



## **ECONOMIC GROWTH – INFLATION NEXUS: THE OPTIMAL INFLATION ARGUMENT FOR GHANA**

**Victor Osei**

Research Department, Central Bank of Ghana, Box 2674 Accra. E-mail: [osei\\_victor@yahoo.com](mailto:osei_victor@yahoo.com)

### **ARTICLE HISTORY**

Received : 12 March 2023

Revised : 05 April 2023

Accepted : 20 April 2023

Published : 30 June 2023

### **TO CITE THIS ARTICLE**

Victor Osei (2023). Economic Growth – Inflation Nexus: The Optimal Inflation Argument for Ghana. *Studies in Economics & International Finance*, Vol. 3, No. 1, pp. 45-61. <https://DOI:10.47509/SEIF.2023.v03i01.04>

**Abstract:** The paper examined the optimal inflation argument in the economic literature using Ghana's data to ascertain the asymmetric inflationary effects on economic activities. The threshold econometric methodology was deployed to investigate the existence of optimal inflation in Ghana. The study found that there is a presence of optimal inflation threshold for Ghana as it was evidenced that inflation rate higher than the optimal inflation had a negative impact on economic growth while inflation below the optimal rate inflation was growth enhancing. This findings from this paper suggests that policymakers for that matter should take cognizance of this key information to inform future policy decisions and actions that affect both economic growth and inflation as unmeasured fiscal and monetary policies that affect inflation could be inimical to growth prospects in the domestic economy. The study therefore recommends that price stability should continuously be a key monetary policy target by the Central Bank of Ghana and all efforts should be geared towards its achievement as uncontrolled inflation could inhibit economic growth in the domestic economy

**Keywords:** Optimal inflation, threshold, economic growth, monetary policy, Ghana

## **1. INTRODUCTION**

Inflation development in every economy remains key to policymakers as it has been observed empirically in many studies that high inflation is inimical to economic growth while other researchers have also concluded that in some cases inflation rate below a certain optimal threshold becomes growth enhancing instead. These several divergent empirical conclusions on the effects of inflation on economic growth in an economy need further exploration in the literature to contribute to the current debate as such. Ghana's situation is not an exception

regarding inflation and its both direct and indirect impact on economic growth as different rates of inflation could also have different dynamic effects on economic growth depending on the existence of an estimated optimal inflation threshold for that matter, thus the need for additional studies aimed at investigating this gap in the literature using Ghana's data to further examine the growth-inflation nexus.

This study has two key objectives, these are, (i) to investigate whether there exists an optimal inflation threshold for Ghana and (ii) further examine which level of inflation is growth-propelling and which rate of inflation is injurious to growth prospects. Few studies (Marbuah, 2011; Quartey, 2010 and Frimpong and Oteng-Abayie, 2010) on Ghana have investigated the growth-inflation nexus satisfactorily and their findings remain inconclusive on the subject matter. Hence, the need to further take a cursory look at this economic relationship between economic growth and inflation especially in Ghana at the time that inflation has become very volatile and persistent due to the recent global and domestic price pressures. Currently, inflation remains elevated above the Central Bank of Ghana's inflation target range of 6–10 percent and the current inflation profile and trajectory is yet to point to reaching a potential peak in the near-term. On the other hand, the growth story is also challenging yet to recover completely from the pandemic to pre-pandemic level. Economic growth since the pandemic till now has been very low and the current year (2022) is also projected to remain weak against the backdrop of global economic headwinds due to the Ukraine-Russia conflict as well as the effects of Omicron virus which has led to the imposition of zero covid-19 policy restriction by China in a way that is contributing negatively to the already worsened global supply bottlenecks. This study will contribute to the existing literature on growth-inflation nexus as well as reshaping and enriching current and future policy discussions regarding the effects of inflation on economic growth in Ghana.

The rest of the paper discusses the stylized facts on growth and inflation in Ghana in section two. Section three highlights key literature issues relevant for this study especially on growth-inflation nexus and the specific findings from the empirical front. Section four discusses the theoretical framework as well as the methodology deployed for this study. Section five analyses the results from the various estimations based on the empirical model and discusses the key findings from the estimation. Finally, section six concludes the study and highlights the suggested and specific policy recommendations based on the findings of the study respectively.

## **2. SOME STYLIZED FACTS ON GHANA**

### **2.1. Growth and inflation trends in Ghana**

Ghana's economy has faced several challenges over the past years till today and the country continues to adopt growth-enhancing strategies to propel its engine

of growth to achieve greater economic expansion for its citizens. Before the adoption of the Economic Recovery Program (ERP) in 1983, the Ghanaian economy suffered growth challenges and high inflation among others. The ERP reversed the negative growth syndrome and restored some hope of strong economy, improving from the downturn observed over the periods before the Ghana's economic program with the IMF. The Ghanaian economy recorded an average growth of 4.1 percent for 1994-2000 period which compares unfavorably with an average of 5.4 percent for the 1984-1990 period. Also, economic growth picked up further between 2011-2021 period to 6.0 percent on the average, up from an average growth of 5.8 percent achieved between 2001-2010 period respectively.

