarter of 2020. It is evident from the graph that where inflation was consistently high, monetary policy followed suit and became more restrictive in order to curtail inflationary pressures.

3. Literature Review

3.1 Theoretical Literature

The Fisher hypothesis refers to the relationship between nominal interest rates, real interest rate, and inflation expectations which was first described by an American economist Irving Fisher in 1930. According to Fisher (1930), the nominal interest rate (l_t) is made up of two components, namely; the expected rate of inflation (π_t^e) and the real interest rate (r_t). The equation is specified bellow;

$$I_t = r_t + \beta\pi_t^e \quad \text{..... (1)}$$

Where; β is the coefficient and the other variables are as described above. β provides an indication of the strength of the fisher hypothesis (Peng, 1995). Fisher (1930) postulated a one-to-one relationship between the rate of interest and expected inflation, and that the real interest rate is independent of inflation. A one-to-one (β =1) relationship between the rate of interest and expected inflation indicates a full Fisher effect whiles a coefficient greater than zero and less than one (0<β) indicates a partial effect. If β = 0, there is absence of a long run relations between interest rate and expected inflation (Peng, 1995, Uyaebo *et al.*, 2016 and Yaya, 2015).

3.2 Empirical Literature

Mitchell-innes *et. al.* (2008) conducted a study on the relationship between expected inflation and nominal interest rates in South Africa using monthly data from April 2000 to July 2005 and used the error correction model. The authors used the three-month banker's acceptance rate to proxy the short term interest. The results revealed that the Fisher Hypothesis did not hold in the short-run over the review period. The authors attributed this to South African Reserve Bank's (SARB) control over short-term interest rates and the effects of the monetary transmission mechanism. The result also could not confirm the long-run Fisher hypothesis in its strictest form but changes in inflation expectations move in the same direction as the nominal long-term interest rate. This suggest that monetary policy has an influence on long term interest rates.

Mkhombo and Phiri (2022) used different methodologies to investigate the Fisher effect in South African Customs Union (SACU) countries; namely Ordinary Least Squares (OLS), Dynamic OLS (DOLS), Fully-modified OLS (FMOLS) and ARDL. The used monthly data spanning from 2005 to 2021. For Eswatini, Using and different

approaches, Mkhombo and Phiri (2022) found a coefficient of 0.46 (P<0.01) through the OLS; 0.49 (P<.01) through the Fully Modified OLS; 0.49 (P<0.01) through the Dynamic OLS and 0.53 through the ARDL approach.

Nigel *et al.* (2015) used an Error Correction Model (ECM) to investigate the Fisher Hypothesis in Sri Lanka over the period 1959-2011. The results revealed the results revealed that nominal interest rates (91 days T-bill rate) in Sri Lanka fully adjust for expected inflation in the long-run. In the short-run, a significant positive relationship between interest rates and expected inflation was observed but without a full Fisher effect.

Zainal *et al.* (2014) used the conducted ARDL approach to determine the existence of the Fisher effect in Malaysia using monthly data spanning a period of 13 years from January 2000 to December 2012. The results revealed the presence of the long-run Fisher effect between inflation and the T-bill and interbank rates. the results further revealed that the interbank rate holds a stronger relationship with expected inflation rates, indicating the its ability to predict future inflation rates.

Sheefeni (2013) tested the Fisher hypothesis in Namibia through the VECM approach using monthly data spanning from 1992M1 to 2011M12. The results indicated that there is no cointegration between interest rates (3 months T-bill rate) and inflation. In Nigeria, Ogboma (2013) used ARDL approach to examine the Fisher effect over the 1970Q1 and 2012Q4. The co-integration results revealed the absence of the cointegration between interest and inflation rates. However, a study conducted by Uyaebo *et al.* (2016) using the Gregory and Hansen cointegration test between use data from 1970 and 2014 reported the presence of a long-run between nominal interest rate (3 months T-bill rate) and inflation. However, the coefficient was very

small (0.08), indicating a weak form of a Fisher effect in the long run. The results also reported the absence of a fisher effect in the short run.

Yaya (2015) used an ARDL approach to examine the Fisher effect in ten African countries and it use the deposit rate to measure as a measure of nominal interest rate. The long-run results revealed the that the full Fisher effect holds in Kenya and partially holds (less than one-for-one) in Cote d'Ivoire and Gabon. Conversely, the results suggest no evidence of the Fisher effect in other seven countries, namely; Benin, Cameroon, Gambia, Ghana, Nigeria, Senegal and South Africa.

In Rwanda, Ruzima *et al.* used an ARDL to examine the Fisher effect over the period 2012M5 to 2020M2. The results revealed the evidence a partial Fisher effect over the period, indicating that changes in inflation are not fully absorbed in nominal interest rates. This suggest that monetary policy may not be fully efficient under such conditions and household savings may suffer a decrease. The short-run results showed no Fisher effect between interest rate and expected inflation.

