



Inflation and economic growth in Cote d'Ivoire

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ABSTRACT

This paper investigates the relationships between inflation and economic growth in Cote d'Ivoire and makes some policy recommendations. The study uses annual data on economic growth and inflation over the period 1985 to 2010 and tests for the long-run and short-run relationships between inflation and economic growth by means of the ARDL bounds testing procedure. The findings are twofold. *First*, inflation imparts a positive and significant economic growth in the long-run. *Second*, in the short-run, inflation has a negative but insignificant effect on economic growth. *Finally*, to gain advantage from inflation, policy makers should target inflation at a level which is conducive to economic growth and promote economic growth through factors such as employment.

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1. Introduction

The relationships between inflation and economic growth have been extensively studied over the past years. The major motivation for such studies is that price stability a key driver for economic growth and economic development. Thus, controlling and carefully managing inflation can be conducive to economic growth through mainly savings and investment. However, to date, the appropriate link between inflation and economic growth continues to be a challenging issue for both policymakers and economists as inflation can have a positive, a negative or a neutral impact on economic growth. In effect, theoretical and empirical studies on this relationship yield mixed results. On the theoretical ground, for example, Tobin (1965) predicts a positive effect of inflation on economic growth whereas Stockman (1981) sees a negative impact of inflation on economic. Sidrauski (1967) finds that there is no relationship between inflation and economic growth. Empirical studies lead to conflicting results as well. Barro (1995) for example concludes that Inflation has a negative and statically significant effect on economic growth whereas Mallik and Chowdhury (2001) conclude that there exists a long-run positive relationship between inflation and economic growth. Others like Kigume (2011) finds an absence of a causal relationship between the two variables.

Given the conflicting views exposed above, it appears that the relationships between inflation and economic growth depend more on economic conditions and respond more to empirical investigations. The present study contributes to this literature by exploring the long-run and short-run relationships between inflation and economic growth in Cote d'Ivoire within the framework of the Auto Regressive Distributed Lag (ARDL) bounds testing cointegration technique developed by Pesaran and Shin (1999) and Pesaran et al. (2001). My results are as follows: there is a positive and significant impact of inflation on economic growth in the long-run whereas in the short-run the impact of inflation on economic growth is negative and insignificant.

The remaining of the paper is organized as follows. Section 2 exposes the literature review after the introduction section. Section 3 presents the methodology and includes a description of the data and an exposition of the ARDL bounds test for cointegration. Section 4 presents the results and discussion and, section 5 concludes the paper while providing policy implications.

2. Review of literature

This section reviews some of the recent empirical work on the controversial relationship between inflation and economic growth. It considers selected literature dealing with positive, negative and neutral relationships between inflation and economic growth.

On the positive ground, Osuela et al. (2013) using annual data over 1970-2011, and grander causality technique showed the existence of a statistically significant positive relationship between inflation and economic growth in Nigeria but did not find a leading variable in the relation between inflation and economic growth. Sattarov (2011) studied the relationship in the case of Finland with annual data over the 1980-2010 period by use of Error correction model (ECM) and Ordinary least squares (OLS) and, found that Inflation and economic growth are positively related in the long-run. Chowdhury and Mallik (2001) analyzed the issue in four South Asian countries using annual time series data for the period 1970-2000. They made use of Cointegration tests and error correction model (ECM) and found a long-run positive relationship between inflation and economic growth for all four countries. Xiao (2009) investigated the issue for China using annual time series data over the period 1978-2007 and, the methodologies of the Correlation matrix, Granger Causality, Cointegration Tests and Error correction model and found a positive long-run relationship between inflation and economic growth and, a bidirectional causality between inflation and economic growth.

Studies also document the adverse impact of inflation on economic growth are numerous. Barro (1995) analyzed that link with a panel data over the 1960 to 1990 period for 100 countries by means of Instrumental variables techniques and found that inflation had a negative and statistically significant effect on economic growth and that investment was the main channel through which inflation reduces economic growth. Faria and Carneiro (2001) in a study on Brazil used time series data for the period 1980-1995, and Vector Auto Regressive (VAR) methodology concluded for the existence of a short-run negative relationship between inflation and economic growth. Thanh (2015) in a study of 5 ASEAN (Association of Southeast Asian Nations) countries over the 1980-2011 period, utilized the Panel Smooth Transition Regression (PSTR) methodology to estimate the threshold of inflation and its effects on economic growth. He arrived at the conclusion that inflation had a significant and statistically negative effect on economic growth beyond the threshold of 7.84%. Mamo (2012) studied the issue for 13 South Saharan African countries using a panel data for the period 1969-2009 while applying Correlation matrix, Fixed effect and Panel Granger Causality tests reached the conclusion of a negative correlation between inflation and economic growth and, inflation Granger caused economic growth for most of the countries except two in which GDP Granger caused inflation. Studies dealing with neutral or absence of a relationship between inflation and economic growth are scanty. Hossain et al. (2012) investigated the long-run relationships between inflation and economic growth in Bangladesh using annual time series data over 1978-2010 and Cointegration and VAR Granger causality tests and, found that there was no long-run correlation between inflation and economic growth. Veni and Choudhury (2007) studied the link between inflation and economic growth in India using annual data series over the period 1981-2004 and Cointegration and Granger causality methodologies. They found no cointegration and no causality between inflation and economic growth.

