Relationship between Inflation and Economic Growth in the West African Economic and Monetary Union (WAEMU): A Search for New Evidence of Causality

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Abstract

In this article, we use recently developed panel causality and cointegration techniques to examine the long-term relationship between inflation and economic growth in the 8 WAEMU countries. A panel of 256 observations was thus constituted from the IMF (WDI) and CBWAS database. Our results highlight a unidirectional causality between inflation and economic growth and support the view that public spending controls can reduce inflation. Economic growth is the main channel through which economic policy can influence inflation. Furthermore, improving the quality of the workforce can further strengthen economic growth.

Keywords: Inflation; Economic growth; Panel causality; Panel cointegration; WAEMU

INTRODUCTION

As in many industrialized and developing countries, one of the most fundamental objectives of macroeconomic policies is to maintain high economic growth and low inflation. The question is whether inflation exerts a causal influence on economic growth. Although this idea dates back at least to Phillips (1958), the fundamental contribution of Vikesh and Subrina (2004) revived interest in the subject and spurred a surge in academic research. Numerous empirical analyses examine the relationship between inflation and economic growth (see for example Aydin et al. 2016, Ghosh & Philips 1998, Bruno & Easterly 1998, Khan, Semlali & Smith 2001, Drukker, Gomis-Porqueras & Hernandez-Verme 2005, Kremer, Bick & Nautz 2009, Vinayagathasan 2013). However, empirical attempts using cross-sectional or panel data techniques to study the impact of inflation on economic growth as precisely as possible have not succeeded in reaching a consensus or clear direction. Moreover, these results are more dependent on correlation than on the causal relationship between the two variables.

Indeed, several theoretical arguments suggest that the causal relationship between inflation and growth cannot be resolved solely by cross-sectional and panel data analysis. Empirical results and policy recommendations vary and are sometimes contradictory. Previous studies are inconclusive in terms of policy recommendations that can be applied consistently across all countries. These differences seem to result from different data sets, country-specific characteristics, and various methodologies used. While many recent studies support the school of thought that inflation delays and negatively influences economic growth, earlier studies argued that inflation promotes growth. Empirical findings on this subject in the existing literature fall into four categories: inflation has no influence on economic growth (Wai 1959, Dorrance 1966, Sidrauski 1967, Cameron, Hum & Simpson 1996); inflation has a positive impact on economic growth (Mallik & Chowdhury 2001, Rapach 2003, Benhabib & Spiegel 2009); inflation has a negative influence on economic growth (Friedman 1956, Stockman 1981, Fischer 1983, Barro 1995, Valdovinos 2003); and inflation impacts economic growth in terms of specific thresholds (Aydin et al. 2016, Ghosh & Philips 1998, Bruno & Easterly 1998, Khan, Semlali & Smith 2001, Drukker, Gomis-Porqueras & Hernandez-Verme 2005, Kremer, Bick & Nautz 2009, Vinayagathasan 2013).