4. Methodology

Following studies by Ediringhe *et al*. (2015) and Mkhombo & Phiri (2022), the study uses the ARDL approach to establish the relationship between interest rates and inflation.

The ARDL model is specified as follows;

$$\Delta T\_bill = \beta_0 + \sum_{i=1}^{n1} \beta_{1i} \Delta T\_bill_{t-i} + \sum_{i=0}^{n2} \beta_{2i} \Delta INF_{t-i} + \alpha_{1i} INF_{t-1} + u_t \quad \text{.....(2)}$$

Where; T-bill is the is the 91 days treasury bill rate; a proxy for monetary policy and INF is Eswatini's inflation. The study uses the T-bill rate because it changes more often to reflect market forces whiles it still closely tracks the policy rate (discount rate) whereas the policy rate changes less frequently. Similar studies like Nigel *et al*. (2015)

in Sri Lanka, Sheefeni (2013) in Namibia and Uyaebo *et al*. (2016) in Nigeria also use the 91 days T-rate rate to proxy monetary policy. β_0 is the intercept, β_i are the short-run coefficients, α_{1i} is the long run-coefficient and μ_t is the error term.

The study used the Augmented Dickey Fuller (ADF) and the Phillips and Perron (PP) tests to determine the stationarity properties of the variables and the Akaike Information Criterion (AIC) test is used to determine the optimum lag length within the ARDL method in Eviews 11.

The study further used the Bounds test for cointegration as espoused by Pesaran *et al.* (2001) to establish if there is a long-run relationship between interest rates and inflation. The null hypothesis of no cointegration is rejected if the computed F-statistic is higher than the upper bound critical values and we fail to reject it if the F-statistic is lower than the lower critical values. The test is inconclusive, if the F-statistic falls in between the lower and the upper bound values (Pesaran *et al*., 2001). Diagnostic tests were conducted to determine the stability of the model used. These include the; CUSUM and CUSUM of Squares test, Jarque Bera test for normality, LM test for serial correlation and the Breusch Pagan Test for heteroskedasticity. For the CUSUM and CUSUM of Squares Test, the CUSUM or CUSUM of squares should lie between the 5 per cent bands for the coefficients to be structurally stable. On the Jarque Bera Test, the F-statistic has to be insignificant for the residuals to be said to be normally distributed. For the LM test we fail to reject the null hypothesis of no serial correlation if the test is insignificant whiles for the Breusch Pagan Test, we fail to reject the null hypothesis of homoskedasticity.

The inflation and T-bill rate data used in the study was obtained from the Central Bank of Eswatini quarterly reports. By design, the treasury bill rate is used as a proxy

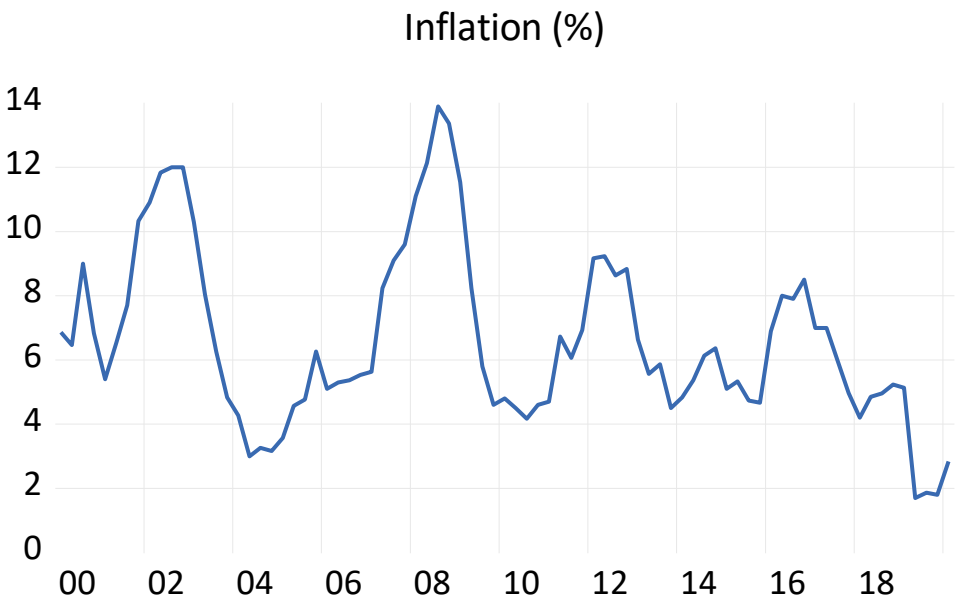
for monetary policy rates as it best captures the money market developments better than the discount rate which remains flat for an extended period.

