

How optimal is Ghana's single-digit inflation targeting? An assessment of monetary policy effectiveness in Ghana

Optimal
inflation rate
for Ghana

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Abstract

Purpose – The purpose of this study is twofold. First, to estimate an optimal inflation rate for Ghana and second, to investigate factors that account for the differences between observed and target inflation.

Design/methodology/approach – The paper explored the questions within two econometric frameworks, the Autoregressive Distributed Lag (ARDL) and Threshold Regression Models using data spanning the period 1965–2019.

Findings – The study estimated a range of 5–7% optimal inflation for Ghana. While this confirms the single-digit inflation targeting by the Bank of Ghana, the range is lower than the central bank's band of 6–10%. The combined behaviours of the central bank, banks and external outlook influence inflation target misses.

Practical implications – The study urges the central bank to continue pursuing its single-digit inflation targeting. However, it implies that there is still room for the Bank to further lower the current inflation band to achieve an optimal outcome on growth and welfare. Again, the Bank should commit to increased transparency and accountability to enhance its credibility in attaining the targeted inflation.

Originality/value – The study is one of the first attempts in Africa in Ghana to estimate an optimal inflation target and investigate the underlying factors for deviation from the targets.

Keywords Optimal inflation rate, Monetary policy, Ghana

Paper type Research paper

1. Background

The optimal level of inflation to target for an economy has engaged the attention of many academics and policymakers (Bhattarai, 2014), particularly because inflation brings forth both positive and negative economic outcomes that require a balance to maximize economic gains. Theoretically, an effective monetary policy aimed at controlling inflation requires in principle that, the gap between actual inflation and target rates should be close (possibly zero) and consistent with growth (Svensson, 2010).

On that account, the key question for a developing country like Ghana is the level of inflation that is ideal and can promote economic welfare and stimulate growth. Since adopting the Inflation Targeting (IT) framework in 2002, Ghana's central bank has failed to achieve its target rate of 8% [1], though it has succeeded in stabilizing prices after years of high inflation in the 1980 and 1990s. Available data reveal that apart from the period December 2010 through to 2011 and 2019 when the country attained single-digit inflation, the central bank has not been able to attain its inflation target.

The central bank's inability to consistently achieve its inflation target is supported by available data. Figure 1 presents the inflation gap for Ghana under the IT regime [2]. It is evident from Figure 1 that the inflation gap has remained largely positive within the entire IT period. This evidence suggests that monetary policy has been ineffective in achieving the desired level of inflation. Why monetary policy is unable to achieve its desired outcome requires investigating. Two important questions that the paper investigated are:



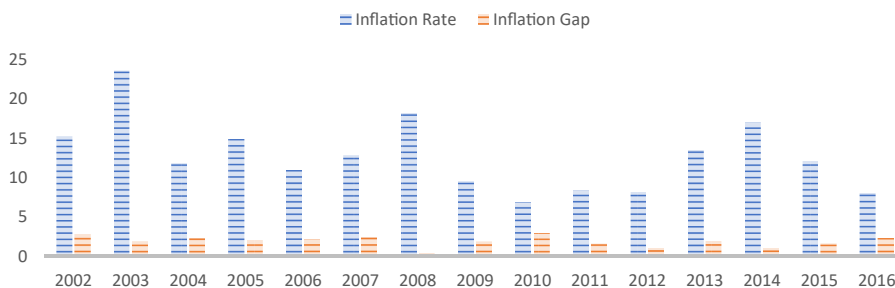


Figure 1.
Graph of inflation and
inflation gap

Source(s): Authors' compilation with data from the Bank of Ghana Database

- (1) Is the deviation resulting from a sub-optimal inflation target rate? Or
- (2) The deviation results from ineffective monetary policy.

The debate on optimal inflation is a very important discussion in the conduct of monetary policy. This is against the backdrop that inflation is a necessary evil, which has the parallel effect of serving as an incentive to production and negatively impacting general welfare. In effect, central banks would target a non-zero inflation rate by forming a balance between the two opposing effects (Adam *et al.*, 2022).

Ghana practising inflation targeting for about two decades has constantly missed inflation targets [3]. Are inflation target misses due to sub-optimal inflation targets or the ineffectiveness of monetary policy? The study explored this objective by estimating an optimal inflation rate for Ghana using two different econometric methods – the threshold and Autoregressive Distributed Lag (ARDL) modelling approaches. This study estimated an optimal inflation rate of 5–7% which agrees with the inflation target rate of the Bank of Ghana (BOG).

