Acta Universitatis Danubius
ŒCONOMICA

The Effectiveness of Dynamic Monetary Policy Practices in Leading African Economies

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Abstract: The effectiveness of the monetary policy in leading African economies categorized as inflation-targeting markets (SA and Ghana) and non-targeting markets (Nigeria, Kenya, and Egypt) in the post-Global financial crisis era is compared in this study. The sampling period stretched from 2007Q1 to 2020Q4. The study estimated the augmented Taylor rule for a small open economy using the autoregressive distributed lags (ARDL) model necessitated by the mixed integration of variables. The results indicate that there is heterogeneity among the inflation-targeting economies because only the South African monetary system could be explained using the Augmented Taylor rule. Contrarily, Ghana's results move with the motion that inflation targeting is not for the lower income countries. Secondly, the policy rates react to exchange rates directly in the short-run for all economies, except South Africa. This indication shows that most emerging markets in Africa show fear of float when it comes to exchange rates system which denotes a lack of a vibrant monetary policy system. Selected emerging market economies regarded as non-inflation targeting markets are fit to adopt inflation targeting but still require a sophisticated financial system. Again they (including Ghana) should move away from the fear of floating phenomena to avoid issues of conflict of interest.

Keywords: ARDL Model; Taylor Rule; Inflation Targeting

JEL Classification: E58

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1. Introduction

Both in developed and emerging nations, inflation targeting has drawn a lot of interest. The United Kingdom (UK), Australia, Sweden, Israel, Poland, and the Czech Republic were among the industrialized nations to adopt inflation targeting after New Zealand, ushering in a new era in which central banks' top priority was price stability. Africa still has Ghana and South Africa, two countries that practice explicit inflation targeting. The hesitation of most African economies to implement inflation targeting may be due to the numerous criticisms IT has received. For instance, the majority of economists have stated that because IT concentrates on price stability, other crucial goals like full employment are left unachieved (Maduku and Kaseeream, 2018). Due to its economy having the largest unemployment rate in Africa and the globe, South Africa is a prominent inflation-targeting developing market that is associated with the aforementioned critics (Mulaudzi and Ajoodha, 2021). On the other hand, experts who have suggested that IT is not suited to lower-income nations may be to blame for Ghana's failure to maintain inflation in the majority of cases (O'Connell, 2012).

But there is historical precedent and solid empirical support for inflation targeting. According to Andersson *et al*, 2017) research, IT served as a buffer against global financial crisis (GFC) shocks. This indicates that even in the face of exogenous shocks, it worked as counter-cyclical growth circumstances. In the same vein, Heintz and Ndikumana, (2010) noted that SA and Ghana, in particular, had responded to the GFC shocks with flexibility and pragmatism. Later, we'll talk about some other advantages. For instance, Australia's approach to the IT regime in terms of monetary policy has increased the communication of potential inflation implications (Mashat *et al.*, 2018). On the other hand, the Czech Republic's forecasting and policy analysis procedures improved as a result of the use of IT, and the same economy also attained exceptional transparency as a result of IT. The literature review will go over further advantages of IT.

A monetary policy tool called inflation targeting prioritizes price stability by using interest rates to adapt in response to changes in inflation. According to some, the policy rates are an effective weapon that, in addition to influencing the credit and exchange rate channels, can have a long-term impact on the rate of inflation, investment decisions and economic growth. Inflation targeting lite (ITL), on the other hand, is a policy strategy that takes the same path as IT, with the exception that most ITL-using economies, like Uganda, typically fail to maintain the strategy. On the other hand, explicit inflation targeting is utilized in SA and Ghana, implicit inflation targeting occurs when the central bank adheres to the elements of inflation targeting without disclosing the target or measures to the public.

With the aforementioned context in mind, Nigeria, Kenya, and Egypt are non-targeting economies that will be contrasted based on how well their monetary policy operation performs in markets that target inflation? The International Monetary Fund (IMF) and

the World Bank's income classifications were the only criteria utilized to choose the economies. As one of the fundamental components that pertain to inflation targeting, they have once more chosen a free-floating currency rate system.

The different factors that will be mentioned shortly make the study's nature crucial. First off, the majority of research in the literature have suggested that inflation targeting is a means of creating an atmosphere that is conducive to economic growth. Second, the majority of African economies have set the goals of attaining economic growth, lowering unemployment rates, preserving price stability, and stabilizing exchange rates. Thirdly, when it comes to financial system development and economic growth, Africa is trailing other continents. For instance, Omoshoro-Jones and Bonga-Bonga, (2022) looked at SA and Nigeria, two major African economies. According to the report, South Africa has a more developed and important financial system than Nigeria. The report also suggested that cataracts should be imported from SA and spread throughout Africa. Therefore, by examining the effectiveness of monetary policy systems for at least the top five major economies, this study builds on the prior study. The study's goal is to show that, like South Africa, other economies like Nigeria, Egypt, and Kenya should implement a dynamic monetary strategy to spur economic growth and have a similar impact on the financial development of other small economies. Since lower-income countries make up the majority of nations in Africa, studies have suggested that inflation targeting is not far more effective for these nations than it is for rising markets (Morozumi, 2020). According to this report, the African monetary system will eventually rank among the most significant ones worldwide.