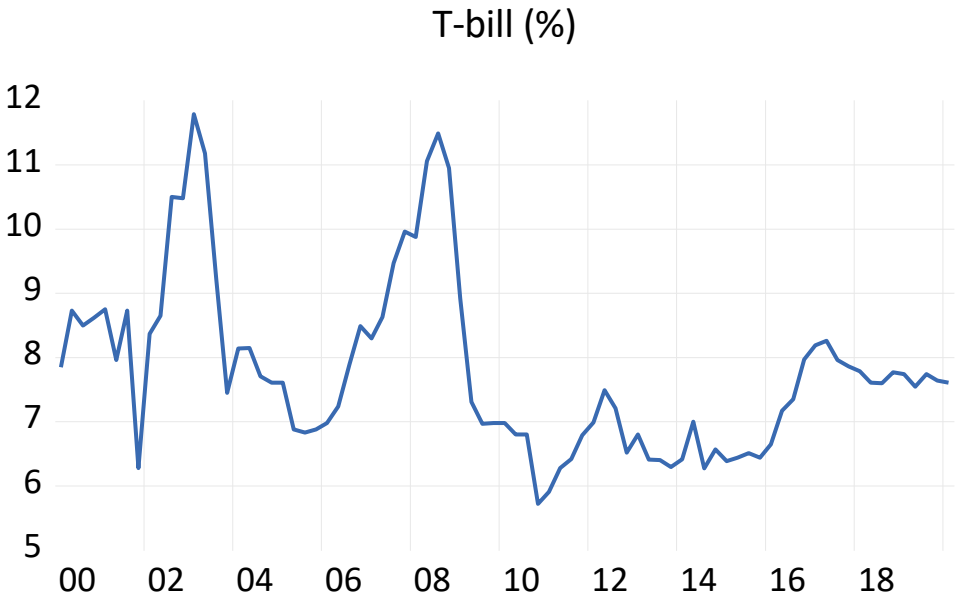
5. Empirical Analysis

5.1 Data Analysis

Figure 2 shows the graphical presentation of the variables used in the study. Both variables, T-bill and inflation appear to be stationary at level with an intercept.

Figure 2: Graphical Analysis of Variables





The stationarity test results are presented on Table 1. The Augmented Dicky Fuller (ADF) test result indicate that the T-bill rate is stationary at levels whilst the PP test indicates that it is integrated of order 1. Both tests indicate that inflation is stationary at levels. The results therefore permit the use of the ARDL model as the variables are I(0) and I(1).

Table 1: Stationarity Test Results

	ADF Test			Philips- Perron Test		
Variable	**Level**	**1st Difference**	**Order of Integration**	**Level**	**1st Difference**	**Order of Integration**
T-bill	-2.629*	-8.769***	I(0)	-2.430	-8.793***	I(1)
Inflation	-3.757***	-6.347***	I(0)	-2.638*-	-6.439***	I(0)

NB: ***, ** indicates significance at 1%, and 5% and 10%, respectively.

The Akaike Information Criterion (AIC) was used to determine the appropriate lag length within the ARDL model in eviews 11. The order of the ARDL model was selected to be (2,2) with maximum number of lags automatically set to be 3.

5.2 ARDL Model Results

5.2.1 Diagnostic Tests

The model diagnostics results are presented on Table 2. The Jarque Bera test for normality was statistically insignificant indicating that the residuals are normally distributed. The LM Test for serial correlation was also insignificant indicating the absence of serial correlation and therefore the study fails to reject the null hypothesis of no serial auto correlation. The model also had no heteroskedasticity as the Breusch-Pagan-Godfrey test was insignificant. The study therefore fails to reject the null hypothesis of homoscedasticity.

Table 2: Diagnostic Test Results

Test	F-Statistic	Prob
LM Test	0.940	0.396
Breusch-Pagan-Godfrey	0.689	0.757
Jarque Bera	4.3122	0.116

5.2.2 Bounds Test Results

The Bounds test results on Table 3indicate the presence of cointegration as the F-statistic is higher than the critical upper bound at 2.5 per cent level. The study therefore rejects the null hypothesis of no cointegration.

Table 3: Bounds Tests Results for Cointegration

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	5.083679	10%	3.02	3.51
K	1	5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58

5.2.3 ARDL Model Long-run Results

The results on Table 4 indicate that in the long-run, inflation is positively but weakly related to the nominal interest rates (P<0.10). A 1 per cent increase in inflation would result in a 0.21 per cent increase in nominal interest rates in the long-run. This indicates the existence of a partial Fisher effect in the long run. The weak link between inflation and interest rates could be explained by the fixed exchange rate regime under the CMA in which South Africa is the anchor economy. Eswatini's interest rates track that of South Africa, albeit with some small deviation at times, in an effort to curb capital outflows hence the weak relation between domestic inflation and interest rates. The results are almost similar to those of Mkhombo and Phiri (2022) which also revealed a partial effect of 0.53 for Eswatini.

