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Assessing the Inflation Targeting in Uganda through Taylor Rule. Evidence from the ARDL Model

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Abstract: The inflation targeting lite in Uganda has received considerable attention in the literature. However, the central bank of Uganda has chosen to target the core inflation rather than headline inflation which involves the consumer price that highly affects the society at large. On the other hand, the central bank plays a game of fear of float in times of high exchange rate volatility. Given the fact that the central bank reaction function of the central bank has limited evidence, this study undertakes the augmented Taylor rule regressed through the autoregressive distributed lads (ARDL) model to analyze if Taylor rule can predict the central bank of Uganda (CBU). The findings of the study indicate that the Taylor rule is a good predictor of monetary policy in Uganda. The first Taylor principle hold since the inflation coefficient is positive and statistically different from one. The second Taylor principle does not hold since the output gap is negative and insignificant. Lastly, the exchange rate is positive and significant to indicate that CBU intervenes in the exchange rates markets. The study indicates that formal inflation targeting can be effective policy in Uganda.

Keywords: ARDL model; Taylor rule and inflation targeting.

JEL Classification: E31

1. Introduction

The inflation targeting lite (ITL) of Uganda have received a considerable attention in the recent literature since it commencement in July 2011. Stone, (2003) define a situation where the economy that uses the inflation targeting as their mandate of the monetary policy but unable to stay within their target band as the ITL. Furthermore,

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the author gives two characteristics of the ITL: first they use the floating or managed floating of the exchange rates and announce their target band. Unlike the formal IT where the economy is expected to stay within the target band. Returning to the economy of Uganda, the poor financial system, and slow growth of the past have prompted the central bank of Uganda (CBU) to follow the steps of inflation targeting (IT). The proponents of the inflation targeting posit that the IT is a channel that guarantees the development of financial system, and it is a good material for creating a growth friendly environment. In ITL like the IT, the policy rates become a central instrument that is used to influence the inflation in the medium run. In the economy like SA that have emerged financial system in Africa, the interest rates channel is used to influence other important channels like credit channel and exchange rate channel to count the few. The latter channels are valid for creating a growth enabling environment.

Singh and Bhuyan, (2016), have formulated the augmented Taylor for small open economy like Uganda. This rule puts the interest rates as the dependent variable, which means the interest rates is assessed based on its reaction to the explanatory variables. For example, in a given economy like Uganda, the interest rates should be low in order to promote the local economic growth and investment. Therefore, in the Taylor rule, the explanatory variables are inflation and the output gap. The coefficients for the latter variables are 1.5 and 0.5 respectively, which means if inflation increases for an inflation targeting economy more weight should be placed on changes on inflation coefficient compared to output gap. In simple terms, if inflation rate increases, then the interest rates should increase more than one-to-one adjustment and they should move together in a long-run. On the other hand, interest should be raised with regards to changes in output gap, but it should be positive and less than one. The above two incidents are called Taylor principles and if the first principle hold that is with regards to inflation coefficient, it means the IT is credible in a particular economy. Similar important if both condition holds, then it means the economy is consistent with stable business cycle (Nikolsko-Rzhevskyy et al., 2019). In the Taylor rule for open economy the exchange rates is included as the explanatory variable to imply that the economy open to trade and can be influenced by exogenous factors.

The adoption of inflation targeting is based on five important elements as highlighted by Salter, (2018) that the central bank should meet. The first is the public announcement of IT to the public. The second is the institutional commitment to the announced target by the central bank and all necessary authorities. The third condition is the inflation inclusive strategy to set policy instruments, such as interest rates that will be used to control the inflation. Fourthly, central bank must be questioned whether the increase in transparency for the public where the policy decisions, strategies, target, and actual inflation are known. The last element is the increase in accountability, where for example, the governor of the central bank must notify, in

writing, the minister of finance the reasons and measures to be taken if the target is missed.

Considering the above IT elements, 2011 marked the year in which the central bank of Uganda has adopted the inflation targeting lite. Therefore, the central bank rate sends the impulses to inflation rates through the interest rate transmission channel hence it also affects the exchange rates channel. Therefore, it is evident from Kayongo *et al,* (2020) that the interest rate channel was weak in the period before 2011, but latter that period it have been playing a significant role. According to the monetary policy report of Uganda, the central bank rates is set every two months using a forward-looking approach and the decisions made are publicly announced in the press briefing.

