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Investigating the Fisher's Effect in Uganda: Evidence from ARDL Model

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Abstract: Given that no other study has conducted the same empirical work in Uganda, the study examined Fisher's (1930) effect in this particular country. While inflation and the money supply served as the explanatory variables, the nominal interest rates served as the dependent variable. Through the use of data collected between 2011M7 and 2021M3, the ARDL model was employed in the study. The results showed that nominal interest rates indeed, in the long term, respond to predicted inflation rates on a one-to-one basis, with positive and statistically significant results. This indicates that Uganda is where Fisher's effect is strongest. These findings demonstrate the validity of inflation targeting and make it easier for economic agents to predict inflation and the nominal interest rate. Granger causality, which has a unidirectional causality extending from inflation to nominal interest rates, likewise confirmed the same findings. The paper suggests that Uganda's monetary policymakers shift to a full-fledged inflation-targeting regime at the second level of inflation targeting to anchor the commercial agents that will produce the highest amount of investment-driven growth.

Keywords: Fisher's effect; interest rates; Granger Causality and ARDL model

JEL Classification: E430

1. Introduction

Even though Fisher's effect has been the subject of a sizable body of literature around the world, no research on the concept has ever been done in Uganda Fisher's (1930) impact has drawn a lot of attention, particularly in developing and wealthy nations. Except Anselme, (2018), who did not provide conclusive evidence supporting Fisher's theory in the inquiry, since the main focus of the study was to investigate the monetary

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policy and stock market returns in Uganda. Therefore Fisher's effect hasn't been studied in other lower-income economies like Uganda. The real interest rate is left unaltered by the Fisher hypothesis, which emphasizes the link between nominal interest rates and inflation rates (Kose, et al., 2012). This suggests that the expectation channel in line with inflation rates amplifies changes in nominal interest rates. The first, known as the weak version of the Fishers effect, takes place when the inflation coefficient is less than one which is one of the two ways in which it can hold. The second one is the so-called "strong form of Fishers effect" criterion, which involves one or more inflation coefficients. When the strong requirement is met, it means that the monetary policy does not affect the short-term interest rate; rather, the monetary policy authorities choose to determine the real interest rate in light of the monetary policy's demands and goals. The policy rate, for instance, becomes the central bank's primary instrument in an economy that targets inflation and is set up to transmit signals to other monetary and real variables via the interest rate channel. As a result, the Fishers effect is crucial because it gives policymakers complete power over economic decisions by allowing them to alter real interest rates, such as raising them to curb inflation in the medium term. Second, real interest rates are the primary factors influencing investment decisions, production, and exchange rates (Alimi, 2014).

Uganda has been using inflation targeting light (ITL) since the program's commencement in 2011. According to Stone, (2003), an economy that adopts inflation targeting as the goal of its monetary policy but is unable to stay within its target range is said to be in an ITL predicament. The author also lists these two ITL characteristics: Before announcing their target band, they use the floating or managed to float off the exchange rates. Being a lower-income economy, the circumstances and monetary activities are likely to be impacted by additional economic shocks. Since the program's inception in 2011, Uganda's economy has been utilizing inflation-targeting light (ITL). An economy that embraces inflation targeting as the objective of its monetary policy but is unable to maintain its target range is considered to be in an ITL conundrum (Stone, 2003). Additionally, the aforementioned author includes these two ITL traits: They use the floating or regulated floating of the currency rates before announcing their goal band. As a lower-income economy, it is more likely that new economic shocks will affect the situation and financial activity. Additionally, Galesi *et al*, (2017) found that maintaining policy rates near to their natural rates causes other significant variables, such as GDP growth, employment, and inflation, to follow a trajectory that maximizes well-being.

The empirical literature is like a dog that never barked concerning the Fishers effect in the region of Uganda. The theory was found on one-to-one adjustment between the nominal interest rates and inflation rates. However, most studies such as (Camba and Camba, 2021) and (Çiğdem, 2019) findings indicate the weaker version of FFisher'shypothesis in different parts of the world. Therefore this study will serve two purposes, firstly it lay new ground by directly investigating Fisher's theory for the first time in Uganda as a small economy exercising the ITL. Secondly, it revisits the Fishers hypothesis in the empirical literature to find out which Fishers hypothesis will hold between the weak and strong Fishers version. [1]