Although many empirical studies have examined the causal relationship between inflation and economic growth, the results of these studies remain ambiguous. These studies have used Granger non-causality and Johansen cointegration tests between inflation and economic growth and report mixed results. This indicates that there is still no consensus on the role of inflation in the economic growth process. This lack of consensus is also true for studies using data from WAEMU countries. In the specific case of the West African Economic and Monetary Union (WAEMU), a group of eight (8) states that share the use of the CFA franc and monetary policy under the guidance of the Central Bank of West African States (CBWAS), the question of the links between inflation and economic growth is of particular interest in several respects (Combey et al., 2010). The Ivorian crisis dashed all hopes of a rapid return to economic growth (Noubukpo, 2012). Since 1989, monetary policy has increasingly relied on market mechanisms, favoring indirect regulation of bank liquidity. A primary role is thus given to the interest rate, which has become the preferred instrument of monetary policy, especially since the abandonment of credit control in January 1994. The pegging of the CFA franc to the euro often leads the CBWAS to align with the key interest rates of the European Central Bank (ECB). This policy, sometimes contradictory to economic conditions, results in imbalances and fragilities in the CFA zone economies. Mubarik and Riazuddin (2005) conducted a threshold analysis for Pakistan and concluded that an inflation rate above 9% had a negative impact on economic growth. Erbaykal and Okuyan (2008) analyzed the relationship between inflation and economic growth for Turkey, using quarterly data from the first quarter of 1987 to the second quarter of 2006. They employed cointegration and causality tests, the bounds test, and the WALD test. They found no significant long-term relationship between inflation and growth but did find a significant negative short-term relationship between the two variables. They also discovered a unidirectional causal relationship between inflation and economic growth. Munir and Mansur (2009), using a dataset from 1970 to 2005, applied the threshold autoregressive (TAR) model revealed that an inflation rate above 3.89% had a negative impact on economic growth, while an inflation rate below this threshold had a positive impact on growth. Ozdemir (2010) examined the dynamic links between inflation uncertainty, inflation, and output growth in the United Kingdom, also using quarterly data from the second quarter of 1957 to the fourth quarter of 2006. The vector autoregressive fractionally integrated moving average (VARFIMA) was performed to examine the causal effect between inflation and growth. The author divided the sample data into three sub-periods and analyzed both the entire sample and the sub-periods. The result for the entire sample revealed that inflation uncertainty determines economic growth. More recently, DJIOGAP C. (2016) conducted a study on 53 African countries over the period from 1980 to 2013. The results show that there is a nonlinear relationship between inflation and growth, and the impact of inflation on growth is more severe in countries with low institutional quality.

In this study, we contribute to the debate on the relationship between inflation and economic growth in three ways. First, we use recently developed panel methods to test for unit roots (Im et al., 2003, Maddala and Wu, 1999, and Pesaran, 2005) and cointegration (fully modified OLS and dynamic OLS), using a large and homogeneous sample over 30 years for WAEMU countries. These methods avoid the low power problems associated with traditional unit root and cointegration tests. Pooling significantly increases the sample size, allowing for higher degrees of freedom and thus more precise and statistically reliable results. It also reduces collinearity between regressors. To our knowledge, there are no recent studies in the WAEMU area that have used panel cointegration tests.

The second contribution of the study is the use of institutional quality indicators. Using a homogeneous panel helps avoid the biases of heterogeneous panels due to the biases of heterogeneous panels due to country-specific characteristics and different economic structures.

By using a homogeneous panel, we ensure that the countries in the sample have similar economic environments and policies, which increases the reliability of the results.

Thirdly, this study incorporates institutional quality indicators to better understand how institutions affect the inflation-growth relationship. By including these indicators, we can account for the varying degrees of institutional development across WAEMU countries and provide a more comprehensive analysis of the inflation-growth dynamic. This approach allows us to identify whether stronger institutions mitigate or amplify the effects of inflation on economic growth.

Overall, our study aims to provide a deeper understanding of the inflation-growth relationship in the WAEMU region, offering policy recommendations that consider both economic and institutional factors.

The definition of governance at the macroeconomic level requires qualitative indicators. The overall governance index is an average of six aggregated indicators: control of corruption, government efficiency, rule of law, regulatory quality, political stability and absence of violence, and voice and accountability (Kaufman, Kraay, and Mastruzzi, 2003). The relationship between governance and economic growth has gained increasing interest since the 1990s, both in economic science and within the international community. Improving the quality of governance has become imperative for donors, given the scarcity of funding sources and the need for economies to be competitive in the context of globalization. Consequently, several theoretical and empirical studies have been conducted to show the relationship between the quality of governance and economic growth. The most prominent studies have been carried out by the World Bank, particularly by Kaufman (1996) and Mauro (1995).

The third contribution lies in our attempt to address the question of causality, namely whether a better functioning of monetary policy or the state exerts a causal influence on growth or vice versa, using the methodology of Pesaran, Shin, and Smith (1999). Cointegration vectors are estimated using the dynamic OLS (DOLS) procedure, supplemented by the Fully Modified OLS (FMOLS) procedure, which provides consistent and efficient estimators of the long-term relationship, addresses the endogeneity of the regressors, and accounts for the integration and cointegration of the data.