The inflation rates in Uganda have been stubbornly high and the monetary targeting regime could not afford the high prices of inflation. From Figure 1, the inflation rates have high fluctuations that consist of high inflation from 2000 to 2011. The high inflation could be coupled with a weak exchange rate, poor financial system, and exogenous shocks such as oil price shocks. The average inflation rate was around 7% in the years between 2002 and 2010 then following the average inflation was 5.16% which is nearly the inflation target of the economy. Implying that although the ITL was introduced during the times of high inflation it managed to discipline inflation around the target level. The slight increase from 2014 to 2016 was still around the target level of 5% which indicates that the CBU is aggressive in response to increase in inflation rates.

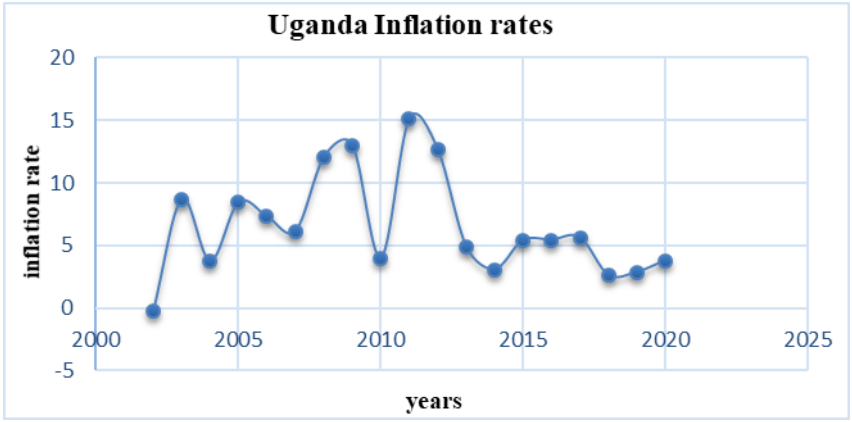

Figure 1. The inflation behavior of Uganda since 2002.

Source: Authors 'computation using data sourced from World Bank.

It must be noted that the central bank of Uganda drifted to ITL where inflation should not exceed 5% which is relatively low if it compared to other low-income economies like Ghana. The ITL replaced reserve money programme (RMP) which was based on

monetary growth from which it failed to fulfil the central bank's objectives. The central bank of Uganda (CBU) targets the core rather than headline inflation rates because of the motive that economic participants make decisions without being shaken by temporal price rise of commodities like food. However, in practice the headline inflation which includes consumer price index have a positive general trend in Uganda, which imply that food inflation is not temporal. The central bank rates (CBR) guide the behaviour of inflation and it ensures that 7 days interest rates are close as possible to the former. The price stability which supports low level of interest rates have ability to stimulate the investment. In the time of excessive exchange rates volatility, the CBU intervenes to reduce it, but the currency is allowed to float.

With the above background, the central bank of Uganda uses the ITL instead of the formal IT, on the other hand it uses managed floating instead of free floating. At the same time, it targets the core inflation which excludes the consumer price that has a direct effect on the living standard of the society. With regard to the above issues this study assessed the adequacy of the monetary policy through the reaction function in Uganda, only a few studies such as Okot, (2020); Nabbosa, (2017); Ssebulime and Edward, (2019) have considered the working of the monetary policy in Uganda in the post-inflation-targeting lite period. Therefore, this study adds to the body of knowledge of how monetary policy through the reaction of interest rates on inflation, output, and exchange rates influence the macroeconomic objectives of Uganda. That includes price stability, exchange rates stability, and enhancing GDP growth. These objectives come from the fact that the first two objectives are crucial to create good environment for growth since inflation and exchange rate are easily affected by both domestic and exogenous shocks. In that sense, even if Uganda is a small economy, it requires highly developed financial system to protect the society from high inflation rates and unemployment. On the other hand, economic growth leads to economic development, reduce poverty, eradicate unemployment, reduces crime and other socio-economic issues affecting the well-being of society.