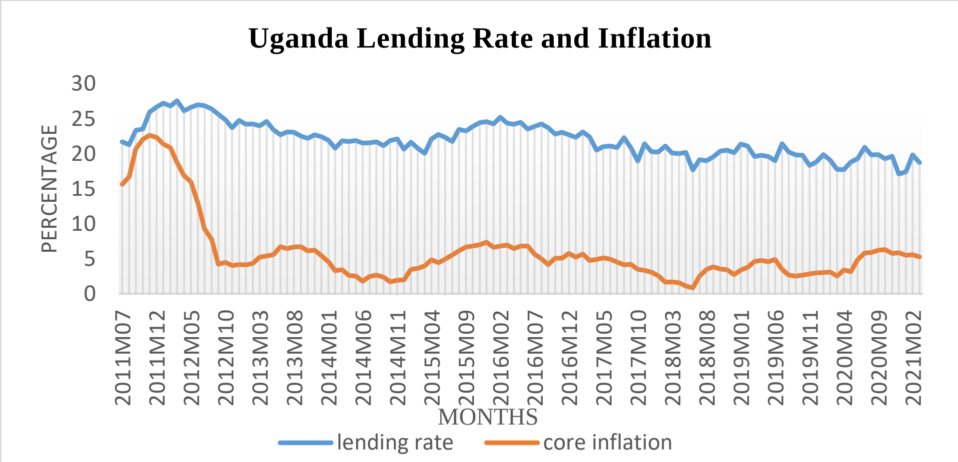

Figure 1. Nominal Interest Rates and the Inflation Rate of Uganda
Authors' computation using the data derived from World Bank

To show that the nominal interest rates and inflation can predict one another, they should move in the same direction. The fluctuation of the interest rate and inflation since July 2011 is shown in Figure 1. This period marks the beginning of Uganda's inflation-targeting system. The graph makes it obvious that inflation targeting made inflation linger near the 5% target so that it would eventually move in step with the lending rate. The aforementioned data set stands out when compared to annual and quarterly data because it depicts both variables' smallest changes. The remainder of this paper proceeds as follows: Section 2 covers the literature review on Fisher's hypothesis and the interest rates channel[2], the methodology is highlighted in Section 3, Section 4 highlights empirical results, and conclusions and recommendations are presented in Section 5.

[1] Inflation targeting light is the condition where central bank announce it target to the general public but it is not expected to meet the target, (Stone 2003). The central bank is also allowed to float the currency.
[2] Salter (2014) highlight some inflation targeting elements such as: 1. to make IT available to the broader populace. 2. Second is the central bank's and all essential authorities' institutional commitment to the announced aim. 3 Third criterion is an inflation-inclusive strategy for determining policy instruments such as interest rates that will be utilized to keep inflation under control. 4, the rise in public transparency, so that policy decisions, plans, target, and actual inflation should be known. 5, the final aspect is increased accountability. See also Bernanke and Mishkin (1997), Rudebusch and Svensson (1999), and Woodford (2001).

2. Literature Review

The initial economist to explicitly link nominal interest rates and inflation rates was Irving Fisher. He argued that one-to-one adjustments should be made so that the nominal interest rates and inflation rates move in the same direction. Influencing changes in investment and saving but leaving the real interest rate untouched, i.e., at the monetary authorities' discretion (Alimi, 2014). Because nominal interest rates and inflation should be kept as low as feasible, Uganda's economy's long-term inflation target is 5%. Inflation is kept low because it is a shared adversary and because it is harmful to economic growth in particular (Ekinci, Tüzün, and Ceylan, 2020) and (Edirisinghe *et al.*, 2015).

The principal tool used by Uganda's central bank to control inflation rates in the medium term is interest rates. It is crucial to watch the interest rates channel for this reason. A central bank's operations, which alter the policy rate, are the first step in the link between monetary policy changes and price levels. By altering its official interest rate, a central bank can have a significant impact on the money market and investment levels. The interest rate is therefore the most crucial policy instrument for controlling demand-pull inflation. When the economy is experiencing demand-side inflation, central banks raise interest rates; conversely, when demand is deficient, central banks reduce interest rates (Taylor, 2019).

As a result, interest rate rises and falls attempt to maintain money market equilibrium, and the higher repo rate reduces inflation in the long run, according to the Keynesian transmission mechanism (Snowdon and Vane, 2005). When inflation is strong, the MPC raises the repo rate to reduce the money supply. A high rate of interest, according to the hypothesis, is negatively connected with investment, lowering overall consumption in the economy, as represented by the symbols ($\Delta i \uparrow \rightarrow \Delta m3 \downarrow \rightarrow \Delta I \downarrow \rightarrow \Delta C \downarrow \rightarrow \Delta \pi \downarrow$). The mechanism that has been emphasized helps to stifle economic activity. Meanwhile, Low inflation necessitates the use of monetary policy instruments to stimulate the economy.