On the other hand, inflation development has evolved over the years due to different monetary policy options adopted by policymakers. Inflation averaged 31.4 percent between 1994-2000 period, up from an average of 27.9 percent recorded between 1984-1990 period. Inflation profile of Ghana significantly changed in the 2000s after the adoption of inflation targeting monetary policy framework by the Central Bank of Ghana by the abandoning the then monetary targeting monetary policy regime anchored on reserve targeting as an operational target. As a consequent, inflation averaged declined to 11.7 percent between 2011-2021 period, significantly down from an average inflation of 18.3 percent recorded between 2001-2010, suggesting a shift from a higher double-digit inflation regime to a lower double-digit inflation era. The adoption of the new inflation-targeting monetary policy framework which uses policy interest rate as a new operational

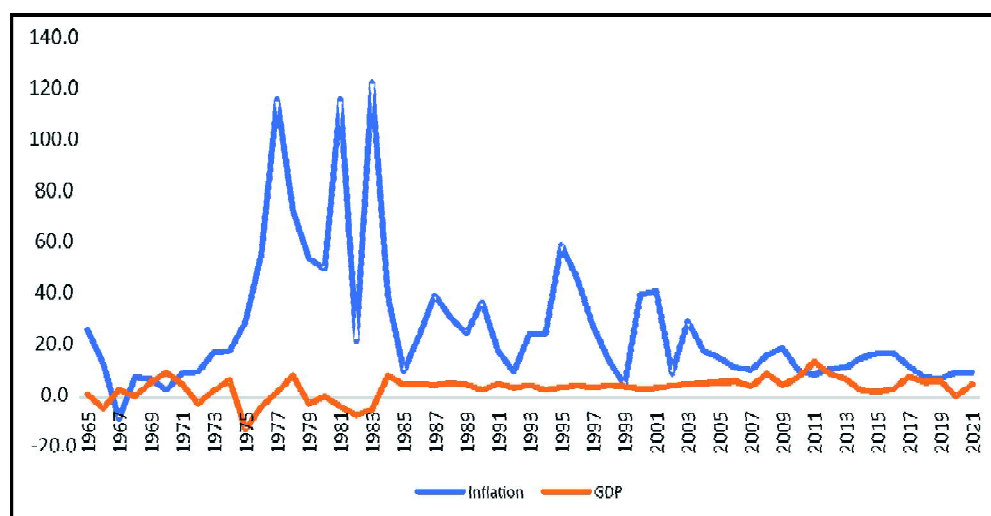


Figure 2.1: Trends in Economic Growth and Inflation (1965-2021)

Source: World Development Indicators (WDI, World Bank Database)

tool restored macroeconomic stability and set in motion continued disinflationary process in Ghana till date.

Ghana's economy has chokod some relative success from the growth front as well as achieving price stability in recent past. However, price stability has become a bigger challenge now to policymakers especially in 2022 due to both global and domestic price pressures although the economy is gradually recovering from the pandemic. Inflation has heightened and continues to remain elevated above the Central Bank's medium-term inflation target of 6-10 percent range. This new development calls for the implementation of both conventional and unconventional monetary tools to eliminate the current threats to price stability in the country as well as increasing policy efforts to prevent de-anchoring of inflation expectations in the horizon.

## **2.2. Explaining economic growth-inflation nexus with stylized facts**

Evidence from available data suggests that the effects of inflation on economic is asymmetric as in some period low inflation contributes to positive growth while in some cases high inflation led to lower economic growth over the years. Using 1965-1970 as a reference period which registered an average inflation of 8.3 percent and 2.7 percent real GDP growth respectively. Inflation reduced on average basis to 5.8 percent between 1971-1975 and this led to an average real GDP growth of 6.0 relative to the period between 1965-1970. A similar trend was observed for the period between 1986-1990 where inflation declined to an average of 5.5 percent, down from an average 65.3 percent recorded between 1981-1990. Also, the same trend was identified between 2011-2015 period where an average inflation declined to an average of 2.8 percent, down from an average of 3.3 percent witnessed between 2006-2010 period, which led to an expansion in economic activity from an average of 1.6 percent to 3.7 percent for the same period under consideration.

However, inflation accelerated to an average of 19.8 percent between 1976-1980, up from an average of 5.8 percent recorded between 1971-1975 and this led to a significant reduction in economic growth to an average of 3.5 percent, also down from an average of 6.0 percent achieved between 1971-1975 period respectively. A similar trend was also observed between 1981-1985 where inflation further worsened to 65.8 percent, up from an average inflation of 19.8 percent registered between 1976-1980. The significant jump in inflation during the period under discussion led to a decline in real GDP from an average of positive 3.5 percent to an average of a negative 0.3 percent respectively (see Table 2.1).