This study follows the work of Okot (2020) who formulated the reaction function for Uganda. Generalized method of moment (GMM) was employed through 2000Q1 to 2017Q4. Using the Autoregressive distributed lags model (ARDL) model this study explores the Augmented Taylor rule for a small open economy. The transition of Uganda from IT lite to formal IT can guarantee the development of financial market, GDP per capita growth, investment, reduction of external debts and other key objectives of the economy. This is because earlier studies such as Nabbosa, (2017), have indicated that ITL ha ave positive impact on growth and it reduce negative impact of inflation growth. On the other hand, Katusiime and Agbola, (2018) have indicated that ITL has reduced the negative effect of exchange rate volatility in Uganda.

The study is organised as follows, Section 2 discusses the theory of inflation targeting and Taylor rule with an aid of the empirical literature. Section 3 covers the theoretical

and empirical models and Section 4 covers the interpretation of the results, conclusion and policy recommendations is presented in Section 5.

2. Literature Review

One of the core monetary policy rules discussed in the literature is the famous Taylor rule which mechanically links the interest rate to inflation and output deviations, also known as the output gap. This rule was developed as a model for the United States, but it is now widely regarded as a standard by which most economies in the world use to implement monetary policy. The Taylor rule is symbolically denoted by the equation below.

$$i^* = r + \alpha(\pi - \pi^e) + \beta(y - y^e) \quad (1)$$

Where i^* denotes the nominal interest rate, r denotes a real interest rate, while π and y denotes inflation and output, respectively. Similar important π^e and y^e are desired inflation and output respectively. Both α and β are positive coefficients in equation (1). If inflation and output are at their goal levels, then both coefficients should be zero, and the interest rate remains unchanged. If inflation is excessive, however, the real interest rate will be raised to lower aggregate demand, resulting in a positive outcome. If the output is higher than the target, the interest rate will be cut, and coefficient β will be negative.

According to Taylor, (2001), the exchange rate for a closed economy should be zero, but the exchange rate for an open economy should have a non-zero coefficient. Furthermore, if there is a direct link between exchange rates and economic variables like interest rates, the exchange rate has a strong pass-through into inflation (Villa et al., 2014). Therefore, consider the following equation for an open economy:

$$i_t = pi_{t-1} + (1 - p)[\alpha(\pi_{t-1}) + \beta(y - y^e) + \gamma(E_t - E_{t-1})] \quad (2)$$

Where i_t denotes the interest rates, p denotes the adjustment coefficient, E denotes the exchange rates, and other coefficients and variables have been explained previously. In this aspect, the Taylor rule is said to be a two-edged sword. It tells the monetary policy committee (MPC) how to respond to changes in the economy by adjusting the interest rate (Salter 2014).

On the empirical microscope, there is lot of evidence that support the motion of the Taylor rule as the good predictor of the monetary policy reaction for most central banks. For example Caporale et al, (2018), investigated five economies namely: Indonesia, Israel, South Korea, Thailand and Turkey. The study found that the Tylor rule is the appropriate measure for central bank's reaction to inflation and output gap through the GMM model employed in the study. The results actually imply that the above-mentioned economies are inflation targeters. On the same context, Saadat *et al*,

(2017), in Iran shared the similar sentiments, the study hailed the Taylor rule for being a flexible enough to command inflation to be stable in the long run. In the opposite end the economy that have multiple objectives might not be able to be described appropriately through Taylor rule. The multiple objectives for Egypt involve price stability, exchange rates stability and GDP growth. The study was conducted using the ARDL model from 1974 to 2019, (Abdalhafez, 2021).