Additionally, the motivation behind this study stems from the ongoing discussion about the function of monetary policy and whether or not certain economies can implement inflation targeting. A number of economists, including Al-shawarby and Mossallamy, (2019) and Nwoko, (2016) suggested that monetary policy, namely inflation targeting, is essential for containing inflation and promoting growth. On the other hand, other researchers were not in agreement. In order to stabilize the economy and prices, monetary policy is ineffectual and ineffectively applied, claim (Ng'ang'a *et al.*, 2019, and Ekwe *et al.*, 2017). The economists who have noted the monetary policy's inefficiency in the aforementioned discussion do not necessarily mean that it is useless. Instead, they contend that the chosen economies typically give less weight to utilizing and enabling monetary policy to achieve the desired economic results.

There is also discussion over whether IT adoption could help the top economies achieve higher levels of economic growth and financial development, as well as lower inflation and more stable monetary policy. Some claim that IT won't help these since they aren't prepared for it and haven't fully grasped all of the IT prerequisites, such (Emad, 2019 and Shobande and Ibrahim, 2018). This implication is in line with the overall findings of the studies, which show that policymakers tend to place less

emphasis on monetary policy when trying to accomplish economic goals. A number of authors, including, Okuyene and Sangosanya, (2019), and Augustine *et al*,(2020), contend that IT needs to be given full attention and implemented in order to advance leading economies. At the conclusion of this study, the debate mentioned above should be resolved depending on whether leading economies effectively apply their monetary policy techniques and whether monetary policy strategy may be suitable for the chosen economies. This study places more focus on the economic demands of the countries that are guided by their aims than it does on the readiness of the non-targeting economies based on their current framework.

In order to compare inflation targeting economies with non-targeting economies (represented by an IT Dummy variable) across Organisation for Economic Co-operation and Development (OECD) countries in the post-Global Financial Crisis (GFC) era, this study will use the same concepts as (Andersen *et al.,* 2015). The monetary policy frameworks of three chosen non-targeting economies will be highlighted in the debate that follows. However, the enhanced Taylor rule for small open economies, which includes interest rates as a dependent variable, will serve as the foundation for this study's comparisons. The output gap should have a coefficient that is over zero but less than one, and the reaction function is focused on the inflation rate, which should have a coefficient that is above one. The Taylor principle refers to these two groups, which will be covered in the literature review. Finally, the exchange rate coefficient must be statistically negligible for monetary policy to demonstrate that it operates independently of governmental interference. According to Taylor (2001), economies with a direct correlation between the two variables are those in which the interest rates are changed in response to changes in exchange rates. These economies are particularly susceptible to having high inflation caused by exchange rate fluctuations. Other research, such as those of Bask (2020), equally supported Taylor's (2001) results.

Nigeria, Kenya, and Egypt all have different monetary policies that affect their own economies. The Nigerian central bank has been given full authority to create and carry out both the credit and monetary policies. Nigeria employs monetary targeting as its monetary policy. The major goals are to maintain foreign reserves, price stability, and monetary stability. Where the key tools are the money supply (M3) and interest rates. Additionally, the central bank employs adjustable exchange rates. Similar to Nigeria, Kenya's central bank is tasked with developing and carrying out monetary policy. The primary goal of the central bank is price stability, and its primary tools are the cash reserves ratio (CRR) and monetary targeting. Price stability is the primary goal of monetary policy in Egypt and should be attained in order to foster an environment that is conducive to growth and investment. The central bank is in the process of switching from monetary targeting to full-fledged inflation targeting with the assistance of the IMF. While the currency rate has been drifting from fixed to free-floating since 2016, interest rates remain the primary tool. The paper is structured as follows. Section 2

uses the empirical literature to examine the theory of inflation targeting and the Taylor rule. Theoretical and empirical models are covered in Section 3 and the interpretation of the findings is covered in Section 4. A conclusion and policy recommendations are then offered in Section 5.