Through several research carried out globally, Fisher's hypothesis has been seen in both developed and developing economies. In the study that looked at the relationship between interest rates and inflation rates in three major economies, namely: Germany, Britain, and Switzerland, Dritsaki, (2017) found a positive relationship. The bound test for cointegration was used in the study to represent the relationship between the variables using the ARDL model. On the other hand, Fisher's theory was ultimately proven correct in the UK (Gocer and Ongan, 2020). The study used the non-linear ARDL model to simulate the impact of changing interest rates on inflation. The analysis upheld the validity of Fisher's theory of interest rates in connection to monetary policy conducts using secondary data spanning the years 1995M1 to 2018M1.

Additionally, although Fisher's hypothesis is the foundation for the one-to-one relationship between nominal interest rates and anticipated inflation, in the case of the Philippines, where Fisher's weak hypothesis has been verified by (Camba and Camba, 2021). The study utilized the Engle and Granger model, with data spanning from 1995M1 to 2020M12, and the ECM and Granger causality techniques derived from Johansen cointegration. The outcomes are consistent with the central bank of the Philippines' concept of credible inflation targeting. According to reports, Turkey follows the same path in terms of Fisher's hypothesis. The work used the daily data taken from the Turkish central bank along with the vector error correction model (VECM), which also made Granger causality possible (Çiğdem, 2019).

Before the global financial crisis (GFC) the South African Reserve Bank, (Phiri, 2022) fully confirmed Fisher's hypothesis South African Reserve Bank (SARB). The investigation also discovered that Fisher's hypothesis was weak in the post-crisis period. The study used secondary data covering the period from 2002 M1 to 2021 M1, Wavelet Power spectrum, and Wavelet phase-difference dynamic model. The paper highlights the GFC's influence and cascading effects, which led to the taper tantrum and quantitative easing. The same results were consistent with the inflation-targeting markets in Brazil and Indonesia. Additionally, the study verified the existence of bi-directional causality between the two variables under consideration (Bayat *et al.*, 2018). Markets that do not target inflation can occasionally counteract Fisher's effects. For instance, because Venezuela disagreed with Fisher's theory, equal amounts of data from 1990 M1 to 2016 M12 were used in the analysis with Johansen for cointegration (Kasim & Bentouir, 2018).

The Fishers effect in the region of Uganda is not mentioned in the empirical literature. MUSE, (2019) used the straightforward OLS and Granger causality test in a vector autoregressive model (VAR) set up to examine the link between the interest rate and inflation rate. In the years between 1998 and 2018, the analysis discovered a negative correlation between inflation and interest rates. The motive behind this study was not based on testing Fisher's hypothesis. According to the aforementioned findings, the factors under investigation travel in a different way than they did before 2011. The regime changes that occurred during the study period were not taken into account.

On the other hand, Fisher's hypothesis is prevalent throughout the extensive literature addressing various economies. The one-to-one relationship between nominal interest rates and the inflation rate is, however, disproved by the majority of investigations. For instance, Yaya, (2015) arrived at comparable conclusions after a thorough analysis of the Fisher effect in Kenya, Gabon, and Cote d'Ivoire. The study used the ARDL model, through which it was determined that the Fishers hypothesis is true for the financial market's effective operation. In Malaysia, similar attitudes were confirmed by (Zainal *et al.*, 2020). The majority of researchers agree that there is a positive relationship between inflation and nominal interest rates, although they disagree that the variables adjust in a one-to-one manner. Kenya Ndiritu, (2018) showed the aforementioned outcomes in the latter economy. The ARDL model and the Granger causality test were used to determine the study's findings. In Nigeria, Awomuse and Alimi, (2012) confirmed similar findings. The Fishers effect is believed to persist over time in other emerging markets outside of Africa, according to the same evidence. Fisher's hypothesis is consistent over the long term, according to Ito, (2016), who also praised the credibility of inflation targeting. The study said that the results came from the cointegration approach used by Engle and Granger. Ayub *et al*, (2014) in Pakistan added to the conclusions made by (Arısoy, 2013 and Güri, 2015). According to a different group of studies, there is a bad correlation between nominal interest rates and inflation rates. For instance, (Sheefeni Sheefeni, 2013) has stated the findings in Namibia as a result of the cointegration strategy. Similar opinions were drawn by (Alimi, 2014). These results suggest that the markets in certain countries might not function effectively.