Due to endogenous and exogenous causes of inflation rates, the interest rate's reaction to changes in inflation might be a central theme in most central banks which can put the deviation of the output gap to receive less emphasis. At the same time for a small open economy, the exchange rates can be linked to interest rates, hence in economics theory, Taylor (2001) have argued that direct link between the two variables can lead to destabilization of inflation and output gap in long run. At the same time inflation can be affected by the exchange rate pass-though, sending a signal for upward adjustment of interest rates. Agwuna *et al*, (2022), have indicated that the interest rates respond to inflation adjustment in both short and long-run. The study employed ARDL and vector autoregressive (VAR) models through the data ranging from 1998 to 2020 in emerging markets: namely South Africa, Mexico, Brazil, Chile, and Turkey. On the other hand, Monfared and Akın, (2017), found that there is positive relationship between money supply and inflation while the latter is also influenced by the exchange rates pass-through in Iran. The study employed VAR model through the data set ranging from 1976 to 2012. The results of the study indicates that Iran does not have an inflation target and it relies on monetary targeting which fails to stabilize the money in circulation. Musyoka and Ocharo, (2018), have indicated that Kenya requires a favourable interest rate that favors foreign direct investment (FDI). Through OLS model, the study indicated that FDI is negatively correlated with interest rates and exchange rates. Kenya uses monetary targeting and for interest rates to be favorable the monetary policy should consider the inflation targeting strategy. Although some inflation targeters show fear of float in their conduct of the monetary policy that is the case where they want to protect the value of the currency. This phenomenon was verified in Indonesia, Malaysia, the Philippines, Thailand and Singapore by (Manogaran and Sek, 2017). The study employed the nonlinear ARDL to capture the positive and negative shocks of exchange rates. The above results indicate lack of inflation and output stability in the conduct of the monetary policy given that the exchange rates have a direct relationship with interest rate. Similar case in Romania, the interest rate is influenced by inflation and exchange rates (Moroşan, 2015). Most of the studies discussed above reveal the interest rates as a reaction function that is more elastic on inflation and exchange rates. The reaction on output changes is like a dog that has never barked on those economies. However, in Federal Reserve of England it is reported that it react to changes in output deviations and react negatively on inflation coefficient which is not normal for Taylor rule theory. Bauer and Neuenkirch, (2017), reported that the cause of that reaction highlighted above was due

to the fact that the central bank does not follow inflation targeting rule. The following literature review will shift focus to the inflation targeting regime.

Inflation could be explained as an increase in the level of prices in a given economy. In general, inflation is quantified by comparing the current period's basket of products to the base period's basket of goods, which is termed as consumer price index (CPI) or the producer price index. The latter serves as an indicator of cost-push inflation while the former serves as an indicator of demand-pull inflation. High inflation appears to be unfavourable to economic growth, according to the literature (Ndoricimpa, 2017). Inflation lowers the value of a currency, as well as investment and consumption spending. It inhibits economic agents from meeting their requirements by utilizing available revenue on a regular basis. High inflation has a significant impact on nations with weak financial systems, such as most African economies.

In terms of how it works, it creates a band or a range within which inflation can float. Continual deviations from this band, depending on whether the divergence exceeds the top or lower band, may necessitate an interest rate change. However, there are some conditions that the economy must meet before adopting IT. Ali-Meerza, (2020), in a recent IMF worldwide assessment, argues that specific IT preconditions are required, particularly in the short term, when the central bank is still trying to establish credibility.

In light of these considerations, the IT central bank must pay close attention to and meet the regime's prerequisites. There are several general rules that vary based on the needs of the reserve bank and the economy's vulnerabilities. The central bank's independence is a critical prerequisite for IT since it must be able to design and implement monetary policy without political interference, as well as perform other related responsibilities. Another important condition is the free-floating exchange rate, where demand and supply determine the value of a currency. As a result, the inflation targeting will help to improve the system. Furthermore, effective central bank models for forecasting and sufficient resources for the new beginning will be enhanced by inflation-targeting policies. Similar important inflation targeting will ensure the constitutional guarantee of central bank independence and developed financial market.

When compared to alternative regimes, like the monetary targeting, employed by most African central banks, IT offers no obvious advantage in terms of reducing inflation. However, Taylor, (2019) argues that IT alone is insufficient and that it should adhere to a set of rules while retaining enough flexibility in the curse exogenous shocks. Simple because in the face of shocks, the rule-based norm becomes ineffective.

Green (1996) provided the model set up for IT that is discussed shortly. IT, as a rule, begins with an important point for monetary policy that is set to minimise the social loss function derived in the following equation:

$$L = (\pi - \pi^e)^2 + \gamma(y - y^e)^2 \quad (3)$$

Where L denotes social loss, $\pi^e$and y^edenote expected inflation and output respectively, and lastly, γ denotes social importance for output. The inflation surprise in the above equation (3) is argued to increase output in the short run.