The rest of the paper is organized as follows: Section 2 provides a brief review of the literature, Section 3 espouses the methodology adopted, Section 4 presents the results and discussions and Section 5 concludes the study with policy recommendations.

2. Literature review

In the literature, many theoretical explanations have been proposed for inflation (Totonchi, 2011). Notwithstanding, there is a consensus that two foundational theories of inflation are the demand-pull and cost-push theories (Dastgerdi, 2020; Nigusse *et al.*, 2019; Shaikh *et al.*, 2022). However, the detailed factors that drive inflation are enshrined in theories such as the Neoclassical Monetarism theory, New Keynesian theory, Post-Keynesian theory, Modern Monetary Theory, Political Economy Theory, Sociological theory and Structuralist Theory (Barta *et al.*, 2023).

According to Abuselidze (2019), inflation in developing countries should be analysed from perspectives different from that of a developed country. As Dastgerdi (2020) points out, inflation in industrial countries is largely supported by demand-pull and cost-push theories but these theories do not completely cover the reasons for inflation in developing countries. Lapavitsas (2022) has emphasized that structural inflation theory espouses the causes of

inflation in developing countries. The structuralist theory considers the essential characteristics of inflation by identifying its chronic and recurrent nature. That notwithstanding, the appropriate theory that underlines inflation dynamics in any country is largely an empirical issue.

Irrespective of the source of inflation in any economy, the most optimal rate requires to be determined. To that extent, countries have adopted Inflation targeting, either explicitly or implicitly, as a policy framework to target inflation and anchor inflation expectations. In inflation targeting, the policymaker commits to achieving an inflation target.

According to [Bernanke et al. \(1999\)](#), “inflation targeting is a framework for monetary policy characterised by the public announcement of official quantitative targets (or target ranges) for the inflation rate over one or more time horizons, and by the explicit acknowledgement that low stable inflation is monetary policy’s primary long-run goal. Among other important features of inflation targeting are vigorous efforts to communicate with the public about the plans and objectives of the monetary authorities, and, in many cases, mechanisms that strengthen the central bank’s accountability for attaining those objectives” (p. 4). It is generally agreed inflation targeting requires a central bank can conduct monetary policy with some degree of independence and a sole focus on inflation, a key requirement for achieving its policy goal.

Nevertheless, inflation-targeting monetary authorities frequently fail to achieve their inflation target. Many explanations are provided. [Ehrmann \(2021\)](#) claims, for example, that point objectives are more likely to be missed than range targets, although [Kahn and Parrish \(2020\)](#) note exceptional conditions such as shocks in the price of oil. According to [Albagli and Schmidt-Hebbel \(2003\)](#), inflation targets would be frequently missed if institutions were weak, the central bank was not independent and risk premiums were large. The necessity of an empirical effort to determine the ideal inflation cannot be overstated if target misses could be attributed to non-optimal targets.

For emerging markets and developing countries, studies on optimal inflation largely focus on the associations between inflation and economic growth, per capita GDP or some macroeconomic indicator exploring the nonlinearities to determine an ideal inflation rate. Various studies in developing and emerging market economies have followed such an approach.

[Dammak and Helali \(2017\)](#) studied the inflation–economic growth nexus in the case of Tunisia for the 1993–2012 period employing a threshold regression model and found that an inflation rate lower than 3.48% fosters economic growth. [Khan and Hanif \(2020\)](#) consider the issue of optimal inflation from a different perspective by looking at the relationship between institutional quality on the one hand, and inflation and economic growth on the other hand for some countries. They observe the existence of a minimum level of institutional quality which has a significant effect on inflation and economic growth.

[Adaramola and Dada \(2020\)](#) also sought to find the level of inflation that was not detrimental to economic growth by considering the effect of inflation on economic growth in Nigeria. [Abdulqadir et al. \(2020\)](#) investigated the optimal inflation targets in an appropriate exchange rate policy framework in 15 major oil exporting countries in Sub-Saharan Africa. They found an optimal inflation rate of 14.47%.

Within the Ghanaian context, there are some studies worth mentioning. A seminal work was done by [Frimpong and Oteng-Abayie \(2010\)](#) analysing the threshold effect of inflation on economic growth in Ghana for the period 1960–2008 using a threshold regression model. The data set employed includes the growth rate of GDP, the growth rate of the aggregate labour force, the growth rate of money supply and the growth rate of terms of trade (TOT). Their

result was finding an inflation threshold level of 11% above which inflation starts to significantly hurt economic growth.