Additionally, the Fisher, (1930) effect is still present in China, but the inflation rate is positive and less than 1. To support the aforementioned conclusions, the study used a fully modified ordinary least square (FMOLS) model (He, 2018). The non-linear autoregressive distributed lags (NARDL) model, on the other hand, was used by Phiri, (2022) to account for the impact of both positive and negative shocks on the dependent variable. The study discovered that positive than negative inflation rate shocks have a greater impact on nominal interest rates. The findings of confirmed the co-movement of the inflation and nominal interest rates in Pakistan (Ayub *et al.*, 2014). Using data collected between 1973 and 2010, the study used the Johansen cointegration approach and the Engle and Granger cointegration approach. The relevant model utilized in the study is covered in the part that follows.

3 Methodology and Data

3.1. Theoretical Model

Fisher's (1930) model is based on the theory formulated by Irvin Fisher who argued that the nominal interest rates are equal to real interest rates and inflation rates. The equation is formulated as follows:

$$i_t = r_t + \pi_t^e + u_t \quad (1)$$

Where i_r denotes the nominal interest rates, r_t denotes the real interest rates, π_t^e denotes the expected inflation rates and u_t denotes the white noise error term with zero mean and constant variance. In general, the above equation can also be expressed as follows:

$$i_t = \alpha + \beta\pi_t^e + u_t \quad (2)$$

Where α and β denote the constant and the slope of the model. The constant is the real interest rates that should not be affected by the monetary policy, and the slope denotes the constant change in the expected inflation that equally affect the nominal interest rates. The slope should be positive and from there, it can have two conditions, that is it can be one or less than one. The interpretation given to a slope of less than one is called a weak form of Fisher's effect and if the slope is one then it is called strong Fisher's effect. The following empirical model will be used to regress Fisher's effect.

3.2. Description of the Variables

The consumer price index measures core inflation in Uganda after the Central Bank (CPI). The nominal interest rates are anticipated to have a positive sign, indicating that they are moving in the same direction. Therefore, based on Fisher's (1930) effect, inflation should have a coefficient of one. The dependent variable in the model is the lending rate, which has been used as a stand-in for nominal interest rates. The data for lending rates begin in 2011 together with the ITL regime, there it can reflect reasonable changes in inflation rates. The M3 indicator of the money supply has been included in the analysis. Simply because there is a negative association between interest rates and money supply in economic theory, it is expected that the money supply will have a negative sign. Additionally, the study is interested in the period between 2011M7 and 2021M3, when the central bank of Uganda (CBU) began inflation targeting, thus the data will cover that time frame as well. The Ugandan Bank provided the data for collection.

3.3. Empirical Model

Before the model is performed it is valid to test for unit roots in time series to avoid spurious regressions. The study relied on two of the most commonly applied tests, namely, the Augmented Dickey-Fuller (ADF) and the Phillips Peron (PP). Both the tests are based on the null hypothesis of no unit root and the decision criteria are to reject this null if the corresponding probability value is less than the maximum 10% level of significance. This study resorted to an Autoregressive Distributed Lag Model (ARDL) whose bounds testing procedure by (Pesaram *et al*, 2004), is designed to test and estimate both short-run and long-run specifications when variables are integrated into different orders, as long as none of the variables is integrated into order 2.

Technically, the ARDL model has econometric advantages of (i) being applicable when variables have a mixed integration, (ii) producing super-consistent estimates in small sample sizes, and (iii) addressing endogeneity when appropriate lags of the endogenous variables are included. The model takes the following form.

$$y_t = \alpha_0 + \sum_{i=1}^{p} \varphi_j \, y_{t-i} + \sum_{i=0}^{q} \aleph_i' \, x_{t-i} + \gamma t + u_t \qquad (3)$$

Where p and q denote the lags order for the lagged dependent and explanatory variables respectively. The variable y_t denotes the dependent variable, φ_j and $\aleph_i'$ are the coefficient vectors for the dependent and independent variables x respectively, t is a time trend and its slope φ while u_t is as defined before and it should have a zero mean value and a constant variance.

$$i_t = \alpha + \sum_{i=1}^{n} \beta\, i_{t-p} \sum_{i=1}^{n} \beta\, \pi_{t-p} + \sum_{i=1}^{n} \beta\, m3 + \varepsilon_t \quad (4)$$