2. Literature Review

Inflation targeting comprises five key aspects. The first is to make IT available to the broader populace. The second is the central bank's and all essential authorities' institutional commitment to the announced aim. The third criterion is an inflation-inclusive strategy for determining policy instruments such as interest rates that will be utilized to keep inflation under control. Fourth, the rise in public transparency, so that policy decisions, plans, targets, and actual inflation should be known, must be questioned. The final aspect is increased accountability, with the governor of the central bank, for example, is required to notify the minister of finance in writing of the reasons for missing the target and the actions that will be taken if the objective is not met. 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:

$$L = (\pi - \pi^e)^2 + \gamma(y - y^e)^2 \quad 1$$

Where L denotes social loss, π^e and y^e denote expected inflation and output respectively, and lastly, γ denotes social importance for output. The inflation surprise in the above equation (1) is argued to increase output in the short run. Therefore:

$$Y = (\pi - \pi^e) - \varepsilon \quad 2$$

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 commitment. The supply curve has been constrained.

$$\pi = \pi^* + \frac{\gamma}{1+\gamma}\varepsilon \quad 3$$

The equation (3) 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. The rule versus the discretion policies has been discussed in the previous section where IT comes in as the solution to discretion policies. When compared to alternative regimes, like the monetary targeting, employed by most African central banks, the 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.

The following section discusses another important monetary policy rule for this study, the Taylor rule. One of the core monetary policy rule discussed in the literature is famous Taylor (1993) 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 symbolical denoted by the equation below.

$$i^* = r + \alpha(\pi - \pi^e) + \beta(y - y^e \qquad 4$$

Where i^* denotes the nominal interest rate, r denotes a real interest rate, while π and y denotes inflation and output, respectively. Similar important $\pi^e$and $y^e$are desired inflation and output respectively. Both α and β are positive coefficients in equation 4. 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 output is higher than the target, the interest rate will be cut, and coefficient β will be negative.

Turning to the similar policy rule that guide the methodology of this study, the famous Taylor rule. 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. Morozumi *et al*, (2020) used the exchange rate in their prior research and discovered that it has a substantial coefficient. Therefore, consider the following equation for an open economy:

$$i_t = pi_{t-1} + (1-p)[\alpha(\pi_{t-1}) + \beta(y - y^e) + \gamma(E_t - E_{t-1})] \qquad 5$$

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. Finding the correct balance between the coefficients, on the other hand, is a challenge. As a result, it is more efficient than the Freidman and McCullum rules, because it tells the MPC how to respond to changes in the economy by adjusting the interest rate (Salter, 2014). According to the first Taylor principle, the above equation the inflation coefficient should be 1.5 or above one and be statistically significant, while the second principle posits that the output gap should be 0.5 or above zero and below one. The first principle implies that if the inflation or output gap decreases then the interest rates will rise in order to take control of the two variables (Nikolsko-Rzhevskyy *et al.*, 2019).

Both principles are rooted in Taylor rule establishes in 1993, while the case of changes in the exchange rates is based on (Taylor 2001). The coefficient for the exchange rate should remain insignificant to indicate that there is an indirect relationship between the exchange rate and interest rates. The reaction of the interest rates should only directly affect the output gap and inflation rates to maintain long-term stability which would be impossible if there is the direct reaction between the interest and exchange rates.

Turning to the empirical evidence, in the inflation targeting setting, the interest rates channel plays a central role in controlling other variables including inflation and growth in the long run. The above sentiments have been validated by Karim, (1999); Mensah, (2020); Were *et al*, (2014), and Ng'ang'a *et al,* (2019) in the empirical literature. The contractionary monetary policy uses a higher repo rate to shrink the economy, and the expansionary monetary policy, which uses a lower repo rate, is intended to stimulate the economy, particularly in the IT setting.

In monetary targeting economies, the general goals of monetary policy are to regulate the supply of money and to influence changes in money demand in response to money stock. As a result, monetary policy can alternatively be described as the central bank's modification of the money supply to avoid monetary imbalance (Salter 2014). According to Emmanuel, (2013) and Okotori, (2019), the money supply is one of the crucial variables that fuel inflation rates. In Kenya, the high pace of financial development in the post-2007 period was associated with instability of the money multiplier and income velocity (Ndirangu, 2013).

Notwithstanding to inflation targeting regime, several studies in empirical literature for emerging and emerged markets have indicated the powerful role of IT in building a sound financial system, creating enabling environment for growth, reducing inflation while building credibility. Among those are (Garriga and Rodriguez, 2020; Melnick and Strohsal, 2016; Guo and Zhang, 2020; Aryeetey and Ackah, 2009 and Kose *et al.*, 2011). The advantage of the IT alternative to other strategies is that it is like a package that contains first the preliminary requirements before the economy is ready to adopt the policy (see introduction section). Each the highlighted preliminary requirements for IT has its own advantages that add value to the overall strategy.