Therefore:

$$Y = (\pi - \pi^e) - \varepsilon \quad (4)$$

Where ε denotes the error term. At the same time, the private inflation expectations are $\pi^e = E_{t-1}(\pi)$. The following equation shows the monetary policy committee. The supply curve has been constrained.

$$\pi = \pi^* + \frac{\gamma}{1+\gamma}\varepsilon \quad (5)$$

Equation (5) above is similar to equation (4) but it differs in the sense that it excludes the output coefficient. The social preference depends on the trade-off between the output and the inflation rates. Hence, the commitment policy is said to be time-inconsistent because the monetary policy authorities can deviate from its announced target and if that takes place it means the discretion policy is in place. IT can be useful even in case where there is discretionary policy.

The inflation-targeting regime started in New Zealand in 1989 following the fall of the Bretton Wood system. IT requires floating exchange rates, in a small open economy like Uganda. The small open economy with floating exchange rates has the advantage of free capital flow. The economy is linked to other economies through trade of goods and services İncekara and Amanov (2019), in that case, the exchange rates should serve as the shock absorber. The IT also requires a sophisticated institutional framework and aggressive models that can provide accurate information and forecast based on updated data. For example, Opolot (2013) indicated that Uganda should invest in the financial system, inclusivity, and markets to attain rightful technological superiority so that growth will yield investment activities. In addition, this could reduce the informal sector that is regarded as residual and hardly affected by the transmission channels. The interest rates must be a chief instrument for IT while price stability remains the chief objective of the central bank. Although IT is regarded as the demand side policy it has the advantage to respond positively to the shocks of the supply side in nature, such as those of oil price, exchange rate pass-through, and external debts to count a few. Therefore, it is a forward-looking policy that follows strict rule but at the same time, its flexibility accommodates discretion stabilizing policy in a time of need. Recent studies have highlighted some causes of inflation in Uganda, for example, Kasekende, (2016) indicated oil price plays a significant role in the former. The study employed the vector autoregressive model (VAR) model as the underlying approach used in the study. It is from that system of equations model that prompted the author to recommend the monetary authorities of Uganda that they

should broaden the monetary policy to curb other monetary variables linked to inflation. Furthermore, Ssebulime and Edward (2019) indicated that both monetary and fiscal policy is in the front line in aggravating inflation in Uganda. The study's conclusion was derived from integration error correction model (ECM) and Granger causality test. The study recommended that policy should have well-structured budgetary and monetary policy systems. One of the most influential sectors in Uganda is Agriculture, with the other two sectors including the financial and external sector were also found to be the main power stations in manufacturing inflation rates, (Mawejje and Lwanga, 2016). The study employed the single equation and general to specific approaches to derive the results. On the other hand, inflation targeting lite in Uganda is argued that it came during a time of need when inflation was around 15%. The inflation targeting has been hailed by most economists in Uganda as the mastering remedy to deal with the high inflation rate and smoothen the exchange rates volatility. For example, Katusiime et al, (2016) have argued that IT is capable for reducing high exchange rate volatility in Uganda. The study derived the findings from the combination of the data observed from 1 September 2005 to 31 December 2015 and the general autoregressive conditional heteroscedasticity (GARCH) approach employed in the study. The aforementioned results were also contended by a great deal of studies such as (Katusiime, 2016; Mawejje and Lwanga, 2016; and Lukwago, 2016). On the other hand, Nabbosa, (2017) have indicated thathas have positive effect on growth that is through creating a friendly enabling environment. The study found all variables that are integrated of order one and therefore used the vector error correction model (VECM).