$i = 1,2 \ldots p$ And t=1, 2…p

Where i_r and i_{t-p} denote the nominal interest rates and their lags respectively, α denote the constant term, $\pi, and\ m3$ denote the inflation rate, and money supply, respectively. As indicated earlier, the ARDL model allows for the variables to be a combination of the I (1) and I (0). In the literature, many integration tests can be used to test long-run relationships, and these include the fully modified OLS procedure of Hansen and Phillips (1990), Engle and Granger (1987) test, maximum likelihood Johansen (1988, 1991) and Johansen-Juselius (1990) tests. This study relies on the bound test for cointegration proposed by (Pesaran *et al.*, 2004). This procedure is conducted upon the estimation of an unrestricted error correction model which should be dynamically stable and free from serial correlation, heteroscedasticity, and residual non-normality. Upon confirmation of a long-run relationship i.e., when the F statistic from the unrestricted error correction model is greater than the 5% critical value, the conditional ARDL model of the following form.

$$\Delta i_t = \alpha + \sum_{i=1}^{n} \beta\, \Delta i_{t-p} \sum_{i=1}^{n} \beta\, \Delta\pi_{t-p} + \sum_{i=1}^{n} \beta\, \Delta m3_{t-p} + \lambda ECT_{t-1} + \varepsilon_t \quad (5)$$

Where Δ is the first difference operator, λ is the coefficient for the error correction term that is expected to be negatively signed and statistically significant. Following any short-term departure, the error correcting term (ECT) illustrates how quickly the system adjusts to its long-run equilibrium, in the event of monotonic adjustment, it is predicted to be between 0 and -1.

The lag length helps to accurately estimate the model. Hence if the lag length is inaccurately short it yields poor estimates. On the other hand, an inaccurately long lag length consumes the degrees of freedom. In this study, the optimal number of lags was automatically selected based on the Schwarz information criterion (SIC). After the estimation of the models, it is necessary to conduct diagnostic tests to determine if any of the critical OLS assumptions are violated. This study specifically tested for heteroscedasticity using the Breusch-Pagan-Godfrey test, autocorrelation using the Breusch-Godfrey test, residual non-normality using the Jarque-Bera test, model misspecification using the Ramsey RESET test, and parameter stability using the CUSUM test.

3.4. Granger Causality Test

Establishing cointegration among the variables implies that there is causality among them. Therefore, a Pairwise Granger Causality Test will be used to identify whether previous values of inflation can be useful in forecasting the present values of nominal interest rates or vice versa. In general, by conducting a Granger causality test this study will be trying to detect which variable is causing the other in a time series. Ultimately, should inflation provide information that allows us to predict the future values of nominal interest rates in the best way than previous information contained by inflation forecasts, the study will conclude inflation Ganger causes nominal interest rates in Uganda. The mathematical form of the Pairwise Granger Causality Test in Equation 6 is:

$$Y_t = \mu_t + \sum_{i=1}^{p} \alpha_i Y_{t-1} + \sum_{i=1}^{p} \beta_i X_{t-1} + \varepsilon_t \qquad (6)$$

Where μ_t symbolizes the deterministic component and ε_t denotes the white noise process. The dependent variable is the nominal interest rate while the independent variable is the inflation rate. The null and alternative hypotheses for the causality running from X to Y are stated as:

$H0: \beta 1 = 0$

$Ha: \beta 1 \neq 0$

The F stat is used to test for causality among the series. We reject the null hypothesis of no causality if the p-value is statistically significant and accept the alternative hypothesis stating that the first series Granger causes the second series.

4. Results and Discussions

The result presented in Table 2 indicates the descriptive statistics from which all variables show high volatility. Table 2 particularly contains measures of central tendency, namely, mean, median, maximum, and minimum, standard deviation, kurtosis, and Skewness.

Table 1. Descriptive Statistics

	lending rates	**M3**	**CPI**
Mean	21.97076	18628.84	153.9682
Std. Dev.	2.398865	6163.204	18.57737
Skewness	0.008811	6163.204	18.57737
Kurtosis	1.837641	2.327944	1.837641
Jarque-Bera	2.533338	6.588021	6.588021
Probability	0.209473	0.019876	0.037105
Observations	117	117	117

Author's computation

The initial test to make sure the model used for the analysis is free of absurd regression findings is shown in Table 2. As previously mentioned, the study uses both the Philips Perron (PP) and Augmented Dickey-Fuller (ADF) tests. After removing the first difference, the findings show that all variables are stationary (1). After the second difference, no variable is stationary at the same time. The idea is that the study can employ the ARDL model/ vector error correcting model (VECM). The VECM provides a long-run relationship and also much of the valid interpretations came from the impulse response functions. Therefore the ARDL model was used to capture both long-run relationships and interpretations of the coefficients from the model, equally important Fisher's hypothesis relies heavily on coefficients interpretations rather than graphical representations.