Some contradictions were also observed the periods 1996-2000, 2006-2010 and 2016-2021 where a deacceleration in inflation was accompanied by a slower economic growth. The observed contradiction in growth-inflation nexus could be explained particularly between 2016-2021, which could be attributed to the

**Table 2.1: Some Statistical Evidence of Optimal Threshold Argument: Growth and Inflation Nexus**

	<i>Inflation</i>	<i>RGDP Growth</i>	<i>Relationship</i>
1965-1970	8.3	2.7	Reference Period
1971-1975	5.8	6.0	Low inflation leads to High Growth
1976-1980	19.8	3.5	High Inflation leads to low Growth
1981-1985	62.3	-0.3	High Inflation leads to low Growth
1986-1990	5.5	0.6	Low inflation leads to High Growth
1991-1995	12.8	0.6	Neutral
1996-2000	26.8	4.3	Contradiction
2001-2005	22.8	5.0	Low inflation leads to High Growth
2006-2010	3.3	1.6	Contraction
2011-2015	2.8	3.7	Low inflation leads to High Growth
2016-2021	2.8	2.0	Contradiction
1965-2021	18.5	3.1	

*Source:* Author's own computation

impact of the covid-19 pandemic on economic activities. The discussions above suggest that inflation could have a potential asymmetric effect on economic activities depending on the direction of inflation, this point to a potential existence of an optimal inflation point below or above which inflation could either growth-enhancing or growth-dampening, which will empirically be addressed in detail in the following section.

### 3. GROWTH-INFLATION NEXUS: SOME LITERATURE SURVEY

Many empirical studies have been conducted primarily examining the growth-Inflation nexus in developed, emerging and developing economies. Empirical conclusions from these studies have been diverse and inconclusive. Some studies have concluded that inflation negatively affects economic growth (Friedman, 1956; Stockman, 1981; Fischer, 1983; Barro, 1995; Valdovinos, 2003) while others on the contrary concluded that inflation promotes economic growth (Mallik and Chowdhury, 2001; Rapach, 2003; Benhabib and Spiegel, 2009). Some studies concluded that inflation has no effect on economic in the literature (Wai 1959, Dorrance, 1966; Sidrauski, 1967; Cameron, Hum and Simpson, 1996). It is clear from the empirical literature that, the various conclusions on the economic growth-inflation relationship has been inconclusive so far (Fischer, 1993; Barro, 1995 and 1996); Sarel, 1996; Phiri, 2010). The following section surveys and discusses the relevant empirical literature on the subject matter.

Applying both panel and cross-section methodology in Fischer (1993) instigating the potential existence of nonlinearity in the economic growth-inflation

nexus in the long-run using data for both industrialized and developing economies, the study found strong evidence of negative relationship between economic growth and inflation in these economies. Similarly, Barro (1995 and 1996) concluded that inflation negatively affected economic growth using a cross-sectional approach. Other studies that supported the negative relationship between economic growth and inflation included Sarel (1995); Ghosh and Phillips, 1998; Bruno and Easterly, 1998. Khan and Senhadji (2001) established an inflation threshold for economic growth below which inflation enhances economic growth and above it inflation becomes inimical to economic growth using a threshold econometric methodology for 140 developed and developing nations between 1960-1998. Studies that also lent credence to this empirical doctrine that inflation hurts economic growth includes Sweidan, 2005; Mubarik, 2005; Mortaza, 2005; Kremer *et al.* (2009)

Among studies on African that established an inflation threshold for respective countries includes the study by Salami and Kelikume (2010) using a nonlinear economic growth-inflation theory. Salami and Kelikume (2010) also found an inflation threshold of 7 percent for Nigeria. Other studies on South Africa similarly concluded that inflation hurts economic growth beyond an optimal point includes the studies by Phiri, 2010; Hodge, 2005; Sarel (1996) established 8 percent inflation threshold for South Africa in his studies. Studies on particularly by Quartey (2010) found a growth-inflation threshold of 22.2 percent for Ghana as well as a growth-revenue threshold of 9.14 percent respectively between 1970-2006 using Johansen co-integration time series econometric methodology.

Employing Two-Stage Least Squares (2SLS) and Ordinary Least Squares (OLS), Frimpong and Oteng-Abayie (2010) found an optimal 11 percent inflation threshold for Ghana in investigating the growth-inflation relationship between 1960-2008. Finally, deploying a threshold methodology using Ghana's economic data, Marbuah (2011) also found a minimum and maximum inflation threshold levels of 6 percent and 10 percent respectively. The study further revealed accounting for structural break in the model suggested an optimal inflation threshold level of 10. The empirical findings by Marbuah (2011) was consistent with the Bank of Ghana's inflation-targeting medium-term inflation range of plus or minus 8 percent ( $\pm 8$ )

## **4. METHODOLOGY**

### **4.1. Modelling optimality or Threshold**

Consider a threshold regression  $n$  with two regions defined by a threshold  $\gamma$ . This is written as

$$f_t = h_t \mu + r_t \alpha_1 + \varepsilon_t \quad \text{if} \quad -\infty < \rho_t \leq \delta$$

$$f_t = h_t \mu + r_t \alpha_2 + \varepsilon_t \quad \text{if} \quad \delta < \rho_t < \infty$$

where  $f_t$  is the dependent variable,  $h_t$  is a  $1 \times k$  vector of covariates possibly containing lagged values of  $f_t$ ,  $\mu$  is a  $k \times 1$  vector of region-invariant parameters,  $h_t$  is a vector of exogenous variables with region-specific coefficient vectors  $\alpha$  and  $\alpha_2$ ,  $\rho_t$  is a threshold variable that may also be one of the variables in  $h_t$  or  $r_t$ , and  $\varepsilon_t$  is an IID error with mean 0 and variance  $\sigma^2$ .