The rest of the paper is organized as follows: Section 2 presents a brief literature review and the empirical approach used to study the relationship between inflation and economic growth. Section 3 discusses the main findings and their robustness. Finally, Section 4 summarizes and concludes.

1. EMPIRICAL LITERATURE ON INFLATION AND GROWTH

The relationship between inflation and growth has been well analyzed, with divergent results. Malla (1997), for example, examined the impact of inflation on growth in 11 OECD and Asian countries using a panel analysis. The result showed that for OECD countries, there was no relationship between inflation and growth, contrary to theories on inflation and growth. However, for Asian countries, there was a significant negative relationship between inflation and growth. Bruno and Easterly (1998), using the threshold model for 26 countries, established that a higher inflation rate hinders growth and that lower inflation costs the economy less. A country is in a high inflation crisis when its inflation exceeds the threshold of 40%. The exact threshold of inflation that is detrimental or beneficial to economic growth is inconclusive, even when analyzing the same group of countries. Khan and Senhadji (2001) analyzed the threshold effect of inflation on economic growth for 140 industrialized and developing countries using a nonlinear least squares method. Using data from 1960 to 1998, they predicted an inflation threshold, in terms of achieving the desired growth rate, of 1 to 3 percent for industrialized countries and 7 to 11 percent for developing countries. In the same year, Gylfason and Herbertsson (2001) analyzed 170 industrialized and developing countries from 1960 to 1992 using a panel regression. They found that an inflation rate between 10 and 20 percent had a negative effect on economic growth. Gillman, Harris, and Mátyás (2004) evaluated the link between inflation and growth for a panel of 29 OECD countries and 18 APEC countries from 1961 to 1997, using cointegration and Pearson's fixed and random effects methods. They also found a negative inflation-growth effect, which was more pronounced when inflation levels were low. The negative effect of inflation for OECD countries is significant, and the results are similar for APEC countries. Mubarik and Riazuddin (2005) conducted a threshold analysis for Pakistan and concluded that an inflation rate above 9% had a negative impact on economic growth. Erbaykal and Okuyan (2008) analyzed the relationship between inflation and economic growth for Turkey, using quarterly data from the first quarter of 1987 to the second quarter of 2006. They used the cointegration and causality tests, the bounds test, and the WALD test. They found no significant long-term relationship between inflation and growth, but a significant negative short-term relationship between the two variables. They also discovered a unidirectional causal relationship between inflation and economic growth. Munir and Mansur (2009), using data from 1970 to 2005, employed a threshold autoregressive (TAR) model, which revealed that an inflation rate above 3.89% had a negative impact on economic growth, while an inflation rate below this threshold had a positive impact on growth. Ozdemir (2010) examined the dynamic links between inflation uncertainty, inflation, and output growth. in the United Kingdom, also using quarterly data from the second quarter of 1957 to the fourth quarter of 2006. The fractionally integrated autoregressive moving average (VARFIMA) model was used to examine the causal effect between inflation and growth. The author divided the sample data into three sub-periods and analyzed the entire sample data and the sub-periods. The result for the entire sample revealed that inflation uncertainty determines economic growth. Moreover, uncertainty related to output growth has a positive impact on the inflation rate and the output growth rate, but no relationship was found for the sub-period analysis. Therefore, inflation uncertainty is one of the most crucial determinants of economic growth. Odhiambo (2011) also examined the causal relationship between inflation, investment, and economic growth in Tanzania. He found a unidirectional causal flow from inflation to economic growth.