Table 2. Stationarity tests ADF and PP test

	Augmented Dickey-Fuller (ADF)			**Philips Perron (PP)**		
Series	I (0)	I (1)	Order	I(0)	I(1)	Order
LM3	-2.886	-4.683***	I(1)	---------	--------	I(1)
LLN	-1.143	-10.033***	I(1)	-1.744	-13.607***	1(1)
LCPI	-2.408	-9.715***	I(1)	-2.170	-9.681***	I(1)

*Note: *** significant at 1% level. ** Significant at 5% level and * significant at 10%. The standard errors are within the brackets.*

The bound test for cointegration is shown in Table 3. This test is still used to determine whether or not the variables will move together over the long term. The null hypothesis that there is no cointegration among the variables is rejected in favor of the alternative hypothesis, which is that there is a long-run relationship between the variables, according to Table 3. This is because the F-statistics is greater than the values observed in both lower and upper bounds, which correspond to 10% up to 1% levels.

Table 3. Bound Test for Cointegration

$(Lln = f(LCPI, LM3)$	**F Stat**	**Lower Bound**	**Upper Bound**
	6.374	3.17*	4.14*
		3.79**	5.52**
		5.15***	6.36***

Note: **** significant at 1% level. ** Significant at 5% level and * significant at 10%. The standard errors are within the brackets.*

The results for both long-run and short-run coefficients are shown in Tables 4 and 5 respectively. The signals of the short-run and long-run outcomes are comparable. In the short term, the Fishers hypothesis is invalid since, for instance, nominal interest rates are positive but statistically insignificant in the short term (Edirisinghe *et al.*, 2015). Additionally, the error correction term is statistically significant at 1% and negative as expected. This suggests that any short-term variation is monotonically corrected back to the long-term equilibrium, with the independent variables correcting the dependent variable by 31.71% each month. This modest rate of change shows that the MPC's monthly decisions about the central bank rate (CBR) are made after carefully weighing all of the facts at their disposal (rational expectation).

Table 4. Short-run coefficients ARDL (1.0.0)

Variable name	Coefficient
D(LCPI)	0.3192
	(0.2097)
D(M3)	-0.2061**
	(0.0912)
ECM(-1)	-0.3171***
	(0.0764)

Note: *** *significant at 1% level. ** Significant at 5% level and * significant at 10%. The standard errors are within the brackets.*

But because the inflation coefficient is exactly one and it is positive and statistically significant at the 10% level, it persists over the long term in its strongest form. These findings, along with the bound test for cointegration, show that the Fishers effect persists over the long term because it displays a one-to-one relationship between inflation and nominal interest rates. According to the original Fisher (1930) theory, these results are aggressive; comparable findings were made (Antoni, 2019). This means that since the introduction of inflation targeting, nominal interest rates and inflation rates have been moving at the same rate, with the monetary policy committee's (MPC) determination of real interest rates determining changes in inflation over the medium to long term. Additionally, Ito (2016) says that it demonstrates the effectiveness of market operations. The outcomes also applaud the credibility of inflation-targeting lite in Uganda. Gocer and Ongan, (2020), Dritsaki, (2017), Camba and Camba, (2021), and Çiğdem, (2019) are a few studies that typically find the weak form of the Fishers effect. The study's findings, while different, may be explained by the fact that the CBU's inflation target is core inflation, which is typically unaffected by consumer prices. The money supply will now be discussed. It has a negative association and is statistically significant in the short- and long-term, respectively, at 5% and 1%. These findings are reliable and consistent with economic theory, which holds that high inflation reduces the amount of money in circulation, which in turn lowers investment and consumption (Snowdon & Vane, 2005).

Table 5. Long-Run Coefficients

Variable name	Coefficients
L(CPI)	1.0065*
	(0.5892)
L(M3)	-0.6500***
	(0.2211)
C	4.3754***
	(0.8879)

Note: **** significant at 1% level. ** Significant at 5% level and * significant at 10%. The standard errors are within the brackets.*

Let's talk about the Granger causality test now. According to the pairwise Granger causality test, there is a one-way causal relationship connecting inflation and nominal interest rates, which suggests that predicted inflation rates are a reliable indicator of nominal interest rates. These findings are consistent with those from the prior model and with those from (Alimi, 2014 and Ruzima *et al.*, 2022).