Given the inclusive evidence in the empirical literature, this study examines the impact of inflation on economic growth in a developing country context i.e. Cote d'Ivoire.

3. Data and methodology

This section covers the data used and exposes the ARDL bounds test for cointegration.

3.1 Data

The data used in this study are annual data on economic growth and inflation rate over the period 1985 to 2010. The source of the data is the *World Bank Development Indicators 2015*. Economic growth is measured as the growth rate of the per capita gross domestic product noted here as GDP and, Inflation noted herein as INF is calculated as the first differenced natural logarithm of consumer price index. It is agreed that inflation would reduce the general purchasing power and would therefore not be conducive to investment. However, the effects of inflation on economic growth can be positive, negative or neutral. The current study sheds light on the case on Cote d'Ivoire.

3.2 ARDL bounds test for cointegration

There are different methods to examine the long-run relationships and the dynamic interactions between two or more time series variables. This study employs the Auto Regressive Distributed Lag (ARDL) bounds testing cointegration technique developed by Pesaran and Shin (1999) over the Johansen (1988), and Johansen and Juselius (1990) approaches for the following reasons. In the first place, it is applicable irrespective of the order of integration that is I (0), purely I (1) or mutually cointegrated. In the second place, it exercises better efficiency in small sample data size. In the third place, it enables estimates of both long-run and short-run parameters simultaneously. Finally, it provides better results for small sample data (Haug, 2002). ARDL specification used to analyze the long-run and short-run relationships between inflation and economic growth can be expressed in the unrestricted error correction model (UECM) below:

$$\Delta GDP_t = \phi_0 + \sum_{i=1}^m \phi_{1i} \Delta GDP_{t-i} + \sum_{i=0}^n \phi_{2i} \Delta INF_{t-i} + \alpha_1 GDP_{t-1} + \alpha_2 INF_{t-1} + \varepsilon_t \tag{1}$$

Variables in equation (1) are defined as in section 3.0.1; $\Delta(\cdot)$ is the differential operator; $\sum(\cdot)$ is the summation operator and, ε_t is the error term assumed to be White noise. The parameters α_1 and α_2 in equation (1) refer to the long-run dynamics and the coefficients ϕ_1 and ϕ_2 are about the short-run dynamics. The null hypothesis of absence of cointegration is tested by: $\alpha_1 = \alpha_2 = 0$ and, the alternative hypothesis of cointegration existences among series in equation (1) is given by $\alpha_1 \neq \alpha_2 \neq 0$. An F-statistic is used to carry out hypotheses tests. In case the calculated F-statistic is superior to the upper critical bound provided by Pesaran et al. (2001), it is concluded that series are cointegrated. In case the calculated F-statistic is below the lower critical bound, there is no cointegration. When the calculated F-statistic lies between the upper critical bound and the lower critical bound, it is impossible to conclude on the state of cointegration. The lag structure (m, n) necessary to utilize the ARDL bound testing procedure is determined by the Schwartz Bayesian criteria whereby the minimum values are selected. Diagnostic tests for serial correlation, the functional form of the model, normality of residuals and, white heteroscedasticity are carried out afterward. Long-run and short-run parameters' stability is checked through the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMsq) tests.

4. Results and discussion

4.1 Unit root tests

It is agreed that bounds testing procedure will apply irrespective of the order of integration of series, but its estimates will not be reliable if series are integrated of order two or higher. I make use of Phillips and Perron (1988) unit root test to check for the order integration to ensure that series are not integrated of order two or higher and that the dependent variable is integrated of order 1. The test is conducted here with a model with constant and trend for the level series and, a model with constant without a trend for the set in first difference. The results are shown in Table 1 below.