Abbott and De Vita (2011) studied the impact of inflation on growth under different exchange rate regimes for 125 countries from 1980 to 2004. They used a panel analysis and found that developing countries with flexible exchange rate regimes experienced lower growth compared to those with fixed or intermediate exchange rate regimes. Akgul and Ozedemir (2012) evaluated the nonlinear relationship between inflation and growth for Turkey. They found that an inflation threshold of 1.26% is appropriate for economic growth. An inflation rate above 1.26% had a negative impact on growth, while a rate below 1.26% had a positive impact on growth. Kremer et al. (2013) conducted another study on 124 industrialized and non-industrialized economies using the dynamic panel threshold model. They found a threshold of 2% for industrialized countries and 17% for non-industrialized countries ; any rate above this level was detrimental. The same year, Vinayagathasan (2013) analyzed 32 Asian countries using the same dynamic threshold analysis methodology and determined a threshold of 5.43%. A rate above the threshold negatively impacted growth, while a rate below the threshold had no significant effect on growth. Tung and Thanh (2015), using a two-step least squares methodology for Vietnam's data from 1986 to 2013, found that an inflation rate above 7% had a negative impact on economic growth. A very recent study conducted by Baharumshah et al. (2016) on inflation, inflation uncertainty, and economic growth in 94 emerging and developing countries used the method of moments Generalized (SGMM). The study reveals that inflation harms growth only in countries without inflation crises and that inflation uncertainty actually promotes growth. High inflation leads to negative growth, while low inflation promotes high growth. The negative cost of failing to control inflation outweighs the positive benefits of uncertainty in countries without inflation crises, across all three regimes. They also found that inflation uncertainty has a positive effect on growth as a precautionary measure when inflation falls within moderate ranges (5.6 to 15.9%).

Regarding the impact of inflation on growth, it has not been proven that moderate inflation has a notably positive impact on growth. Real growth rates during periods of relatively high inflation have sometimes been surprising and better than the figures recorded in comparable countries that have managed to contain inflation. Table 1 below examines growth in several countries that have experienced episodes of high inflation or hyperinflation, as well as countries with low or moderate inflation rates. Despite historical inflation events in the WAEMU zone since 1990 and according to economic norms on inflation, we consider low inflation to be below 4%, moderate inflation to be between 4% and 11%, and hyperinflation to be above 11%. High and hyperinflation rates have generally been associated with growth declines or recessions in open economies, although there are exceptions to the rule, such as in Benin and Togo between 1994 and 1995.

Low inflation rates have often been accompanied by rapid economic growth, as seen in Côte d'Ivoire between 2013 and 2021, in Burkina Faso between 1996 and 2007, and in Benin between 1990 and 1993, with the exception of Mali, Senegal, and Togo between 1990 and 1993, a period marked by severe political and economic instability. According to these statistics, inflation is generally relatively low in the WAEMU zone and seems to be negatively correlated with economic growth, subject to the econometric investigations that we will conduct in the following sections.

TABLE 1. INFLATION CLUSTERS IN WAEMU

Countries	Years	Low Inflation		Moderate Inflation		High Inflation/Hyperinflation	
		Inflation(%)	Growth(%)	Inflation(%)	Growth(%)	Inflation(%)	Growth(%)
Benin	1990-1993	0.41	5.5				
	1994-1995					26.5	4.03
	1996-2007	3.16	4.56				
	2008-2012			4.1	3.42		
	2013-2021	0.64	5.43				
Burkina-Faso	1990-1993	3.09	3.04				
	1994-1995					16.32	3.52
	1996-2007	2.45	6.35				
	2008-2012	3.82	6.06				
	2013-2021	0.8	5.26				
Cote d'Ivoire	1990-1993	1.82	-0.37				
	1994-1995					20.19	3.97
	1996-2007	2.9	1.75				
	2008-2012	2.95	3.5				
	2013-2021	1.27	7.11				
Guinée-Bissau	1990-1993					52.07	3.6
	1994-1995					30.27	3.8
	1996-2007			10.69	0.9		
	2008-2012	3.7	3.51				
	2013-2021	0.93	3.3				
Mali	1990-1993	-1.02	2.3				
	1994-1995					18.31	2.35
	1996-2007	1.98	5.75				
	2008-2012	4.2	3.45				
	2013-2021	0.52	4.23				
Niger	1990-1993	-3.57	0.14				
	1994-1995					23.3	2.16
	1996-2007	2.21	3.44				
	2008-2012	3.22	6.24				
	2013-2021	1.38	5.02				
Senegal	1990-1993	-0.53	1.15				
	1994-1995					20.8	2.71
	1996-2007	1.89	3.77				
	2008-2012	2.23	3.04				
	2013-2021	1.05	5.22				
Togo	1990-1993	0.45	-5				
	1994-1995					27.8	11.41
	1996-2007	2.68	2.48				
	2008-2012			4	5.73		
	2013-2021	1.13	5.01				