Tylor (2019) argues that IT alone is insufficient and that it should adhere to a set of rules while retaining enough flexibility in the face of exogenous shocks. Furthermore, if there is a direct link between exchange rates and interest rates. Svensson, (1998) used the exchange rate in their prior research and discovered that it has a substantial coefficient. Taylor (2001) argued that the economies that respond to the exchange rates by adjusting the interest rates are those that have a direct relationship between the two variables and cannot reach a desirable level of output and inflation

stabilisation. Those economies are most likely to experience high inflation influenced by the exchange rate. The work of Taylor (2001) has been corroborated by other studies that include (Bask 2020)

In African selected economies there is disagreement in the literature pertaining to the monetary policy conduct and its effects to achieve economic goals. For example in Egypt, Bhanumurthy and Sarangi, (2019) indicated that inflation is not influenced significantly by monetary policy instruments. The study analysed quarterly data from 2008 to 2018 using the structural vector autoregressive (SVAR) model, while Mohieldin and Hussein, (2019) empirically supported the claim. Other research, contrary to the aforementioned findings, have revealed that monetary policy is not employed to its full potential to achieve particular goals. The impact of fiscal policy on inflation and output is greater than that of monetary policy. Misati and Munene, (2015) used data from 1996Q1 to 2010Q2 in their investigation, which used the VAR and Granger causality models. Ekwe *et al*, (2017), on the other hand, looked into the link between monetary policy and growth. Multiple regression analysis was utilized in the study, and the results showed that monetary policy did not have a substantial role in fostering growth in Nigeria.

The second debate is linked to the inflation targeting regime. Farid, (2018) carried out the econometrics analysis which included the VAR and VECM models, using sample data from 2005Q1 to 2017Q3, and revealed that IT is underway in Egypt. Furthermore, the central bank of Egypt directs the monetary policy towards the fully-fledged IT regime. Similar important, according to Okuyene and Sangosanya, (2019), an IT regime in Nigeria could be beneficial because it has the capacity to stabilize both inflation and output levels. These sentiments were similarly shared by Augustine *et al*, (2020) across the leading African economies.

Although IT is a neat mastering cure in most emerging economies, Emad (2019) argued that it is not yet the time for Egypt to adopt it. Shobande and Ibrahim, (2018), meanwhile, contended that the IT regime should be given less weight because the current monetary policy is capable of achieving the goals. The researchers employed the ARDL model and data from 1986Q1 through 2018Q4. The studies above derive their findings based on the readiness of the economy, from which it is easy to say the economy is not ready especially if the economy does not put things in order for IT strategy. However, the economy might be ready based on the level of development and based on the vulnerability the economy experiences that require an IT regime. In favour of the aforementioned argument O, Connell (2012) have shared a similar argument. In African economies, the expectations channel is not well understood. The following section will describe the methodology followed by this study.

3. Methodology

3.1. Description of Data

The data sample for selected economies namely Egypt, Ghana, Kenya, Nigeria and SA were collected from 2007Q1 to 2020Q4 covering only the period during and after the 2007/8 GFC in a time-series format. The selected variables include inflation, GDP per capita, interest rates and exchange rates. Due to data unavailability on quarterly GDP per capita, the sample annual data was converted into quarterly data using the cubic interpolation method. Furthermore, the GDP per capita was also converted to output gap using the Hodrick-Prescott (HP) filter. The data was collected from international financial statistics for IMF, World Bank, FRED and Easy data.

3.2. Description of the Variables

Inflation is measured by the consumer price index (CPI). According to the Taylor rule, deviations of this variable from the target value induces 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. The deviations of GDP from potential GDP computed using the HP filter method was used to capture the output gap. A positive output gap signals economic overheating hence monetary policies are expected to adjust the policy rates upwards. The output gap is expected to have a positive sign that differs from zero, below one and close to 0.5. According to Taylor (2001), however, central banks that react to the changes in the exchange rates do not achieve an optimal level of inflation and the output gap. Therefore, the exchange rate variable is expected to have an insignificant coefficient. The repo rate has been used as the proxy for short-term 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.

3.3. Empirical Model

The following discussion indicates the econometrics formulation of the model used in the study after a considerable review of the consistency of the model. With regards to ARDL model as an approach to estimate the Taylor rule there are lot of studies that have used the same model such as (Agwuna *et al.,* 202); Narta and Yayla, 2019). Technically, the autoregressive distributed lags (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.

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

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 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 white noise error term and it should have a zero mean value and a constant variance. Following (Singh and Bhuyan, 2016), the augmented version of the Taylor rule was extended to accommodate the exchange rate and the US quantitative easing dummy can be specified in the ARDL format as follows. Similar important Ceylan *et al*, (2018) contended that the aforementioned version is better explaining of the Taylor's reaction function selected economies. Consider the following equation:

$$i_r = \alpha + \sum_{i=1}^{n} \delta \, i_{t-p} \sum_{i=1}^{n} \delta \, \pi_{t-p} + \sum_{i=1}^{n} \delta \, y_{t-p} + \sum_{i=1}^{n} \delta \, ER_{t-p} + \omega' QE + \varepsilon_t \quad (2)$$

$i = 1,2 \ldots p$ And t=1, 2…p

Where $i_r \; and \; i_{t-i}$ denote the real interest rates and their lags respectively, α denotes the constant term, $\pi, y \; and \; ER$ denote the inflation rate, output gap and the exchange rate, respectively, QE is a dummy variable which captures the US quantitative easing (QE) period relative to the non-QE period. 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.