The estimated threshold  $\hat{\gamma}$  is one of the values in the threshold variable  $\rho_t$ . To estimate the threshold, we minimize the least squares of the following regression with  $T$  observations and two regions,

$$f_t = h_t \mu + r_t \alpha_1 I(-\infty < \rho_t \leq \delta) + h_t \mu + r_t \alpha_2 I(\delta < \rho_t < \infty) + \varepsilon_t$$

for a sequence of  $T_1$  values in  $w_t$ , where  $T_1 < T$ . The default trimming percentage is set to 10%, which implies that  $T_1$  corresponds to the number of observations between the 10th and the 90th percentile of  $\rho_t$ . The estimator for the threshold is

$$\hat{\delta} = \arg \min_{\gamma \in \Gamma} S_{T_1}(\delta)$$

Where  $\Gamma = (-\infty, \infty)$ ,

$$S_{T_1}(\gamma) = \sum_{t=1}^{T_1} \{f_t - h_t \mu + r_t \alpha_1 I(-\infty < \rho_t \leq \delta) - h_t \mu + r_t \alpha_2 I(\delta < \rho_t < \infty)\}^2$$

is a  $T_1 \times 1$  vector of SSR, and  $\delta$  is a  $T_1 \times 1$  vector of tentative thresholds.

#### 4.2. Threshold model with more than one threshold or more regions

In general, a threshold regression model with  $m$  thresholds has  $m+1$  regions. Let  $j = 1, \dots, m+1$  index the regions. We can write the model as

$$f_t = h_t \mu + r_t a_1 I_1(\delta_1, \rho_t) + \dots + r_t \alpha_{m+1} I_{m+1}(\delta_{m+1}, \rho_t)$$

where  $\delta_1 < \delta_2 < \dots < \delta_m$  are ordered thresholds with  $\delta_0 = -\infty$  and  $\delta_{m+1} = \infty$ .  $I_j(\delta_j, \rho_t) = I(\delta_{j-1} < \rho_t \leq \delta_j)$  is an indicator for the  $j$ th region. Conditional on all estimated thresholds  $(\delta_1, \dots, \delta_m)$ , the threshold regression model is linear, and the remaining parameters are estimated using least squares.

The thresholds are estimated sequentially as described below. Let  $\delta_1^* \dots \delta_m^*$  represent the  $m$  thresholds in the order of estimation. Gonzalo and Pitarakis (2002) show that the thresholds estimated sequentially are  $T$ , consistent. The first threshold ( $\delta_1^*$ ) is estimated assuming a model with two regions as described in the previous section. Conditional on the first threshold, the second threshold is estimated as the value that yields the minimum sum of squared errors over all observations in  $\rho_t$  excluding the first threshold. The estimator of the second



threshold  $\delta_2^*$ , is obtained by minimizing the least squares of a regression with three regions conditional on the first estimated threshold  $\hat{\delta}_1^*$ . The estimator is given by

$$\hat{\delta}_2^* = \arg \min_{\delta_2^* \in \Gamma_2} S_{T_2(\delta_2^*/\hat{\delta}_1^*)}$$

Where  $\Gamma_2 = (\delta_0, \hat{\delta}_1^*) \cup (\hat{\delta}_1^*, \delta_3)$  and  $T_2 < T_1$ .

In general, the  $l$ th threshold minimizes the SSR conditional on the  $l-1$  estimated thresholds and is given by

$$\hat{\delta}_l^* = \arg \min_{\delta_l^* \in \Gamma_l} S_{T_l} \left( \frac{\delta_l^*}{\hat{\delta}_1^*}, \dots, \hat{\delta}_{l-1}^* \right)$$

Where  $\Gamma_l = (\delta_0, \hat{\delta}_{m+1}^*)$  excluding  $\hat{\delta}_1^*, \dots, \hat{\delta}_{l-1}^*$

When the number of thresholds is not known a priori, threshold selects the optimal number of thresholds based on Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC) or Hannan-Quinn Information Criteria (HQIC), which is defined based on Regression Sum of Squares (RSS) from the fitted model as

$$AIC = N \ln \left( \frac{SSR}{N} \right) + 2f$$

$$BIC = N \ln \left( \frac{SSR}{N} \right) + f \ln(N)$$

$$HQIC = N \ln \left( \frac{SSR}{N} \right) + 2f \ln\{\ln(N)\}$$

Where  $f$  is the number of parameters in the model and  $N$  is the sample size respectively. See Gonzalo and Pitarakis (2002) for Monte Carlo studies of selecting the number of thresholds based on information criteria.