In another study, [Musah et al. \(2019\)](#) examined the threshold effects of inflation on economic growth in Ghana and also observed that inflation negatively affects overall growth but estimated a threshold inflation rate of 21.57%.

For the Ghanaian setting, two salient issues observed are the use of a single methodology in estimation and varying estimates and non-consistency in results. The contribution of this present paper is by employing two different methodologies with a more recent dataset.

3. Methodology

3.1 Variable selection and data source

The variables were selected considering the inflation-growth nexus with a special focus on Per Capita GDP growth. Neoclassical growth theory considers the capital stock, labour force and technological progress as the main determinants of growth whereas endogenous growth theory considers human capital, knowledge and new technologies ([Piętak, 2014](#)).

Following [Fischer \(1993\)](#), [Barro \(1995\)](#), [Tien \(2021\)](#) and [Siddik \(2023\)](#) and principally [Mohsin Khan and Senhadji \(2001\)](#) we select variables utilizing the neoclassical growth theory underscored by the growth characteristics of Ghana and existing studies. Again, we consider data constraints and adjust accordingly. The variables were selected from the World Bank's Development indicators (WDI) [The World Bank \(2019\)](#) and the descriptions are discussed below:

- (1) Growth rate of GDP Per Capita (PCI): dependent variable employed in the estimation. It is computed as the percentage change in real GDP divided by population.
- (2) Inflation Rate (INFRATE): computed as the annual percentage change in consumer price index (CPI) with 2010 as the base year as the main explanatory and threshold indicator. Growth is expected to be lower at high rates of inflation over long-term economic growth but unaffected or even positive when inflation is lower ([Mandeya and Ho, 2021](#)).
- (3) Broad Money as a Percentage of GDP (M2) or Money Supply: used as one of the explanatory variables to represent an index of financial depth in a country at a particular point in time, as indicated by [King and Levine \(1993\)](#). The variable M2 as a proportion of GDP has been used as a proxy for financial development. Its computation is based on the annual percentage change in money and quasi-money as a percentage of real GDP. The expected sign of the coefficient for the broad money supply is positive.
- (4) Gross Capital Formation (GCF). Gross Capital formation was formerly called gross domestic investment. It is computed as the annual percentage change in gross capital formation as a percentage of GDP. Given the relevance of capital formation in growth modelling, this variable is included as a proxy. Gross capital formation is expected to be positive in this model
- (5) General government final consumption expenditure (GOVT_EXP): General government final consumption expenditure was previously known as general government consumption. It includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defence and security but excludes government military expenditures that are part of government capital formation. This variable is expected to be positive because of the enormous role of the government in the economy of Ghana.

3.2 Econometric approach

The main goal of the study is to estimate the optimal inflation rate for Ghana. To this end, we employed the well-known Autoregressive Distributed Lag (ARDL) model as proposed by Pesaran *et al.* (2001) and the Threshold Regression Model as proposed by Hansen (2000). The generalized form of the study model is represented as follows:

$$\widehat{PCI}^{\text{GrowthrateofPerCapitaGDP}} = f \left(\overbrace{\text{INFRATE}}^{\text{Inflation}}, \overbrace{\text{GCF}, \text{GOVT}_{exp}, \text{M2}}^{\text{ControlMacroeconomicVariables}} \right) \quad (1)$$

The econometric equation is specified as a growth model augmented with inflation as

$$PCI_t = \beta_0 + \beta_1 \text{INFRATE}_t + \beta_2 \text{GCF}_t + \beta_3 \text{GOVT}_{exp_t} + \beta_4 \text{M2} + \mu_t \quad (2)$$

Where variable source and expected signs are as previously defined in section 3.1 and β s represent the marginal effects and μ_t is the white noise error term.

3.2.1 Autoregressive distributed lag model. ARDL modelling technique, an Ordinary Least Square (OLS) based model applies to stationary and non-stationary time series. Being a least squares-based model implies it can be estimated as least squares regressions using lags of both dependent and independent variables.