Source : Author’s investigations based on CBWAS data

2. EMPIRICAL METHODOLOGY

2.1 PANEL UNIT ROOT TESTS

Before proceeding to cointegration techniques, we need to verify that all variables are integrated in the same order. To do this, we used the first-generation panel unit root tests by Im, Pesaran, and Shin (2003) and the second-generation panel unit root test by Levin, Lin, and Chu (1993). The tests proposed by IPS address the serial correlation problem of Levin and Lin by assuming heterogeneity between units in a dynamic panel framework. The basic equation for the panel unit root tests for IPS is as follows:

$$\Delta y_{i,t} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{p} \varphi_{ij} \Delta y_{i,t} + \varepsilon_{it} \; ; i = 1,2, \dots, N; T = 1,2, \dots, T \qquad (1)$$

Where $y_{i,t}$ represents each variable considered in our model, α_i is the individual fixed effect, and is selected to render the residuals uncorrelated over time. The null hypothesis is that ρ_i =0 for all *i* versus the alternative hypothesis (ρ_i < 0) for some i = 1,..., N_1 and $\rho_i = 0$ for i = N_1 + 1,..., N. The IPS statistic is based on the mean of the individual augmented Dickey-Fuller (ADF) statistics, as follows:

$$\bar{t} = \frac{1}{N} \sum_{i=1}^{N} (t_{iT}), \qquad (2)$$

Where (t_{iT} is the ADF t-statistic for country *i* based on the country-specific ADF regression as in equation (1). IPS shows that under the null hypothesis of non-stationarity in the panel data framework, the -statistic asymptotically follows the standard normal distribution. The standardized (t_{iT}) statistic is expressed as follows :

$$t_{IPS} = \frac{\sqrt{n}\left(\bar{t} - \frac{1}{N} \sum_{i=1}^{N} E\left[t_{i,T/}\rho_i = 0\right]\right)}{\sqrt{\frac{1}{N} \sum_{i=1}^{N} Var\left[t_{i,T/}\rho_i = 0\right]}} \qquad (3)$$

2.2 PANEL COINTEGRATION TEST

Once the order of stationarity is defined, we apply the Pedroni cointegration test.

Indeed, like the IPS panel unit root test, the panel cointegration tests proposed by Pedroni (1999) also account for heterogeneity by using specific parameters that can vary between individuals in the sample. Accounting for such heterogeneity is advantageous because it is unrealistic to assume that the cointegration vectors are identical across individuals in the panel. Implementing the Pedroni cointegration test requires estimating the following long-term relationship:

$$y_{i,t} = \alpha_i + \delta_i t + \beta_{1i} x_{1,it} + \beta_{2i} x_{2,it} + \cdots + \beta_{Mi} x_{M,it} + \varepsilon_{it} \; ; \qquad (4)$$

$i = 1,2, \ldots., N;\ t = 1,2, \ldots, T\ ; m = 1, \ldots, M$

Where N refers to the number of individuals in the panel, T refers to the number of observations over time, and M refers to the number of exogenous variables. The structure of the estimated residuals is as follows:

$$\hat{\varepsilon}_{it} = \hat{\rho}_i\ \hat{\varepsilon}_{it-1} + \hat{u}_{it}. \quad (5)$$

Pedroni proposed seven different statistics to test for cointegration in panel data. Of these seven statistics, four are based on pooling, known as the "Within" dimension, and the remaining three are based on the "Between" dimension. Both types of tests focus on the null hypothesis of no cointegration. However, the distinction lies in the specification of the alternative hypothesis. For "Within" dimension tests, the alternative hypothesis is $\rho_i = \rho < 1$ for all i while for the "Between" dimension tests, the alternative hypothesis is $\rho_i < 1$ for all i .