Table 1: Phillips and Perron unit roots test

Model with intercept and trend for series in level		Model with intercept without trend for first differenced series		
GDP	INF	Δ GDP	Δ INF	
-2.6264	-3.7913	-4.9774	-12.1226	
NS	S	S	S	
5% critical value is -3.6032 (level)		5% critical value is -2.9918 (difference)		

Notes: GDP and INF are the growth rate of per capita GDP and inflation rate respectively; $\Delta(\cdot)$ is the difference operator; S denotes stationery and NS non-stationery.

It appears from Table 1 above that INF series in level and INF, and GDP differenced series is stationary since their calculated Phillips and Perron statistics are all inferior to their critical values at the 5% level. This stationary characteristic of those series implies that they are not integrated of order two or higher. The GDP series in level is however non-stationary as its calculated Phillips and Perron statistics of -2.6264 is superior to the 5% critical value of -3.6032. This result indicates that the dependent variable GDP is not integrated of order 2. The combination of stationary and non-stationary series qualifies them for the application of the ARDL bounds testing procedure to test for the existence of long-run relationships among variables.

4.2 Bounds tests for cointegration

This section tests for the existence of cointegration between INF and GDP. To that end, equation (1) is estimated by means of ARDL bounds testing methodology using lags determined by the Schwartz Bayesian Criterion. The results from the estimation are reported in Table 2 below.

Table 2: F-statistics of bounds test

Equation	F-statistic	critical values		Cointegration
		Lower bounds	Upper bounds	
GDP/INF	20.4588	6.84	7.84	Yes

Notes: GDP and INF are growth rate of per capita GDP and inflation rate respectively; Lower bounds and upper bounds are reported at the 1% level

The result from Table 2 above indicates that the null hypothesis of no cointegration is rejected at the 1% significance level since the calculated F-statistic of 20.45 exceeds the Upper bounds critical value of 7.84. This result suggests the existence of a long-run relationship between INF and GDP. The next step consists therefore in the estimation of a long-run and short-run coefficients.

4.3 Long-run and short-run results

Table 3 below reports estimates of a long-run and short-run coefficients.

Table 3 : Long-run and short-run estimates

	Variables	Coefficients	P-Values
Long-run estimates	INF	0.3367	0.0358**
	Constant	-1.6941	0.0009*
	$\Delta(\text{GDP}(-1))$	0.1899	0.1870
Short-run estimates	$\Delta(\text{GDP}(-2))$	0.2146	0.1220
	$\Delta(\text{GDP}(-3))$	0.4635	0.0023*
	ΔINF	-0.0185	0.7027
	ECM(-1)	-0.7485	0.0000*

Notes: GDP and INF are the growth rate of per capita GDP and inflation rate respectively; $\Delta(\cdot)$ is the difference operator; ECM(-1) denotes the coefficients of the lagged error correction term; * and ** denote significance at the 1% and 5% respectively.

The results from Table 3 above show that inflation has a positive and significant effect on growth in the long-run at the 5% level. This result is in line with that of the Bounds test above that suggested the existence of a long-run relationship between inflation and economic growth. This result is also in line with the conclusions of Osuela et al. (2013), Sattarov (2011) and, Chowdhury and Mallik (2001) amongst others. Furthermore, that positive sign on inflation might indicate low unemployment thereby implying a positive impact on economic growth after the Phillips (1958) curve. In the short-run, the coefficient on the change in inflation is negative but not significant at the 5% level. This indicates that below a certain threshold, changes in inflation will not be harmful to economic growth. The negative and significant coefficient on the error correction model (ECM(-1)) at the 1% level indicates a relatively quick adjustment in the growth rate when the rate of inflation changes.

4.4 Diagnostic tests

The results of the various diagnostic tests are reported in Table 4 below.