#### 4.2. The empirical model specification

The empirical model to be estimated follows the works by Ghosh and Phillips(1998), Khan and Senhadji(2001) Mubarik(2005), Hussain(2005), Salami and Kelikume(2010) and Marbuah (2014). To investigate a threshold impact of inflation on economic growth in Ghana, the following empirical model was estimated.



$$d_t \log(RGDP_t) = \delta_0 + \delta_1 d_t(CPI_t - q) + \delta_{2+i} Z_t + U_t$$

Where  $d_t \log(RGDP_t)$  = Real GDP growth rate,  $d_t(CPI_t)$  = Inflation rate and  $q$  is the threshold level of inflation. The variable  $Z_t$  is the vector of other control variables. It consists of government expenditures ( $GE_t$ ), Exchange rate ( $EX_t$ ) and monetary policy rate ( $MPR_t$ ).

$$d_t^p = \begin{cases} 1: \text{if } CPI_t > q \\ 0: \text{if } CPI_t \leq q \end{cases} = \text{Dummy variable and } 1, 2, 3, \dots, N; t = 1, 13, \dots, T$$

The threshold value  $q$  has a unique property that expresses the inflation ( $\delta_1$ ) and growth association as low inflation ( $\delta_1$ ) and high inflation ( $\delta_1 + \delta_2$ ). The rationale is that if the long-term inflation parameter is significant then the high inflation ( $\delta_1 + \delta_2$ ) will be the effect on economic growth at the threshold level of inflation in this case. The value of  $q$  is chosen arbitrarily for estimation purposes in ascending order to estimate the threshold model. The optimal value of  $q$  is obtained by looking for the corresponding value of  $q$  that minimizes the residual sum of squares (RSS) in each estimated model respectively.

## SECTION V

### 5. OPTIMAL INFLATION REGIME: ESTIMATED MODEL RESULTS AND ANALYSIS

#### 5.1. Stationarity test for the selected variables

To avoid spurious regression results for this study, unit root tests were conducted for each of the selected variables in the threshold model as a requirement for effective and quality time series analysis as well as ascertaining the stationarity status of the model variables. As a result, both the standard unit root tests for time series variables using Augmented Dicky-Fuller (ADF) approach and the Unit root test with a break methodology were deployed to investigate the time series properties of the model variables. All the variables except real GDP had unit root as the null hypothesis which stated the variables had unit was not rejected as confirmed by the Augmented Dicky-Fuller unit root statistic value as well as the unit root test with a break methodology at 5 percent significance level. However, all the variables became stationary after first differencing as shown by the rejection of the null hypothesis of unit root at 5 percent level of significance employing both standard Augmented Dicky-Fuller and Unit root with a break tests respectively (see Table 5.1). The tests results suggested that all the variables are now stationary and they can therefore be used to freely estimate the inflation threshold equation in order to investigate whether there exists optimal inflation

Table 5.1: Unit Root Tests Summary for the Selected Threshold Variables for the Model

Variable name	ADF at Level		ADF at first Difference		Unit Root with Break at level		Unit Root with break at first Difference	
	Statistics	Probability	Statistics	Probability	Statistics	Probability	Statistics	Probability
Gross Fixed Capital Formation	-2.2393	0.1930	-15.4942	0.0000	-4.0770	0.1316	-16.1832	< 0.01
Inflation	-2.5845	0.0977	-13.1108	0.0000	-4.1949	0.0997	-15.6790	< 0.01
Real GDP Growth	-4.4194	0.0004	-10.1776	0.0000	-5.4790	< 0.01	-16.0241	< 0.01
Remittance	-0.1495	0.9409	-7.6405	0.0000	-3.1253	0.1039	-14.6097	< 0.01
Broad Money Supply	-2.2141	0.4792	-15.4916	0.0000	-3.0120	0.6790	-16.9677	< 0.01
Population Growth	-1.7513	0.7251	-4.3145	0.0036	-2.2418	0.9566	-15.7217	< 0.01

Source: Author's Own estimation and computation. Notes that \*\*\*, \*\* and \* represent 1%, 5% and 10% significance levels respectively.

below which economic growth will not be negatively affected or above which economic growth could be negatively affected by high inflation spiral.

## 5.2. Threshold test for optimal inflation model for Ghana

To begin with the optimal threshold analysis, a formal threshold test was conducted to ascertain the optimal level of thresholds for the model. The optimal threshold model test suggested that the presence of two (2) thresholds for the growth-inflation equation as the sequential F-statistic determined two thresholds for the robust model estimation which was significant at 5 percent level with F-statistic value of 4.5169 and a scaled F-statistics value of 22.5847 respectively (see Table 5.2).

**Table 5.2: Threshold Test for the Optimal Inflation Model for Ghana**

Sequential F-statistic determined thresholds:			
<i>Threshold Test</i>	<i>F-Statistics</i>	<i>Scaled F-Statistics</i>	<i>Critical Values</i>
0 vs. 1 **	6.4593	32.2966	18.2300
1 vs. 2 **	4.5169	22.5847	19.9100
2 vs. 3	3.6001	18.0007	20.9900

\* \*Significant at the 0.05 level.

\*\* Bai-Perron (Econometric Journal, 2003) critical values.