3.4 Estimation Procedure

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 Pesaram *et al*, (2001) 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 in order 2.

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).

The bounds testing procedure proposed by Pesaran and Shin (2001) is relevant in this case but sine the sample sizes is small the study relied on the table provided by Narayan, (2004) 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. 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 (2004), the conditional ARDL model of the following form will be considered for each country.

$$\Delta i_r = \alpha + \sum_{i=1}^{n} \delta\, \Delta i_{t-p} \sum_{i=1}^{n} \delta\, \Delta \pi_{t-p} + \sum_{i=1}^{n} \delta\, \Delta y_{t-p} + \sum_{i=1}^{n} \delta\, \Delta ER_{t-p} + \omega' QE + \lambda ECT_{t-1} + \varepsilon_t \quad (3)$$

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.

After 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. Discussion of Results

The descriptive statistics lay the foundation of the results section from which the data samples of selected variables are analysed statistically. The interest rate was on the highest average in Ghana, Nigeria and Kenya reflecting tight monetary policies in these economies. Policy rates that measure the asymmetry of the distribution of the series are positively skewed across all five countries which suggests a long right tail. This observation suggests that the volatility of policy rates was highest in Egypt and lowest in Nigeria. The kurtosis measures the relative peak of a distribution. The mean of the CPI is lowest in SA and thereafter the highest in Ghana, this indicates the well-mannered inflation targeting practice that favours SA.

Table 1. Descriptive Statistics Table for Egypt.

	CPI	EX	IN	GDP GAP
Mean	161.4048	9.6568	9.656870	1.90E-10
Std. Dev	77.59172	5.0321	5.032089	28.70352
Skewness	0.665383	0.7996	0.799576	0.427019
Kurtosis	2.036716	1.7917	1.791667	3.162792

Author's computation

Table 2. Descriptive Statistics Table for Ghana

	CPI	EX	GDP GAP	IN
Mean	166.7227	2.938931	3.72E-10	17.40625
Std. Dev	78.397434	1.618777	103.4117	3.922198
Skewness	0.39748	0.298688	-0.345003	0.914474
Kurtosis	1.773748	1.574584	2.171608	2.914474

Author's computation

Table 3. Descriptive Statistics Table for Kenya

	CPI	EX	GDP GAP	IN
Mean	137.0341	10.90097	5.38E-11	14.92446
Std. Dev	39.46886	3.271192	13.54324	2.197399
Skewness	0.017080	0.305240	-0.060863	0.729925
Kurtosis	1.870887	1.803080	0.341837	2.680721

Author's computation

Table 4. Descriptive Statistics Table for Nigeria

	CPI	EX	GDP GAP	IN
Mean	157.4110	209.6524	1.49E-10	16.56617
Std. Dev	69.30217	82.45870	28.90269	1.352519
Skewness	0.549044	0.677324	0.738766	0.774218
Kurtosis	2.044415	1.883899	2.672685	5.440630

Author's computation

Table 5. Descriptive Statistics Table for SA

	CPI	EX	GDP GAP	IN
Mean	122.5723	10.90097	8.06E-10	10.24107
Std. Dev	26.05087	3.271192	95.44147	1.978590
Skewness	0.088984	0.305240	0.772475	1.189687
Kurtosis	1.768484	1.803080	5.311045	4.001692

Author's computation

As it has been highlighted in the methodology section that this study follows the ADF and PP tests for stationarity tests. According to the results, inflation, interest rates and real effective exchange rates are non-stationary in levels but become stationary after first differencing. On the other hand, the output gap computed using the Hedrick-Prescott filter is stationary in levels for all the countries which are not surprising since this variable measures output deviations.

The following table shows the Bound test for cointegration. The null hypothesis is that of no long-run relationship among the level variables and it is rejected if the computed F-statistic is above the 5% upper critical bound tabulated in Narayan (2004) for cases with a trend and an intercept. With k=3, the F-statistics in Table 6 are all above the computed 5% upper critical bound value hence the null hypothesis of no long-run relationship is strongly rejected in favour of the alternative.