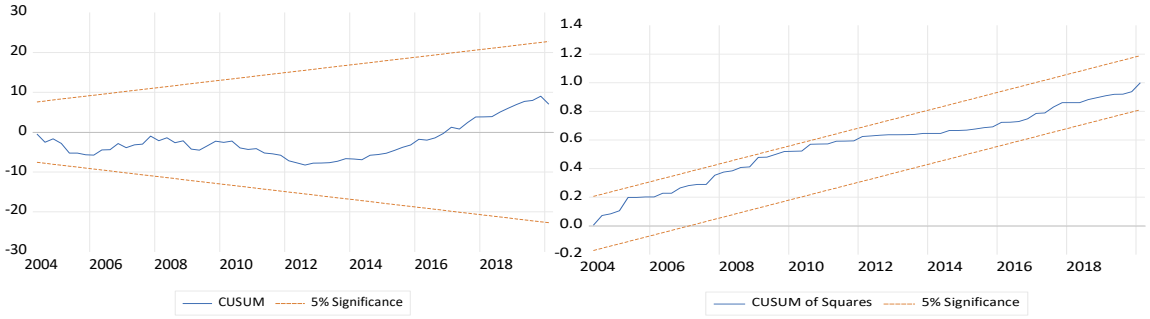
Table 4: ARDL Long-run Coefficient Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INFLATION	0.212866	0.119460	1.781900	0.0794*
C	6.305518	0.804290	7.839858	0.0000***

NB: *** indicates significance at 1% level and * indicates significance at 10%.

The CUSUM test and CUSUM of Squares graphs are within the 5 per cent bound as shown in Figure 3, indicating that the model is stable.

Figure 3: CUSUM and CUSUM of Squares



5.2.4 ARDL Model Short-run Results

Table 5 below shows the short-run results of the ARDL model. The results indicate that the discount rate lagged once has a positive effect ($p<0.01$) effect on the interest rate. A 1 per cent increase in the discount rate lagged once would increase the current interest rate by 0.26 per cent. Inflation also has a positive effect ($p<0.10$) on interest rates. A 1 per cent increase in consumer price index would increase interest rates by 0.09 per cent. Furthermore, the consumer price index lagged once also has a positive effect ($p<0.05$) on interest rates. A 1 per cent increase in consumer price index lagged once would increase interest rates by 0.11 per cent. The results show the presence of a partial Fisher effect in the short-run. The results indicate that about 19.7 per cent of deviation from the long-run path is corrected every quarter ($P<0.01$).

Table 5: ARDL Short-run Coefficient Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(T_BILL(-1))	0.260377	0.086950	2.994543	0.0039**
D(INFLATION)	0.087332	0.043516	2.006919	0.0489*
D(INFLATION(-1))	0.108814	0.044347	2.453671	0.0168**
DUM2008Q2	1.185720	0.441247	2.687200	0.0091***

DUM2009Q1	-1.317329	0.443453	-2.970615	0.0041***
DUM2004Q1	1.381672	0.450775	3.065101	0.0032***
DUM2001Q4	-2.852912	0.443147	-6.437838	0.0000***
CointEq(-1)*	-0.196714	0.049625	-3.963987	0.0002***
R-squared	0.695624	Mean dependent var		-0.014177
Adjusted R-squared	0.650863	S.D. dependent var		0.722929
S.E. of regression	0.427163	Akaike info criterion		1.265240
Sum squared resid	12.40786	Schwarz criterion		1.595163
Log likelihood	-38.97699	Hannan-Quinn criter.		1.397418
Durbin-Watson stat	2.134182			

NB: *** and ** indicates significance at 1% level and 5%, respectively.

6. Conclusion and Policy Recommendations

The study examines the relationship between interest rates and inflation in Eswatini using the ARDL approach. The long-run results revealed that the consumer price index is positively related to the interest rates indicating that the Fisher Hypothesis is valid in the long-run in the case of Eswatini. Whiles the Fisher Hypothesis exist for Eswatini, the study found that it is weak. The weak Fisher effect can be attributed to the CMA arrangement in which Eswatini's interest rates are closely linked to that of South Africa which is the anchor economy in the CMA. The short-run results revealed that interest rates have an inertia effect with the interest rate lagged once having a positive effect on interest rates. The consumer price index also has a positive effect on interest rates which indicates the presence of the Fisher hypothesis in the short-run.

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