Table 6. Granger Causality Test

Null Hypothesis	F-statistics
D(interest rate) does not Granger cause D(LCPI)	0.0585
D(LCPI) does not Granger cause D(interest rate)	8.5629***

*Note: *** significant at 1% level. ** Significant at 5% level and * significant at 10%. The standard errors are within the brackets.*

The ARDL model derived above is meaningless without testing its validity through diagnostic tests as presented in the following table. The p-value of the heteroscedasticity test indicates that we reject the null hypothesis that the errors are not normally distributed. Once again the P-value which is above 0.05 indicates that the model is free from serial correlation. Furthermore, the RESET test indicates that the model has correctly specified through its p-value that is above 0.05.

Table 7. Diagnostic Tests

Diagnostic Tests	F-statistic	P-value
Heteroskedasticity Test	0.4855	0.6930
Serial Correlation LM Test:	0.9878	0.3756
Ramsey RESET Test	0.8150	0.4474
Jarque-Bera (JB)	1.599	0.449

Author's computation

Lastly, the variables of the model are normally distributed in the series this evidence comes from the Jarque-Bera (JB) test with a high p-value as previously stated in the aforementioned tests. Equally important are diagnostic tests on parameter stability which are presented below. The CUSUM test is used to test the systematic movement of the model's parameters within a 5% significance level. As indicated below, the CUSUM line fluctuates within the 5% significance band.

5. Conclusion and Policy Recommendations

Even though Fisher's effect has been the subject of a sizable body of literature around the world, no research on the concept has ever been done in Uganda. According to the hypothesis, real interest rates are unaffected as long as nominal interest rates change in the same direction as inflation. The validity of the bound test, which mandated that there is a long-run correlation between all variables utilized in the study, made the adoption of the ARDL model necessary. The study's findings support Uganda's strong Fisher's effect, which dictates that the nominal interest rate moves in lockstep with anticipated inflation rates while having little impact on real interest rates. This is consistent with Uganda's central bank policy, which is to set interest rates every two months. Granger causality results also showed that there is a unidirectional causal relationship connecting inflation rates and nominal interest rates. The study also discovered a negative association between interest rates and money supply, which states that when interest rates are raised to slow the economy, they also lower the amount of money in circulation, which is consistent with economic theory. To anchor the business agents that will lead to the highest degree of growth through investment, the study advises the monetary policy authorities to drift to a second level of inflation targeting, which is a formal inflation targeting regime. Additionally, interest rates should be kept low to encourage domestic investment and increased agricultural exports, which will serve as Uganda's main drivers of economic growth

References

Alimi, R.S. (2014). 'ARDL Bounds Testing Approach to Cointegration: A Re-Examination of Augmented Fisher Hypothesis in an Open Economy'. *Asian Journal of Economic Modelling*, 2(2), pp. 103–114. https://doi.org/10.18488/journal.8.2014.22.103.114.

Anselme, B.C. (2018). *'Monetary policy and stock market returns in Uganda'*. (November).

Antoni (2019). *The Relationship Threshold Inflation with Fisher Effects in Indonesia : An Investigation Using Bounds Test'*, pp. 53–68. Available at: https://doi.org/10.18502/kss.v3i14.4298.

Arısoy, I. (2013). Testing for the fisher hypothesis under regime shifts in Turkey: New evidence from time-varying parameters. *International Journal of Economics and Financial Issues*, 3(2), pp. 496–502.

Awomuse, B. & Alimi, S. (2012). The Relationship between Nominal Interest Rates and Inflation: New Evidence and Implications for Nigeria. *Journal of Economics and Sustainable …*, 3(9), pp. 158–165. http://iiste.org/Journals/index.php/JEDS/article/view/2563.

Ayub, G. *et al.* (2014) 'Relationship Between Inflation and Interest Rate: Evidence from Pakistan', *Research Journal of Recent Sciences*, 3(4), p. 55. www.isca.me.

Bayat, T.; Kayhan, S. & Taşar, İ.A. (2018). *Re-Visiting Fisher Effect for Fragile Five Economies Re-Visiting Fisher Effect for Fragile Five Economies*'. https://doi.org/10.2478/jcbtp-2018-0019.

Camba, A.C. & Camba, A.L. (2021). An Engle-Granger and Johansen Cointegration Approach in Testing the Validity of Fisher Hypothesis in the Philippines An Engle-Granger and Johansen Cointegration Approach in Testing the Validity of Fisher Hypothesis in the Philippines', 8(December). https://doi.org/10.13106/jafeb.2021.vol8.no12.0031.