Table 6. Bound Test Based on Narayan Critical Values

	F-stat	I(0)	I(1)	Outcome
Egypt	15.49***	3.30	7.01	Long-run relationship exists
Ghana	5.91**	3.30	5.86	Long-run relationship exists
Kenya	8.38***	3.30	7.01	Long-run relationship exists
Nigeria	6.35**	3.30	5.86	Long-run relationship exists
SA	4.16**	3.30	4.13	Long-run relationship exists

*Note: * significant at 1% level. ** Significant at 5% level and *** significant at 10%.*

The following equations indicate the short-run equations for the augmented Taylor rule estimated using the ARDL model. In these unrestricted error correction models, the optimal order of the ARDL model is automatically determined using the Akaike information criterion (AIC). The F-statistic from each of these models is then compared with the critical values. For small sample sizes, it is recommended to use critical values in Narayan (2004) over those reported in (Pesaran *et al.,* 2001). Since this study is based on a relatively small sample size of 55 observations, critical values reported in Narayan (2004) were used. The trend component was included in all

specifications as it mostly entered significantly reflecting time-dependent shocks on policy rates that could not be explicitly included in the model.

The long-run equations for each of the five selected economies are shown in Table 7. The policy rate is the dependent variable across all variables, and the levels and lags of inflation, the output gap, and real effective exchange rates are the explanatory variables. Starting with South Africa and Egypt, which have positive, greater-than-one, and statistically significant coefficients of inflation at 10% and 1%, respectively. This suggests that both economies adhere to the first Taylor principle, as the outcomes are related to those of (Caporale, Maria *et al.*, 2018; Agwuna *et al.*, 2022 and Saadat *et al.*, 2016). While Egypt is moving toward IT, SA is an inflation-targeting market. These findings suggest that both economies place more emphasis on fluctuations in inflation in order to achieve their goal of price stability, and that they respond to rising inflation by raising interest rates over the long term in order to keep prices as low as possible for the economy. SA has a coefficient of 1.6 compared to Egypt's 1.07, which may be explained by the fact that the former uses formal IT that is aggressively responsive to changes in inflation while the latter is approaching IT strategy with rigor. In some circumstances, SA has been able to keep inflation within the desired range. It also boasts one of the most sophisticated financial systems in Africa and contributes to the growth of other African countries (Omoshoro-Jones & Bonga-Bonga, 2022).

Table 7. Long-Run Reaction Function for Policy Rate

Variables	Egypt ARDL (3.2.2.3)	Ghana ARDL (8.7.4.3)	Kenya ARDL (2.2.3.4)	Nigeria ARDL (4.3.0.2)	SA ARDL (3.3.2.0)
Inflation	1.079***	0.507***	0.556***	0.8508***	1.6496*
	(0.209)	(0.072)	(0.088)	(0.1253)	(0.9614)
GDP gap	-0.027	0.001	0.0004	0.0112	0.0064**
	(0.021)	(0.001)	(0.0006)	(0.008)	(0.0030)
Exchange	-0.133	-0.385	0.0001	-0.017*	0.1059
Rate	(0.192)	(0.257)	(0.003))	(0.009)	(0.3384)
QE dummy	0.635	-0.170	0.005	0.6340	-3.7824***
	(0.759)	(0.186)	(0.008)	(0.453)	(1.3204)
C	9.245	-0.206	-2.285	17.242	10.4942***
	(0.784)	(0.266)	(0.3985)	(1.017)	(3.7104)
@trend	0.011032	0.057*	-0.010***	-0.0276	-0.1068*
	(0.0388)	(0.021)	(0.001)	(0.037)	(0.0545)
R^2	0.988890	0.988682	0.958219	0.869573	0.984620
$\underline{R}^2$	0.984385	0.972598	0.939120	0.820222	0.9793
F-stats	219.5481***	61.46993***	50.16936***	17.62027***	187.13***
D-Watson	1.737679	1.918713	2.1111	1.732	2.14

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

The inflation coefficients of the remaining economies (Ghana, Kenya & Nigeria) are 0.51, 0.56, and 0.85, respectively. Although each coefficient is less than 1, they are all statistically significant and positive. This suggests that monetary targeting in Nigeria and Kenya responds to fluctuations in inflation, but that their response is distorted by factors such as the unstable money supply, a weak financial sector, external shocks, an unstable currency rate, and a lack of coordinated transmission channels. However, Ghana has the coefficient of inflation rate, which may indicate that the country's economy wasn't yet prepared to implement full-fledged inflation targeting. This might be explained by the fact that Ghana, a lower-income nation, has frequently failed to keep inflation within the desired range.