Equation (1) is specified in an ARDL framework as follows:

$$\begin{aligned} \Delta PCI_{GR_t} = & \alpha_0 + \sum_{i=1}^n \beta_i \Delta PCI_{GR_{t-1}} + \sum_{i=1}^n \gamma_i \Delta \text{INFRATE}_{t-1} + \\ & + \sum_{i=1}^n \gamma_i \Delta \text{M2}_{t-1} + \sum_{i=1}^n \gamma_i \Delta \text{GCF}_{t-1} + D_{\text{INFRATE}} + \\ & \varphi_1 PCI_{t-1} + \varphi_2 \text{INFRATE}_{t-1} + \varphi_3 \text{GCF}_{t-1} + \varphi_4 \text{GOVT}_{exp_{t-1}} + \varphi_5 \text{M2}_{t-1} + \mu_t. \end{aligned} \quad (3)$$

$$\begin{aligned} \Delta PCI_{GR_t} = & \alpha_0 + \sum_{i=1}^n \beta_i \Delta PCI_{GR_{t-1}} + \sum_{i=1}^n \gamma_i \Delta \text{INFRATE}_{t-1} + \\ & + \sum_{i=1}^n \gamma_i \Delta \text{M2}_{t-1} + \sum_{i=1}^n \gamma_i \Delta \text{GCF}_{t-1} + D_{\text{INFRATE}} + \emptyset \text{ECM}_{t-1} + \mu_t \end{aligned} \quad (4)$$

where equation (2) is the ARDL specification and equation (4) is the Error Correction Model (ECM) specification. D_{INFRATE} is a dummy variable generated for selected levels of inflation from 5 to 30%. Δ represents the first difference, and \emptyset coefficients of parameters.

Optimal lag orders which are possibly different across variables were obtained by minimizing the Akaike information criterion (AIC). The bounds procedure for testing the existence of a long-run relationship is based on the Error Correction (EC) representation of the ARDL model. Indeed, the dynamic error correction model (ECM) as shown in equation (4) can be derived from ARDL through a simple linear transformation. The ECM term is typically the cointegrating relationship.

Furthermore, an ARDL model is diagnosed by testing for serial correlation in the residuals, checking the stability as well and performing a bounds test.

3.2.2 Estimation procedure of the ARDL model. Examining the data from equation (3), the ARDL bound test for cointegration is applied, which is also a Wald test. The null hypothesis of the Wald test suggests cointegration exists whereas the alternative implies the existence of

cointegration. If the computed F-statistic falls below the lower bound we would conclude that the variables, are I (0), so no cointegration is possible, by definition. If the F-statistic exceeds the upper bound, we conclude that we have cointegration. Finally, if the F-statistic falls between the bounds, the test is inconclusive Pesaran *et al.* (2001).

3.2.3 *Threshold regression.* This article follows the work of Khan and Senhadji (2001) and adopts the threshold regression of Hansen (1999, 2000) in addressing the non-linearity perceived in the growth and inflation relationship. This serves as a robustness check to the estimate from the ARDL.

The threshold model takes the form

$$PCI_t = \begin{cases} \beta_0^1 + \beta_1^1 INFRATE + \beta_2^1 GCF + \beta_3^1 GOVT_{exp} + \beta_4^1 M2 + \varepsilon_t & \text{if } INFRATE \leq \gamma \\ \beta_0^2 + \beta_1^2 INFRATE + \beta_2^2 GCF + \beta_3^2 GOVT_{exp} + \beta_4^2 M2 + \varepsilon_t & \text{if } INFRATE > \gamma \end{cases} \quad (5)$$

with PCI denoting per capita GDP growth rate as a regime-dependent variable, INFRATE representing inflation and the threshold variable Inflation (INFRATE), the threshold variable is used to split the sample into the regimes and the control variables as defined previously.

Where $I(\bullet)$ is the indicator function, and the regimes are separated into the lower and beyond the optimal threshold parameter γ while β_1 and β_2 are the regression slope under each regime and the error term $u \sim iid(0, \sigma^2)$.

3.2.3.1 *Test for threshold effect.* The test for the existence of threshold effect involves a hypothesis test that the equation can be divided into regimes depending on the value of the threshold variable. Upon the detection of at least one threshold value, the relationship between the dependent variable and threshold can be deemed as nonlinear. In the testing [procedure, the null hypothesis of linearity $H_0: \beta^1 = \beta^2$ is tested against the alternative that the coefficient varies across the regimes. This test employs a likelihood ratio test where;

$$F_1 = \frac{(S_0 - S_1\hat{\gamma})}{\hat{\sigma}^2} \quad (6)$$

where S_0 and $S_1\hat{\gamma}$ are sums of squared errors for both the null and alternative hypotheses respectively.