3. Methodology

3.1 Description of the Variables

Following the central bank of Uganda, the core inflation is measured by the consumer price index (CPI). According to the Taylor rule, deviations of this variable from the target value induce an upward adjustment of the interest rate. A central bank that is concerned with stabilising inflation is expected to have a positive sign on inflation that is 1.5 in terms of size according to the Taylor rule. Positive output signals that the economy is overheating hence monetary policies are expected to adjust the policy rates upwards. The output is expected to have a positive sign that differs from zero, below one, and close to 0.5. Due to data unavailability on quarterly GDP per capita, the sample annual data was converted into quarterly data using the cubic interpolation method in Eviews 9 following (Omini, *et al.,* 2017). According to Taylor's principle, central banks that react to the changes in the exchange rates (EX) do not achieve an optimal level of inflation and output. Therefore, the exchange rate variable is expected to have an insignificant coefficient but with regards central bank of Uganda which intervenes occasionally to maintain the value of the currency the coefficient is

expected to be statistically significant. The lending rate has been used as the proxy for central bank interest rates. The significance of the lagged interest rate variable in most studies implies that static models may have the problem of under-fitting and variable omission. The aforementioned variables that include interest rates (dependent variable), and explanatory variables (CPI, GDP gap and exchange rates) have been used to study the Taylor rule by other studies such as (Singh and Bhuyan 2016; Caporale *et al.*, 2018; Manogaran and Sek, 2017 and Manogaran and Kun Sek, 2016). Moreover, the data will cover the period from 2000Q1 to 2021Q3 collected from the bank of Uganda World Bank.

3.2. 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. Since the variables exhibit a mixed integration as shown in the results section. This study resorted to an Autoregressive Distributed Lag Model (ARDL) whose bounds testing procedure by Pesaran, (2006) 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.

$$y_t = \alpha_0 + \sum_{i=1}^{p} \delta_j \, y_{t-i} + \sum_{i=0}^{q} \vartheta_i' \, x_{t-i} + \gamma t + u_t \quad (6)$$

Where p and q denote the lags order for the lagged dependent and explanatory variables respectively. The variable y_t denotes the dependent variable δ_j and ϑ_i' are the coefficient vectors for the dependent and independent variables x respectively, t is a time trend and its slope γ while u_t is as defined before and it should have a zero mean value and a constant variance. Following Singh and Bhuyan, (2016), the augmented version of the Taylor rule extended to accommodate the exchange rate can be specified in the ARDL format as follows.

$$\Delta i_{r\,t} = \alpha + \sum_{i=1}^{n} \omega \, \Delta i_{t-p} \sum_{i=1}^{n} \omega \, \Delta \pi_{t-p} + \sum_{i=1}^{n} \omega \, \Delta y_{t-p} + \sum_{i=1}^{n} \omega \, \Delta ER_{t-p} + \lambda ECT_{t-1} + \varepsilon_t \quad (7)$$

i=1,2…p And t=1, 2…p

Where $i_r \; and \; i_{t-i}$ denote the real interest rates and their lags respectively, α denote the constant term, π,y and ER denote the inflation rate, output gap, and the exchange rate, 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, there are many integration tests that 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. These methods however assume that all-time series variables are integrated of order one i.e., I (1) and are also not reliable in cases of small sample sizes. The bounds testing procedure proposed by Pesaran (2006) is relevant in this case with k=3 where k is the number of explanatory variables excluding the lagged dependent variable. 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 reported in Narayan (2006), the conditional ARDL model of the following form will be considered for each country.

$$\Delta i_{r\,t} = \alpha + \sum_{i=1}^{n} \omega\, \Delta i_{t-p} \sum_{i=1}^{n} \omega\, \Delta \pi_{t-p} + \sum_{i=1}^{n} \omega\, \Delta y_{t-p} + \sum_{i=1}^{n} \omega\, \Delta ER_{t-p} + \lambda ECT_{t-1} + \varepsilon_t \quad (8)$$

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 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 Akaike information criteria (AIC). After the estimation of the models, it is necessary to conduct diagnostic tests in order 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.

4. Discussions and Results

The descriptive statistics result is presented in Table 1 and this indicates that all variables show high volatility. The table particularly contains measures of central tendency, namely, mean, median, maximum, and minimum, standard deviation, kurtosis, and Skewness.

Table 1. Descriptive Statistics Table.