Table 4: Diagnostic tests

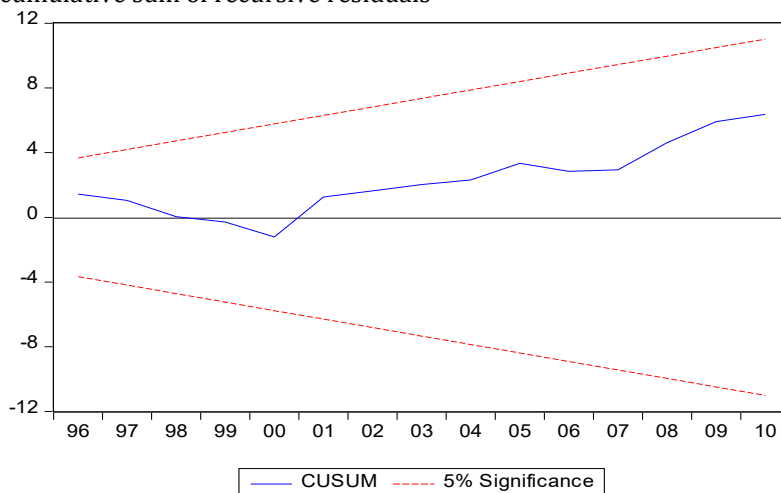
Hypotheses	Tests	P-Values
Normality	Bera-Jarque	0.9651*
Serially uncorrelated	Breusch-Godfrey	0.8773*
Homoscedasticity	Breusch-Pagan-Godfrey	0.1902*
Functional form	Ramsey RESET test	0.9524*

Notes: * denote insignificance at the 5% level. All P-Values reject the null hypotheses.

It appears from Table 4 that all tests do reject the null hypotheses of normality, the absence of serial correlation, homoscedasticity and, functional form thereby indicating that the model is properly specified.

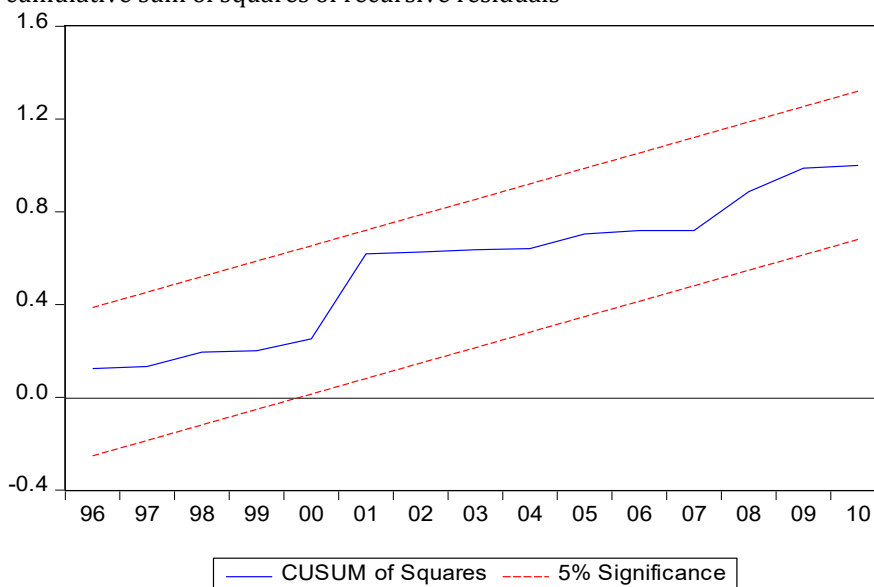
Further tests as prescribed by Pesaran and Shin (1999) to check for the stability of long-run and short-run estimates by means of the CUSUM and CUSUMsq are carried out.

Figure 1: Plot of cumulative sum of recursive residuals



Note: The straight lines represent critical bounds at 5% significance level.

Figure 2 : Plot of cumulative sum of squares of recursive residuals



Note: The straight lines represent critical bounds at 5% significance level.

Figures 1 and 2 are graphs of the CUSUM and CUSUMsq that are between the critical boundaries at the 5% significance level. It confirms that long-run and short-run parameters are accurate. In the Long-run, inflation has a positive and significant impact on economic growth whereas in the short-run changes in inflation have a negative and insignificant effect on economic growth. These also confirm the stability of ARDL model.

5. Conclusion and policy implications

The present study has analyzed the relationships between inflation and economic growth in Côte d'Ivoire. The study makes use of annual data on the per capita growth rate of GDP and inflation rate over the period 1985 to 2010 and, utilizes the ARDL bounds test methodology to test for the long-run and the short-run relationships between inflation and economic growth. The study finds that over the long term inflation has a positive and significant impact on economic growth whereas, in the short-run, changes in inflation have a negative but not significant effect on economic growth. The study reveals further that the model is properly specified as all null hypotheses of tests for normality, the absence of serial correlation, homoscedasticity and, the functional form could not be rejected. The plot of Cumulative Sum of recursive residuals and the plot of the cumulative sum of squared recursive residuals confirm the stability of ARDL model. Finally, the study has two major policy implications. First, it will be interesting for policy makers to target inflation at a level where it will be conducive

to economic growth in the long-run. Second, in order to take advantage of the positive relation between inflation and economic growth in the long-run, policymakers should promote economic growth through such factors as employment and investment.

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