Since the F_1 has a non-standard distribution Hansen (1996) shows that the Wald LM static for each possible value of λ with inference can be computed based on the bootstrap calculation of a Wald or LM statistic for each possible value of λ and subsequently basing inferences on the supremum of the Wald or Lm statistic across all possible λ s.

Furthermore, the limiting distribution of their supremum statistic is non-standard and depends on numerous model-specific nuisance parameters. Obtaining an estimate of λ which is based on the minimisation of the residual sum of squares computed across all possible values of λ , as estimates of the $B1(\lambda)$ and $B2(\lambda)$

$$y_t = x_t\beta + z_t\delta_1 I(-\infty < w_t \leq \gamma) + z_t\delta_2 I(\gamma < w_t < \infty) + \epsilon_t \quad (7)$$

For a threshold regression with two regions identified by a threshold value ' λ ', the threshold of the estimator is given as

$$(\hat{\lambda}) = \underset{\gamma \in \Gamma}{\operatorname{argmin}} S_{T_1}(\gamma) \text{ Where } \Gamma = (-\infty, \infty) \quad (8)$$

the λ is obtained based on the minimized residual sum of squares computed across all possible values of λ , estimates of the slope parameters followed trivially as $\hat{\beta}_1(\hat{\lambda})$ and $\hat{\beta}_2(\hat{\lambda})$.

The impact of inflation considering the other control variables on per capita GDP growth will be $\hat{\beta}_1$ when the inflation rate is less than or equal to v and $\hat{\beta}_2$ when inflation is greater than the threshold value. If the null hypothesis is not rejected then the threshold model would transform into a linear model implying that a threshold effect does not exist.

3.2.3.2 Asymptotic distribution of threshold estimate. Understanding the characteristics of parameter estimates and hypothesis testing in this modelling framework depends heavily on the asymptotic distribution of threshold regression. The asymptotic distribution of the threshold estimate is tested with the null hypothesis; $H_0 = \gamma = \gamma_0$ using the likelihood ratio statistic test of

$$LR_1(\gamma) = \left[\frac{(S_1 - S_1\hat{\gamma})}{\hat{\sigma}^2} \right] \quad (9)$$

The asymptotic confidence interval is known as

$$c(\beta) = -2\log \left(1 - \sqrt{1 - \beta} \right) \quad (10)$$

Such that for a given of β , the null hypothesis of $\gamma = \gamma_0$ is rejected if $LR_1(\gamma)$ exceeds $c(\beta)$. The model can be modified if a double threshold exists.

In the estimation, we compute the critical values at the asymptotic distribution of the LR, at the 1%, 5 and 10% significance levels and find.

4. Results and discussions

We began by presenting the characteristics of the variables in [Table 1](#) showing the summary statistics. The statistics reveal that between 1965 and 2019 the average inflation rate (INFRATE) was approximately 27.16%, with the highest being 122.87% and the lowest – at 8.42%. Within the same sample period, the average annual per-capita GDP growth (PCI) is about 1.02%, with a maximum of 11.28% and a minimum of –14.45%. Average annual Per capita GDP growth (PCI) is far lower than the average inflation rate.

Further, a correlation analysis suggests that the correlation between the variables is low. [Table 2](#) presents the correlation results, and it shows that the lowest correlation among the variables is 0.01 which is between per capita GDP growth (PCI) and final government

Variable	Mean	SD	Min	Max
PCI	1.130535	4.40386	-14.50853	11.31545
INFRATE	27.16475	27.10922	-8.422486	122.8745
GCF	16.28002	7.555804	3.37764	30.04927
GOVT_EXP	10.98494	2.313663	5.86129	16.76471
M2	22.78945	5.689418	11.30499	34.10823

Source(s): Authors' estimation with data from WDI, 2019

Table 1.
Summary statistics

	PCI	INFRATE	GCF	M2	GOVT_EXP
PCI	1.0000				
INFRATE	-0.3643	1.0000			
GCF	0.3483	-0.4000	1.0000		
M2	-0.2229	-0.2522	0.5424	1.0000	
GOVT_EXP	0.0119	-0.2173	0.0991	0.1551	1.0000

Source(s): Authors' estimation with data from WDI, 2019

Table 2.
Correlation matrix

expenditure (GOVT_EXP). The highest correlation among any of the variables is 0.54 between gross capital formation (GCF) and broad money (M2).

To ascertain the applicability of the ARDL model and to prevent any spurious analysis, we subjected the variables to a unit-root test using the Augmented Dickey-Fuller (ADF) test. The ADF test results as shown in Table 3 indicates a mixture of I (0) and I (1) variables, appropriate for ARDL modelling.