Descriptive stat	Interest rates	GDP	REER	CPI
Mean	21.19515	2.12E+10	89.50695	104.0994
Std. Dev.	2.157661	1.12E+10	9.049286	41.99990
Skewness	0.823660	-0.216011	-0.122320	0.263930
Kurtosis	3.055827	1.355830	2.327953	1.551321
Jarque-Bera	9.055935	9.753537	1.704985	7.924355
Probability	0.010803	0.007622	0.426351	0.019022
Observations	81	81	81	81

Source: Author's computations

Table 2 below provides the initial test that ensures that the model that is going to be performed is free from nonsensical regression results. The study relies on both ADF and PP tests as indicated earlier. The results indicate that only the interest rate is stationary at levels, and the other three independent variables are stationary after taking the first difference. At the same time, there is no variable that is stationary after the second difference. The order of integration and the results necessitate the idea that the study can use the ARDL model that will be interpreted just after the bound test for cointegration.

Table 2. Unit Root Test on Each Variable

Augmented Dickey-Fuller (ADF)				Philips Perron (PP)		
Series	I (0)	I (1)	Order	I(0)	I(1)	order
LIN	-3.517**	--------	I(0)	-3.508**	--------	I(0)
LY	-0.854	-3.273*	I(1)	-1.094	-4.514***	I(1)
LREER	-2.4519	-8.075***	I(1)	-1.977	-6.992***	1(1)
LCPI	-1.005	-5.464***	I(1)	-1.350	-6.097***	I(1)

*Note: *** imply 1%, ** 5%, and * 10% significant levels. The figures in brackets are standard errors.*

Table 3 indicates the bound test for cointegration which remains a benchmark to decide if the variables move together or not in a long run. According to Table 4, the F-statistics is greater than the values observed in both lower and upper bounds corresponding to 10% and 5% levels which then leads to a rejection of a null hypothesis of no cointegration among the variables in favour of the alternative hypothesis that there is a long-run relationship between the variables.

Table 3. Bound Test for Cointegration.

Function:	F Stat	Lower Bound	Upper Bound
$(In = f(LY, LCPI, LREER)$	5.737	3.47*	4.45*
		4.01**	5.07**
		5.17***	6.36***

*Note: *** imply 1%, ** 5%, and * 10% significant levels. The figures in brackets are standard errors*

Table 4 shows the long-run equation for the reaction function of interest rates being a dependent variable. The inflation rates coefficient is 1.4 which is above one and it is around 1.5 prescribed by the first Taylor principle (see Nikolsko-Rzhevskyy *et al*, 2019) and it is statistically significant at a 1% level. This implies that BoU reacts to rising inflation by increasing the interest rates in a long run to maintain low possible prices for the economy. In this regard, it complements the fact that price stability is the main objective of BoU in practice. The aforementioned results are in line with (Caporale *et al.,* 2018; Agwuna *et al.,* 2022 and Saadat *et al.,* 2017). The second variable is the GDP per capita, and it is negative and statistically insignificant. This is consistent with BoU's practice of the monetary policy where the increase in output gap has not received considerable attention from the monetary authorities. Unlike the results indicated by Okot's (2020) study which found a negative and significant coefficient on the output gap. When the model specification of GMM improved the study found that the BoU put high weight on the output gap than inflation, which is not the case in the monetary policy practice of the CBU. Therefore, the second Taylor principle does not hold in the long run, these findings contradict those of Bauer and Neuenkirch, (2017) who in their findings indicated that the Bank of England react more to GDP because the bank does not have an inflation-targeting mandate. Moving further to the exchange rates, the coefficient is positive and statistically significant at 10%. The positive coefficient implies that the appreciation of the currency is accompanied by high-interest rates. This means there is a direct relationship between interest rates and exchange rates in Uganda. The results are consistence with the monetary policy report of Uganda that states that the central bank often intervenes in the exchange rates to restore the value of the currency and to reduce the excess volatility. These results are in line with (Ashad and Ali 2016; Manogaran and Sek 2017; Musyoka and Ocharo 2018; and Agwuna *et al.,* 2022). Furthermore, according to Taylor (2001), an economy that displays a direct relationship between exchange rates and interest rate does not stabilise effectively the output and inflation rate as coated by (Villa et al., 2014).

Table 4. Long-Run Reaction Function for Interest Rates.