Threshold values:

	<i>Sequential</i>	<i>Repartition</i>
1	9.1300	9.1300
2	11.4300	11.4300

Source: Author's own estimation and computation. Note that \*\* represents 5% significance level

## 5.3. Optimal inflation threshold model discussions and analysis

The check the robustness of the optimal inflation threshold model for Ghana, a partial model was estimated between real gross domestic product and inflation, the estimated model result (See Table 5.3) suggested that optimal inflation rate for Ghana was estimated at 9.5 percent (could be rounded to 10%) below which inflation positively affects real gross domestic product and above which inflation becomes inimical to growth. The model results indicated that with an inflation threshold of 9.5 percent, one percent increase in inflation will positively impact on economic growth by 2.16 percent which was significant at 5 percent level. This is consistent with the inflation target range 6 percent and 10 percent set by the

Monetary policy Committee of Bank of Ghana. However, the results further showed that, any inflation rate above the optimal inflation threshold of 9.5 percent (rounded up to 10%), any percentage increase inflation could potentially lead to a reduction in economic activities by 2.99 percent, which was also significant at 5 percent level.

**Table 5.3: Optimal Inflation Threshold Model 1 for Ghana**

Dependent Variable: Real Gross Domestic Product (RGDP)

Method: Discrete Threshold Regression

Included observations: 84

Selection: Trimming 0.15, Max. thresholds 5, Sig. level 0.05

Threshold variable: Inflation

<i>Variable</i>	<i>Coefficient</i>	<i>Standard Error</i>	<i>T-Statistic</i>	<i>Probability Value</i>
Inflation < 9.4799 — 16 observations				
Inflation	2.1685	1.2676	1.7107	0.0410
C	-8.3474	10.6264	-0.7855	0.4345
9.4799 <= Inflation — 68 observations				
Inflation	-0.0299	0.0779	-0.3837	0.0222
C	5.5203	1.3820	3.9943	0.0001
R-squared	0.1869	Mean dependent var		5.9263
Adjusted R-squared	0.1565	S.D. dependent var		4.7121
S.E. of regression	4.3278	Akaike info criterion		5.8145
Sum squared resid	1498.4170	Schwarz criterion		5.9302
Log likelihood	-240.2074	Hannan-Quinn criter.		5.8610
F-statistic	6.1314	Durbin-Watson stat		1.3975
Probability Value (F-statistic)	0.0008			

*Source:* Author's Own estimation and computation. Notes that \*\*\*, \*\* and \* represent 1%, 5% and 10% significance levels respectively.

A more robust optimal inflation threshold model (see Table 5.4) was subsequently estimated after the estimation of the partial optimal inflation threshold model as discussed above. According to the estimated robust optimal inflation threshold model, inflation below the optimal threshold of 9.1 is growth-enhancing as a unit increase in inflation had 3.2 percent positive impact on economic growth while exchange rate had 1.3 percent significant impact on economic. With inflation below the optimal threshold regime, any unmeasured hikes in monetary policy rate could potentially dampen economic growth 3.1 percent which is significant at 1 percent level. However, any inflation rate the

**Table 5.4: Estimated Results for the Threshold Model for Ghana****Dependent Variable: Real Gross Domestic Product (RGDP)**

Method: Discrete Threshold Regression

**Included observations: 84**

Selection: Trimming 0.15, Max. thresholds 5, Sig. level 0.05

**Threshold variable: Inflation**

<i>Variable</i>	<i>Coefficient</i>	<i>Standard Error</i>	<i>T-Statistic</i>	<i>Probability value</i>
INF < 9.1299 – 12 observations				
Inflation	3.2111	1.9985	1.6067	0.0127**
Government Expenditure	0.0532	0.0429	1.2391	0.2195
Exchange Rate	1.3048	0.3812	3.4228	0.0010***
Monetary Policy Rate	-3.4595	0.9062	-3.8174	0.0003***
C	22.6703	24.5578	0.9231	0.3592
9.1299 <= INF < 11.4299 – 19 observations				
Inflation	-5.6749	1.3911	-4.0795	0.0001***
Government Expenditure	0.0065	0.0507	0.1298	0.8971
Exchange rate	-0.43301	0.1636	-2.6473	0.0100**
Monetary Policy Rate	-0.7502	0.6536	-1.1478	0.2552
C	75.3779	17.2589	4.3674	0.0000***
11.4299 <= INF – 53 observations				
Inflation	-0.0195	0.1004	-0.1945	0.0463**
Government Expenditure	0.0132	0.0209	0.6317	0.5296
Exchange Rate	-0.0541	0.0479	-1.1282	0.2631
Monetary Policy Rate	-0.2211	0.1447	-1.5276	0.1312
C	10.9294	2.3849	4.5826	0.0000***
R-squared	0.5242	Mean dependent var		5.9263
Adjusted R-squared	0.4276	S.D. dependent var		4.7121
S.E. of regression	3.5647	Akaike Info Criterion		5.5405
Sum Squared Residual	876.8311	Schwarz Criterion		5.9745
Log-likelihood	-217.7017	Hannan-Quinn Criterion		5.7150
F-statistic	5.4304	Durbin-Watson statistics		2.0282
Probability Value (F-statistic)	0.0000			

Source: Author's Own estimation and computation. Notes that \*\*\*, \*\* and \* represent 1%, 5% and 10% significance levels respectively.