4.1 Results from the auto-regressive distributed lag (ARDL) model

The study fits the ARDL model as specified in equation (3) using the Akaike Information Criteria to select the optimal lag length and incorporate a dummy variable INFRATE – k. INFRATE is the observed inflation rate while k is an arbitrarily selected inflation rate from 5% to 30%. The dummy variable D_t is generated as INFRATE– k. When the dummy variable D_t is 1 then inflation is greater than k% and D_t is 0 when the inflation rate is less than or equal to k%.

The estimation involved running equation (3) twenty-six (26) times with the dummy inserted consecutively. The dummy variables will be used separately in the equation such that it will be the only item that would change in the estimation and the optimal value of k(observed/actual inflation) is obtained from the equation with the lowest residual sum of squares or maximum R^2 .

The significance of the dummy will determine the overall optimality of those inflation rates. If D_t is not significant then it means inflation rates lower than k are not optimal, while a range of significant inflation rates may also be determined. The result of the estimation of the ARDL model is presented in Table 4.

Accordingly, k is the observed inflation rate put into equation (2). k values 5 to 9 declared single-digit inflation rate and 10 to 30% as double-digit respectively, then the significance of the coefficient of D_t(INFRATE – k) where k represents inflation from 5–30% would establish the optimality or otherwise of the single-digit or double-digit inflation rate respectively.

From the result in Table 4, it is seen that inflation rates(k) of 19%, 20%, 21% and 22% have the highest R^2 and are also significant at the 5% significance level. Furthermore, the first ten values of the selected inflation rates have four of them with double digits (i.e. 19%,

Variable	Model	Level t- statistic	1st Difference t-statistic	Conclusion
PCI	None	-4.5023***	-5.730549***	I (0)
	Intercept	-5.399***	-12.62013***	
	Intercept and trend	-5.5483***	-5.728079***	
INFRATE	None	-1.593721	-12.74817***	I (1)
	Intercept	-2.536288	-12.74817***	
	Intercept and trend	-4.516948	-12.51140***	
GCF	None	-0.570123	-6.378851***	I (1)
	Intercept	-1.703443	-6.328836***	
	Intercept and trend	-2.958621	-6.224476***	
M2	None	-0.153069	-7.064946***	I (1)
	Intercept	-1.741525	-7.003379***	
	Intercept and trend	-2.071525	-6.933596***	
GOVT_EXP	None	-1.025046	-7.783881***	I (1)
	Intercept	-3.210004**	-7.722896***	
	Intercept and trend	-3.410158	-7.642048	

Table 3. Stationarity test results **Source(s):** Authors' estimation with data from WDI, 2019

Optimal
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k	Coefficient	Std. Error	t-statistics	Prob	R ²	Adj R ²	F-value
5	-8.260088	3.793424	-2.18	0.037	0.6328***	0.4437	0.0014
6	-8.260088	3.793424	-2.18	0.037	0.6328***	0.4437	0.0014
7	-8.260088	3.793424	-2.18	0.037	0.6328***	0.4437	0.0014
8	-2.321623	1.865426	-1.24	0.221	0.5097	0.3714	0.0008
9	-2.771939	1.710435	-1.62	0.113	0.5224	0.3877	0.0008
10	-2.400193	1.688225	-1.42	0.163	0.5154	0.3787	0.0010
11	-2.780088	1.493367	-1.86	0.071	0.5724	0.4061	0.0014
12	-1.912189	1.499464	-1.28	0.211	0.6244	0.4131	0.0036
13	-2.091718	1.466253	-1.43	0.162	0.5236	0.3732	0.0016
14	-2.091718	1.466253	-1.43	0.0016	0.5236	0.3732	0.0016
15	-1.739223	1.375886	-1.26	0.214	0.5103	0.3722	0.0012
16	-2.755907	1.477814	-1.86	0.070	0.5725	0.4063	0.0014
17	-2.938242	1.432738	-2.05	0.048	0.5803	0.4170	0.0011
18	-2.728998	1.466194	-1.86	0.072	0.6200	0.4242	0.0022
19	3.284562	1.473254	-2.23	0.033	0.6350***	0.4470	0.0013
20	3.835134	1.565703	-2.45	0.020	0.6447***	0.4616	0.0010
21	-3.835134	1.565703	-2.45	0.020	0.6447***	0.4616	0.0010
22	-3.835134	1.565703	-2.45	0.020	0.6447***	0.4616	0.0010
23	0.3084246	1.629002	0.19	0.851	0.4907	0.3471	0.0022
24	0.3084246	1.629002	0.19	0.851	0.4907	0.3471	0.0022
25	0.252078	1.592926	0.16	0.875	0.4906	0.3469	0.0022
26	-0.6388085	1.696462	-0.38	0.709	0.4921	0.3488	0.0021
27	-0.0162326	1.854859	-0.01	0.993	0.4902	0.3465	0.0022
28	-0.9832936	1.881384	-0.52	0.604	0.4938	0.3510	0.0020
29	-0.9832936	1.881384	-0.52	0.604	0.4938	0.3510	0.0020
30	3.447786	1.934309	1.78	0.082	0.5286	0.3957	0.0007