Regarding the second Taylor principle, the output gap coefficient in South Africa is 0.006 and statistically significant at the 5% level. The second principle of the Taylor rule does not totally hold in its strongest form since the output gap is far from 0.5, (Narta *et al.*, 2019). This indicates that since the GDP is growing slowly and the SA business cycle is described by dramatic swings in inflation, monetary policy does not place more focus on output variations. The output gap coefficient in the other economies is positive but not statistically significant, indicating that there is no equilibrium between increases in inflation and the output gap. This indicates that the monetary targeting strategies used in Nigeria, Egypt, and Kenya do not prioritize interest rates as the primary instrument of policy, while Ghana exhibits subpar techniques for targeting inflation.

Moving on to the long-term fluctuations in currency rates, there is evidence of a long-term association between interest rates and exchange rates for Nigeria exclusively. The findings are praised by (Agwuna *et al.*, 2022). Contrarily, the coefficients for the remaining four economies are statistically negligible, which accords with the economic theory supported by (Taylor 2001and Bask 2014)

The results are consistent with those of Tran and Pham and show that average interest rates were lower during the quantitative easing in the post-GFC period for SA. This might be explained by the fact that between late 2008 and 2013, the policy interest rates fell from 12% to 5%. On the other hand, the QE had little to no long-term impact on the surviving economies. The advanced financial system directly experiences a significant impact from QE on the economy. The weak financial system is in contrast to (Lim *et al.*, 2014). The goodness of fit for all economies is strong, and the R-squared for all economies is lower than the Dubin-Watson test in proving that the model is valid. Additionally, for all economies, the DB-Watson tests are near to two, indicating that the models are autocorrelation-free. The results section is summarized in the section that follows. The following equations summarize the short-run equation of the ARDL model.

South Africa ARDL

$$IN_t = 0.44^{***}\, IN_{t-1} - 0.21^{**}\, IN_{t-2} + 0.17^{***}\, INFL_t + 0.18^{***}\, INFL_{t-1} + 0.001^{**}\, GAP_t + 0.002^{***}\, GAP_{t-1} - 0.52^{**}\, QE_t - 0.02^{*} TREND - 0.14^{***} ECT_{t-1}$$

Ghana ARDL

$$IN_t = 0.26^{*}\, IN_{t-2} - 0.53^{***}\, IN_{t-6} + 0.057^{***}\, INFL_t + 0.033^{***}\, INFL_{t-2} + 0.055^{**}\, INFL_{t-4} + 0.001^{***}\, GAP_{t-1} - 0.002^{***}\, GAP_{t-2} + 0.002^{**}\, GAP_{t-3} - 0.093^{**} QE_t + 0.196^{**}\, XR_{t-2} + 0.031^{*} TREND - 0.55^{*} ECT_{t-1}$$

Kenya ARDL

$$IN_t = 0.45^{***}\, IN_{t-1} + 0.22^{***}\, IN_{t-2} + 0.10^{*}\, INFL_t + 0.0008^{**}\, GAP_{t-1} + 0.003^{*} EX_{t-1} + 0.03^{**} EX_{t-3} - 0.003^{***} TREND - 0.34^{***} ECT_{t-1}$$

Egypt ARDL

$$IN_t = 0.28^{**}\, IN_{t-1} + 0.33^{***}\, IN_{t-2} + 0.07^{***}\, INFL_t - 0.06^{***}\, INFL_{t-1} + 0.01^{***}\, GAP_{t-1} + 0.09^{**} EX_{t-1} - 0.17^{***} EX_{t-2} + 0.03^{***} TREND - 0.19^{**} ECT_{t-1}$$

Nigeria ARDL

$$IN_t = 0.29^{***}\, IN_{t-1} + 0.41^{***}\, IN_{t-2} + 0.32^{**}\, IN_{t-3} + 0.14^{*}\, INFL_{t-1} - 0.17^{**}\, INFL_{t-3} - 0.02^{**} EX_{t-1} - 0.55^{**} ECT_{t-1}$$

Emanating from the short-run equations, the lags of the policy rates have a positive and significant effect on the current level of the interest rates (interest rates inertia) for four economies except for Ghana. The interest rate inertia could be associated to the fact that the monetary policy committee does not change the interest rates in the short run since the transmission mechanism takes time to affect other variables. These results are consistent with those of Chekpoiwo, (2011) concerning interest rate smoothing. The inflation coefficients show positive signs for all selected economies supporting the hypothesis that central banks in these countries respond to short-run inflation dynamics albeit less aggressively as similarly observed in (Khumalo *et al.*, 2022). All selected economies respond to inflation changes as it has alluded to in the introduction that all central banks put price stability as the main objective. The output gap also enters with an expected positive and significant sign in the short run across all the five countries reinforcing the notion of central banks reacting to economic overheating through contractionary monetary policies.