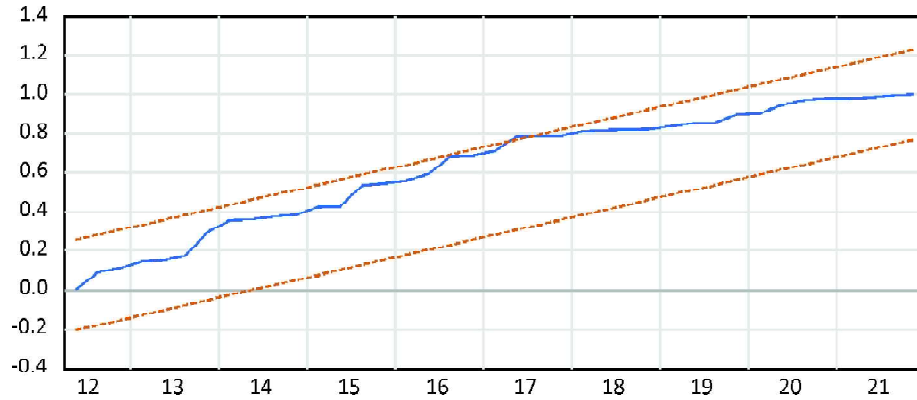
optimal inflation threshold (which is within Bank of Ghana's inflation targeting range of 6-10%), had dampening effect on economic growth. With an inflation greater than the threshold of 9.1 percent but less than a threshold of 11.42 percent for instance, a unit increase in inflation rate negatively affected economic activities by 5.7 percent, which was significant at 1 percent level. The results further suggested that with inflation above the optimal threshold, a unit increase in exchange rate could also negatively affect economic growth by 0.43 percent while monetary policy rate insignificantly impact on economic by 0.75 percent, highly insignificant at 1 percent. The result confirms empirical evidence that higher inflation in an economy serves as disincentive and creates uncertainties that higher depreciation and thereby affects growth negatively as the Marshall-Lerner condition does not hold for most developing countries which depends on commodity exports to the rest of the world. Also, higher inflation affects real government spending negatively as real purchasing power of government revenue becomes significantly reduced and this partly explains the insignificant impact of government expenditure on economic growth as suggested the model results.

The estimated model further indicated that, with an inflation greater than 11.42 percent, a percentage increase in inflation will lead to a reduction of 0.02 percent. It is also observed that with the inflation less than the optimal threshold, exchange rate tends to impact positively on economic growth by 1.3 percent with inflation greater than the inflation threshold but less than 11.4, it affects economic growth negatively by 0.05 percent respectively. This result suggests that price stability remains key to exchange rate stability as higher inflation leads to more uncertainties which affects the forex market and hence, its dampening impact on economic growth. The other determinants of economic growth in the model presented a mixed result, thus indicating the present of asymmetries in their impact on economic growth in Ghana. One striking observation from the results stem from the fact, government expenditure had no significant impact on economic growth irrespective of the higher inflation regime or low inflation regime, thus highlighting the fact that government spending tends to be non-growth enhancing within the study period. There is the need for government to redirect its expenditure to spend more items that have capacity to generate future wealth which could have the potential to transform the domestic economy.

## **5.4. Model diagnostics**

### ***5.4.1. Model stability test summary***

In terms of model diagnostics, the model satisfies the stability condition as suggested by the Cusum of squares test lies within restricted confidence bands at 5 percent significance level (see figure 5.1).



**5.4.2. Serial correlation LaGrange multiplier and heteroscedasticity tests summaries**

The model also passed both the serial correlation test as the null hypothesis of no presence of serial correlation is accepted by the Lagrange Multiplier (LM) serial correlation test (see Table 5.5). The null hypothesis of no heteroscedasticity is also accepted by the Breusch-Pagan-Godfrey heteroscedasticity test respectively, indicating no heteroscedasticity in the model (see Table 5.5).

**Table 5.5: Serial Correlation LaGrange Multiplier and Heteroscedasticity Tests**

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	0.0275	Prob. F (2,67)	0.9728
Obs*R-squared	0.0690	Prob. Chi-Square (2)	0.9661
2. Heteroscedasticity Test			
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
Null hypothesis: Homoskedasticity			
F-statistic	1.4503	Prob. F (14,69)	0.1543
Obs*R-squared	19.098	Prob. Chi-Square (14)	0.1612
Scaled explained SS	20.9768	Prob. Chi-Square (14)	0.1022

Source: Author’s own estimation and computation. Note that \*\* represents 5% significance level

**SECTION VI**

**6. CONCLUSION AND POLICY RECOMMENDATION**

The paper examined the optimal inflation argument in the economic literature using Ghana’s data to ascertain the asymmetric inflationary effects on economic activities. The found that there is a presence of optimal inflation threshold for



Ghana as it was evidenced that inflation rate higher than the optimal inflation had a negative impact on economic growth while inflation below the optimal rate inflation as estimated by the model was pro-growth or growth enhancing. This findings from this paper suggests that policymakers for that matter should take cognizance of this key information to inform future policy decisions and actions that affect both economic growth and inflation as unmeasured fiscal and monetary policies that affect inflation could be inimical to economic in the domestic economy.