Variable	Coefficients
D(LCPI)	1.4258 [0.2753]***
D(LGDP)	-0.0750 [0.4372]
D(LREER)	0.5482 [0.3004]*
C	-3.233 [2.4675]
@TREND	-0.0242 [0.0053]***
R^2	0.8631
$\bar{R}^2$	0.8366
F-Stat	32.59***
D-Watson test	2.03

*Note: *** imply 1%, ** 5%, and * 10% significant levels. The figures in brackets are standard errors*

In Table 4 above R-squared is above 80% which implies the goodness of fit in the model this is accompanied by the adjusted R-squared. The F-statistics is significantly high and shows the overall model's validity. The D-Watson value is greater than the R-squared which validates the rule of thumb that the model is not spurious. At the same time since the D-Watson is around 2, it indicates that the model is free from the serial correlation.

Moving on to the short-run reaction function in table 5 below, the inflation rates have been derived as the sum of all significant lags of CPI. It is noticeable that the inflation coefficient is above 2 which is explosive. This means that the BoU practice of ITL is more aggressive in the short run, this is in line with the monetary policy statement that indicates that the central bank rate is set once every two months.

Table 5. Short-Run Reaction Function for Interest Rates.

Variable	Coefficients
D(LCPI)	2.4617
D(LGDP)	-0.030 [0.0314]
D(LREER)	-0.0273 [0.1384]
D(@TREND())	-0.0097 [0.0027]***
CointEq(-1)*	-0.40 [0.1081]***

*Note: *** imply 1%, ** 5%, and * 10% significant levels. The figures in brackets are standard errors*

The output entered is statistically insignificant in the long run. In the same lane, the exchange rate in the short run is statistically insignificant at 1% and the sign is negative. This implies that the central bank of Uganda put price stability as the chief objective that is maintained daily compared to other variables. The error correction term is negatively signed and statistically significant as expected. This implies that the independent variables correct 40% of short-run deviation for interest rates towards the long-run equilibrium in every quarter and it adjusts monotonically. Therefore, the overall results indicate that the forward-looking model for augmented Taylor rule for

a small open economy is a good predictor of monetary policy in Uganda (Caporale *et a.l,* 2018 and Saadat *et al.,* 2017). Moving on to the diagnostic tests in Table 6.

Table 6. Diagnostic Tests.

Diagnostic Tests	F-statistic	P-value
Heteroskedasticity Test	0.5340	0.8559
Serial Correlation LM Test:	0.1016	0.8810
Ramsey RESET Test	0.8150	0.4474
Jarque-Bera (JB)	1.766	0.413

Author's computation

In table 6 above, a 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 there 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. Lastly, the variables of the model have normally distributed in the series this evidence comes from the 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, in particular, the results of which are presented graphically, 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 level.

5. Conclusion

Inflation targeting has been beneficial in Uganda since it was adopted in 2011. These benefits have been cited in relation to lowering inflation rates, reducing exchange rate volatility, and being beneficial to economic growth. This study employed the augmented Taylor rule under the ARDL model setting to regress the reaction function from which interest rate is the dependent variable and CPI, GDP per capita and exchange rates are the explanatory variables. The findings of the study correspond to the practice of CBU pertaining to the conduct of the monetary policy. For example, the inflation coefficient is above one and statistically significant which means the first Taylor principle is satisfied and in practice price stability is the overriding objective of the central bank. The output coefficient is negative and insignificant since output has not received considerable attention from CBU and the second Taylor principle does not hold. Lastly, the exchange rate is positive and statistically significant since the CBU intervenes to reduce the excessive volatility of the currency. The above result indicates that the Taylor rule is a good predictor of the monetary policy operation in Uganda. However, given the fact that the core inflation rather than headline inflation is targeted the inflation behaviour might not reflect an efficient figure. Since it might contradict the public verifiable high prices that consumers experience every day from

which the policymakers are viewed as they put less focus on them. Therefore, the study recommends that policymakers should start targeting headline inflation that reflects the consumer price index that directly affects society since these prices keep on reducing the buying power of consumers as they grow in long run. Moreover, since the central bank intervenes occasionally in the market for exchange rates and the results also verify the fear of the floating phenomenon. The policymakers are recommended to adopt the pure floating of the exchange rates to avoid conflicting objectives and to gain the long-run stability of the exchange rate. Inflation targeting lite should continue to be in place in the central bank of Uganda but it should be shaped to develop towards fully-fledged inflation targeting.

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