As discussed earlier in the theoretical section of the study, the exchange rate can also be a potentially significant source of policy rate adjustments. For inflation targeting economies operating a flexible exchange rate regime in which the exchange rate determination should be guided by market forces in theory, recent literature has documented fear of floating tendency in which monetary policy authorities implicitly internalise exchange rate dynamics in assessing policy adjustments. The short-run equations validate this proposition for all countries except South Africa where the exchange rate entered insignificantly. South Africa's central bank decisions on policy adjustments are not directly influenced by exchange rate dynamics (Ftiti, 2011). Monetary policy that responds to the exchange rate does not reach the good level of the desired inflation and output stabilisation (Talbi2, 2014). This is indicated in the results across the four countries namely Kenya, Nigeria, Egypt and Ghana. This means these economies are highly affected by the exchange rate pass-through to inflation. These findings are in line with that of Alabi and Ike-anikwe, (2016) who found that Nigeria's interest rate responds to exchange rate movements between 1998 and 2014. Similar sentiments were equally shared by (Agwuna *et al*,. 2022).

The QE dummy indicates that in the short run, the interest rates were on average lower during the quantitative easing period relative to the baseline period. This result is particularly true only in IT countries (South Africa and Ghana) where the QE dummy is statistically significant.

The error correction term indicates the speed of adjustment following the short-run deviation from the long-run equilibrium. The error correction terms are (-0.19; -0.17; -0.34; -0.55 and -0.13) for Egypt, Ghana, Kenya Nigeria, and SA respectively. South Africa has the lowest value, which indicates that the policy rate adjusts gradually towards its equilibrium level. This could be attributed to the fact that the MPC does not react very fast to changes in the inflation rates, but instead they consider rational expectations.

The post-estimation diagnostic checks which are necessary to ensure the reliability of the estimated results. For all the five selected countries, evidence indicates that the residuals from the estimated models are free from autocorrelation, heteroscedasticity (apart from South Africa whose model was re-estimated with Heteroscedasticity and autocorrelation consistent (HAC) standard errors as a corrective measure), model misspecification and residual non-normality. As indicated below, the CUSUM line fluctuates within the 5% significance band for all five selected countries. This means that the estimated models for Kenya, South Africa, Ghana, Egypt, and Nigeria do not suffer from parameter instability.

5 Conclusion

The study has provided evidence concerning the conduct of the monetary policy through policy reaction function to its lags, inflation rate, output gap and exchange rates. On the selected economies were grouped as inflation targeting economies (SA and Ghana) and non-targeting economies (Nigeria, Kenya and Egypt) using the augmented Taylor rule under the ARDL model. The study is concerned about the role of monetary policy practices and questions the issue of inflation targeting that most African economies hesitate to adopt explicitly. The study base its findings on two highlighted Taylor principles and the reaction of interest rates to exchange rate.

The findings showed that the second Tylor principle does not hold in its strongest form in the SA. However, the first principle holds only South Africa and Egypt to adhere to it over the long term. The findings imply that while Egypt's explanation is not comprehensive, SA's monetary policy practice can be described by Taylor's rule. The results from South Africa also show how well inflation targeting works in an economy that does better than other African developing markets. Additionally exchange rates was entered significantly, in every economy, with the exception of SA, illustrating the phenomena of the long-term dread of floating. As opposed to non-targeting economies, inflation-targeting economies had lower interest rates during the QE period. In terms of managing real interest rates, currency rates, and financial development as well as fostering an atmosphere that encourages investment and economic expansion. There is no question that Africa could have a financial sector that is rapidly expanding if rising nations in the continent could implement monetary policy similarly to SA. Additionally significant, it suggests that Egypt's switch to inflation targeting was a wise decision that will bear rewards for some time. On the other side, Taylor's rule cannot account for Ghana, Nigeria, or Kenya.

The analysis concludes that Nigeria, Egypt, and Kenya, three middle-income emerging markets, are suitable for adopting inflation targeting on the basis of their degree of development compared to SA. However, in order to fulfil all prerequisites, they need a very advanced financial system which SA can provide as an excellent example. Therefore, the analysis agrees with the view that IT is not appropriate for developing nations like Ghana (Morozumi, 2020). The two inflation targeting economies' different reaction functions may be to blame for this. The results also show that the use of monetary policy is one of the main tactics in all of the economies that were chosen, but not all of these strategies can be explained by the Taylor rule because some of the economies do not employ the interest rate rule. The Taylor rule, however, exposes the flaws in monetary policies that ignore the mechanism causing interest rate reaction. Additionally, it demonstrates the impact of direct relationships between interest rates and exchange rates, which skew attempts to stabilize the production gap and inflation in Nigeria, Ghana, Egypt, and Kenya. The study concluded that IT economies should continue to pursue this policy, while non-targeting should conduct

flexible monetary policy stances around the objective of price stability and adopt flexible exchange rates. Future studies could focus on economies that are exclusively practising implicit IT versus economies targeting flexible average IT (FAIT).

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