In terms of policy recommendation, based on the findings of this paper, it is recommended that price stability should be one of the key economic policy targets of government and all efforts should be geared towards its achievement as uncontrolled inflation could inhibit economic growth efforts in the country due to its associated uncertainties. Controlled inflation environment creates the enabling macroeconomic landscape for businesses to thrive which is growth promoting. Finally, government policies should aim at promoting economic growth in the country as appropriate policies are being executed to achieve and maintain price stability as well.

### *References*

- Ahmed, S. and Mortaza, M. G. (2005). Inflation and economic growth in Bangladesh: 1981-2005. *Working Paper Series: WP 0604*, Bangladesh Bank.
- Barro R.J. (1995). Inflation and economic growth. *National bureau of economic research*, w5326.
- Barro R.J. (1996). Inflation and growth. *Federal Reserve Bank of St. Louis Review*, 78, 153–169.
- Benhabib J. & Spiegel M.M. (2002). Moderate inflation and the deflation–depression link. *Journal of Money, Credit and Banking*, 41(4), 787–798.
- Bruno M. & Easterly W. (1998). Inflation crises and long run growth. *Journal of Monetary Economics*, 41(1), 3–26.
- Cameron N., Hum D. & Simpson W. (1996). Stylized facts and stylized illusions: Inflation and productivity revisited. *Canadian Journal of Economics*, 29, 152–162.
- Dorrance S. (1966). The effect of inflation on economic development. *IMF Staff Papers*.10 1–47. Washington, DC: International Monetary Fund.
- Fischer S. (1993). The role of macroeconomic factors in growth. *Journal of Monetary Economics*, 32, 485–512.
- Friedman M. (1956). The quantity theory of money: A restatement. [in:] M. Friedman (Ed.), *Studies in the quantity theory of money* (pp. 3–21). Chicago: University of Chicago Press.
- Frimpong, J.M and Oteng-Abayie, E.F. (2010). When is Inflation Harmful? Estimating the Threshold Effect for Ghana. *American Journal of Economics and Business Administration* 2 (3): 232-239.

- Gonzalo, J. & Pitarakis, J.Y. (2007). Estimation and model selected based inference in single and multiple threshold models. *Journal of Econometrics*, 110, (2), 319-352.
- Ghosh A. & Phillips S. (1998), Warning: Inflation may be harmful to your growth. *IMF Staff Papers*, 45 672–710. Washington, DC: International Monetary Fund.
- Hodge, D. (2005). Inflation and growth in South Africa. *Cambridge Journal of Economics*, 30: 163-180.
- Hussain, M. (2005). Inflation and growth: Estimation of threshold point for Pakistan. *PBR, State Bank of Pakistan Research Papers*.
- Khan M.S. & Senhadji A.S. (2001). Threshold effects in the relationship between inflation and growth. *IMF Staff papers*<sup>¼</sup>, 48(1), 1–21.
- Kremer S., Bick A. & Nautz D. (2009). Inflation and growth: New evidence from a dynamic panel threshold analysis. SFP 649 *Discussion Paper No. 036*. Zuberlin: Humboldt Universität.
- Quartey, P. (2010). Price stability and the growth maximizing rate of inflation for Ghana. *Modern Economy*, 1: 180-194.
- Marbuah, G. (2011). On the Inflation-Growth Nexus: Testing for Optimal Inflation for Ghana. *Journal of Monetary and Economic Integration*, 11, 2:55-82.
- Mallik G. & Chowdhury R.M. (2001). Inflation and economic growth: Evidence from South Asian countries. *Asian Pacific Development Journal*, 8, 123–135.
- Mubarik, Y. A. (2005). Inflation and growth: An estimate of the threshold level of inflation in Pakistan. *State Bank of Pakistan – Research Bulletin*, 1 (1-2): 35-44.
- Phiri, A. (2010). At what level is inflation least detrimental towards finance-growth activity in South Africa. *Journal of Sustainable Development in Africa* 12, no. 6: 354-364.
- Rapach D.E. (2003). International evidence on the long run impact of inflation. *Journal of Money, Credit, and Banking*, 35(1), 23–48.
- Salami, D. and Kelikume, I. (2010). An estimate of inflation threshold for Nigeria 1970-2008. *International Review of Business Research Papers* 6, No. 5: 375-385.
- Sarel, M. (1996). Nonlinear effects of inflation on economic growth. *Staff Papers, International Monetary Fund*, 43: 199 - 215.
- Sidrauski M. (1967). Rational choice and patterns of growth in a monetary economy. *American Economic Review*, 57, 534–544.
- Stockman A.C. (1981). Anticipated inflation and the capital stock in a cash in advance economy. *Journal of Monetary Economics*, 8, 387–393.
- Sweidan, O. D. (2005). Does inflation harm economic growth in Jordan? An econometric analysis for the period 1970-2000. *International Journal of Applied Econometrics and Quantitative Studies*, 1-2: 41-66.
- Valdovinos C.G.F. (2003). Inflation and economic growth in the long run. *Economics Letters*, 80(2), 167–173.
- Wai U.T. (1959). The relation between inflation and economic development: a statistical inductive study. *Staff Papers (International Monetary Fund)*, 7(2), 302–317.