Table 4.
Auto Regressive
distributed lag model
estimation results

Source(s): Authors' estimation with data from WDI, 2019

20%, 21% and 22%) while three of them are single digits (i.e. 5%, 6% and 7%). This implies that there are two sets of significant inflation rates; on one hand, single-digit rates 5, 6 and 7% respectively and on the other hand are double-digit rates, that is 19%, 20%, 21% and 22% also being significant at the 5% level.

Considering the coefficient of the single-digits that is 5, 6 and 7% being larger and thus more negative than the double-digit inflation rates, it presupposes that the single-digit rates have a larger inverse impact on the growth of Per Capita Income (PCI). What this means is that if inflation is larger than these single-digit rates the impact on Per Capita Income is larger. The conclusion, therefore, is that single-digit inflation rates have a much larger effect on welfare as measured by the growth of per capita income (PCI). Hence, inflation rates between 5–7% are optimal per the data employed for this study.

Further, we ascertain the validity of the above results using the coefficient diagnosis (bound) test, which result is presented in Table 5. We show in Table 5 that the computed *F*-statistic of 5.136 is above the lower and upper bound levels at the 10 and 5% significant levels, respectively. Hence, the null hypothesis of no cointegration cannot be rejected,

	10%		5%		1%		<i>p</i> -value	
	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)
F	2.564	3.786	3.080	4.445	4.276	5.954	0.003	0.024

Note(s): H_E: no level relationship F = 5.136

Source(s): Authors' estimation with data from WDI, 2019

Table 5.
Result of coefficient
diagnosis (bounds test)

suggesting a long-run relationship among the variables. The confirmation of a long-run relationship among the variable reinforces the optimality of the threshold band from 5–7%.

4.2 Results from the threshold regression model

To circumvent the issues of non-stationarity in the data, we differentiate the data to its level of stationarity for the estimation of the threshold model, the results of which are presented in Table 6.

In the estimation of the threshold model, we trim the data by 20% and estimated a threshold of 7.71% that splits the sample into two regimes; regime 1, corresponds to the sample for which the inflation rate is less than or equal to 7.71% signifying a relatively low inflation regime, and regime 2, which corresponds to the portion of the sample for which inflation is greater than 7.71% signifying a relatively high inflation regime.

The results established that whereas an inflation rate below 7.71% generates a positive impact on GDP per capita, with a coefficient of 0.0453, the rate above 7.71% generates a negative impact on per capita GDP growth such that when inflation increases by about 1% it leads to decrease in the per growth rate of GDP per capita by 0.15%. This finding supports a low inflation target, suggesting a single-digit inflation rate as optimal.

In summary, the study estimated the optimal inflation rate to be between 5–7% using the ARDL model. This optimal rate is reinforced by the threshold method which concluded that there existed a threshold of 7.71% inflation above which inflation was not conducive to the growth of per capita GDP. Therefore, regarding the first objective, the study concludes that the optimal inflation for Ghana is estimated to be within the single-digit band.

4.3 Unmasking the drivers of the inflation gap

Establishing that the estimated optimal inflation rate corroborates the target inflation rate of the central bank, the question we interrogate is why the central bank has constantly missed the target. We can evaluate this situation under two scenarios: 1) the gap arising from how fast monetary policy affects its goals, that is smoothness in monetary transmission and/or; 2) deficiency in monetary policy credibility that adversely affects monetary policy effectiveness.

Ghana as a small open economy whose financial system is highly integrated with the global market may not enjoy monetary independence and credibility. Since monetary independence and credibility is a cornerstone in the inflation targeting framework to shape agents' response to policy, lack of credibility may cause policy target to deviate from the actual. As a result, the study explored the drivers of the inflation gap by identifying the effect of monetary independence, exchange rate stability and financial sector conditions on the gap.