Çiğdem, G. (2019). *A Paradox : An Empiric Approach to Inflation-Interest Rates Relationship : Evidence from Turkey*', 11(3). https://doi.org/10.5296/rae.v11i3.15171.

Dritsaki, C. (2017). *Toda-Yamamoto Causality Test between Inflation and Nominal Interest Rates :*

Evidence from Three Countries of Europe'. January.

Edirisinghe, N.; Sivarajasingham, S. & Nigel, J. (2015) 'International Journal of Business and Social Research An Empirical Study of the Fisher Effect and the Dynamic Relationship between Inflation and Interest Rate in Sri Lanka', 05(01), pp. 47–62.

Ekinci, R.; Tüzün, O. & Ceylan, F.A. (2020).The relationship between inflation and economic growth: Experiencing some inflation targeting countries. *Www.Econstor.Eu*, 24(1 (87), pp. 6–20.

Fisher, I. & Clifton, I. (1930). The theory of interest.

Galesi, A.; Nuño, G. & Thomas, C. (2017). *The natural interest rate : concept, determinants, and implications for monetary policy'.*

Gocer, I. & Ongan, S. (2020). The Relationship between Inflation and Interest Rates in the UK : *The Nonlinear ARDL Approach'*, 12(410), pp. 77–86. https://doi.org/10.2478/jcbtp-2020-0037.

Güri, B. (2015). Does the Fisher hypothesis hold for the G7 countries ? Evidence from ADL threshold cointegration test, pp. 2549–2557. https://doi.org/10.1007/s11135-014-0127-3.

He, Y. (2018). A Study on the International Fisher Effect : An Investigation from South Korea and China', 9, pp. 33–42.

Ito, T. (2016). Does the Fisher Hypothesis Hold in Sweden ? An Analysis Of Long-Term Interest Rates Under The Regime Of Inflation Targeting. *Review of Integrative Business & Economics Research*, 5(3), pp. 283–295.

Kasim, M. & Bentouir, N. (2018). *The relationship between inflation and nominal interest rates in the Bolivarian Republic of Venezuela: Revisiting Fisher's nominal interest rates in the Bolivarian Republic*, (April 2020).

Kose, N.; Emirmahmutoglu, F. & Aksoy, S. (2012). 'The interest rate-inflation relationship under an inflation targeting regime: The case of Turkey', *Journal of Asian Economics*, 23(4), pp. 476–485. https://doi.org/10.1016/j.asieco.2012.03.001.

Muse, A. (2019). *Interest Rate And Inflation In Uganda* (1998-2018), pp. 1–9. https://doi.org/.1037//0033-2909.I26.1.78.

Ndiritu, J. (2018). *The Relationship Between Interest Rate And Inflation Rate In Kenya.*

Pesaram Hashem, Til, S. & Weiner M, S. (2004). *Modeling Regional Interdependencies using a Global Error-Correction Macroeconomic Model.*

Phiri, A. (2022). Fishe' s hypothesis in time – frequency space : a premier using South Africa as a case study. *Quality & Quantity* [Preprint], (0123456789). https://doi.org/10.1007/s11135-022-01561-z.

Ruzima, M. *et al.* (2022). Does the Fisher effect hold in Rwanda ? *Quality & Quantity* [Preprint], (June). https://doi.org/10.1007/s11135-022-01479-6.

Sheefeni Sheefeni, J.P. (2013). Testing For The Fisher Hypothesis In Namibia. *Journal Of Emerging Issues In Economics, Finance and Banking (JEIEFB)*, 2(1), pp. 571–582.

Snowdon, B. & Vane, H. (2005). *Modern Macroeconomics*'.

Stone, M. R. (2003). Inflation Targeting Lite. *IMF Working Papers*, 03(12), p. 1. https://doi.org/10.5089/9781451842920.001.

Taylor, J.B. (2019). Inflation targeting in high inflation emerging economies: Lessons about rules and instruments. *Journal of Applied Economics*, 22(1), pp. 102–115. https://doi.org/10.1080/15140326.2019.1565396.

Yaya, K. (2015). Testing the Long-Run Fisher Effect in Selected African Countries : Evidence from ARDL Bounds Test', 7(12), pp. 168–175. https://doi.org/10.5539/ijef.v7n12p168.

Zainal, N. *et al.* (2020) 'Does the Malaysian Islamic Money Market Efficiently Predict Inflation in the Future ? Evidence from Fisher Effect Theory, *International Journal of Innovation, Creativity, and Change*, 11(3), pp. 665–682.