The study adopted the [Aizenman et al. \(2008\)](#) approach to construct the monetary policy independence (MPI) and exchange rate stability (ERS) indices. The MPI index is constructed using the inverse of the annual correlation between the monthly interest rates of Ghana and that of the United States. The United States was chosen as the benchmark country because,

Variables	Regime 1 INF \leq 7.71%	Regime 2 INF $>$ 7.71%
Dependent variable: PCI		
INFRATE	0.4532	-0.1493
GCF	0.1144	0.47056
M2	-0.4356	-1.1682
GOVT_EXP	0.72412	-1.1721
CONSTANT	2.8495	1.9744

Table 6.
Result of threshold regression result

Source(s): Authors' estimation with data from WDI, 2019

according to Shambaugh (2004), Ghana's monetary policy is most closely related to that of the United States.

The MPI index is mathematically expressed as:

$$MPI = 1 - \frac{corr(i_i, i_j) - (-1)}{1 - (-1)} \quad (11)$$

Where $0 \leq MPI \leq 1$. A value of zero implies a complete absence of monetary policy independence or an exact correlation between the interest rate of Ghana and the United States, whereas a value equal to one assures complete monetary policy independence of the Ghanaian economy.

The ERS index is constructed using the annual standard deviation of the monthly exchange rate between Ghana and the United States as

$$ERS = \frac{0.01}{0.01 + stdev(\Delta \log(exchangerate))} \quad (12)$$

The study, therefore, presents the effect of the financial structure, the behaviour of the policy maker captured by monetary independence, and the external effect captured by exchange rate stability on the inflation gap. Within the study period, we estimate the average monetary policy independence and exchange rate stability as 0.65 and 0.185 respectively. This suggests that while Ghana has experienced independent monetary policy, its exchange rate has been very volatile. The study also estimated a very weak negative correlation between monetary independence and exchange rate stability of about -0.07 . This reveals that the MPC sets the directions of monetary policy with little or no cognizance of the stability of the Ghana cedis.

The variation in the inflation gap is estimated to be influenced by variations in monetary policy independence, the structure of financial structure (approximated by private sector credit) and exchange rate stability. At a 1% significant level, the combined effect of monetary independence, financial structure and exchange rate stability explains about 48% of variations in the inflation gap. However, independently these variables do not explain the variations in the inflation gap statistically. A unit change in exchange rate stability, monetary independence and structure of the financial sector resulted in 0.03-, 0.88- and 12-unit changes in the inflation gap respectively, though not statistically significant.

5. Concluding remarks

The paper has sought to investigate the optimal inflation rate target of the Central Bank of Ghana and to determine whether the deviation from the target rate is due to a sub-optimal target or otherwise. We established through both the ARDL and threshold regression approaches that the target rate of $8\% \pm 2$ target pursued is ideal in terms of economic growth. Therefore, the inflation deviation from the target rates could not be due to a sub-optimal target. Implying that although the central bank has consistently missed its inflation target, the single-digit target is however ideal and worthy of pursuit. Unmasking the drivers of the gap, the study established that the combined effect of own policy behaviour (monetary independence), external outlook (exchange rate stability) and the financial structure affect actual inflation deviation from the target rate.

We, therefore, recommend that inflation has to be brought under control within growth-enhancing ranges. This stems from the regular occurrences of target misses resulting from overshooting the target evidenced by the high number of positive inflation gaps identified in this study, and the optimal inflation rate estimated. Again, the Central Bank is urged to maintain its single-digit inflation target as it would aid in achieving robust economic growth and consequently improve the growth of per capita GDP.

Finally, the central bank of Ghana as a policymaker must commit to policy rules as a key requirement of successful policy outcomes would hinge the credibility of the policy-making body. All policymakers must strive to commit themselves to achieving targets and stimulating credibility as the study established that their policy behaviour is related to the conduct of monetary independence and has large effects on achieving targets.

Notes

1. The Bank of Ghana's inflation target is within a band of $8\% \pm 2$
2. The gap is the difference between the target and actual inflation rate. A zero gap indicates the desired rate was achieved. A positive gap indicates that the target was not achieved while a negative gap indicates that the actual rate was below the target rate.
3. A forward-looking rule based monetary policy framework unofficially adopted by the Bank of Ghana in year 2002 and officially in the year 2006.

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