The finite sample distributions for the seven statistics were tabulated by Pedroni through Monte Carlo simulations. The calculated test statistics must be lower than the critical value tabulated to reject the null hypothesis of no cointegration.

2.3 ESTIMATION OF THE COINTEGRATION RELATIONSHIP

Although Pedroni's method allows us to test for the presence of cointegration, it does not provide an estimation of the long-term relationship. For panel cases, in the presence of cointegration, several estimators are proposed: OLS, Fully Modified OLS (FMOLS), Dynamic OLS (DOLS), and Pooled Mean Group (PMG). Chen, McCoskey, and Kao (1999) analyzed the properties of the OLS estimator and found that the bias-corrected OLS estimator does not improve over the standard OLS estimator. These results suggest that alternatives such as the Fully Modified OLS (FMOLS) or Dynamic OLS (DOLS) estimators may be more promising in cointegrated panel regressions. However, Kao and Chiang (2000) demonstrated that OLS and FMOLS have a small sample bias, and that the DOLS estimator seems to outperform the other two estimators. In this study, we consider two estimators with error correction to study the long-term relationship between inflation and economic growth: FMOLS and Dynamic OLS (DOLS). The issue of causality is analyzed using the Pooled Mean Group (PMG) methodology developed by Pesaran et al. (1999).

2.4 FMOLS and DOLS Estimators

The FMOLS and DOLS estimators are proposed by Kao and Chiang (2000) to estimate the long-term cointegration vector for non-stationary panels. These estimators correct the standard pooled OLS for serial correlation and endogeneity of regressors, which are typically present in the long-term relationship.

Consider the following fixed effects panel regression:

$$y_{i,t} = \alpha_i + x'_{it}\beta + u_{it} \ , i = 1, \dots, N \ , t = 1, \dots, T, \qquad (6)$$

Where $y_{i,t}$ is a matrix of dimension (1,1), β is a vector of slopes of dimension (k,1), $\alpha_i$is an individual fixed effect, and u_{it} are the stationary disturbance terms. It is assumed that x_{it} of dimension (k,1) are integrated of order one for all i, where:

$$x_{it} = x_{it-1} + \varepsilon_{it}. \qquad (7)$$

Under these specifications, (Eq. 6) describes a system of cointegrated regressions, meaning $y_{i,t}$ is cointegrated with x_{it}. Examining the limiting distribution of FMOLS and DOLS estimators in cointegrated regressions, Kao and Chiang (2000) show that they are asymptotically normal. The FMOLS estimator is constructed by making corrections for endogeneity and serial correlation to the OLS estimator. It is defined as follows:

$$\hat{\beta}_{FMOLS} = \left[\sum_{i=1}^{N} \sum_{t=1}^{T} (x_{it} - \overline{x_\iota})' \right]^{-1} \left[\sum_{i=1}^{N} \left(\sum_{t=1}^{T} (x_{it} - \overline{x_\iota}) \hat{y}_{it}^{+} + T\hat{\Delta}_{\varepsilon\mu}^{+} \right) \right], \qquad (8)$$

Where $\hat{\Delta}_{\varepsilon\mu}^{+}$ is the serial correlation correction term and $\hat{y}_{it}^{+}$ is the transformed variable of $y_{i,t}$ to obtain the endogeneity correction. Serial correlation and endogeneity can also be corrected using the DOLS estimator. The DOLS is an extension of the Stock and Watson (1993) estimator. To obtain an unbiased estimate of the long-term parameters, the DOLS estimator uses a parametric adjustment to the errors by including past and future values of the differenced explanatory variables of order I of the model.

The dynamic OLS estimator is derived from the following equations:

$$y_{i,t} = \alpha_i + x'_{it}\beta + \sum_{j=-q_1}^{j=q_2} c_{ij} \, \Delta x_{i,t+j} + v_{it}. \qquad (9)$$

Where c_{ij} represents the lag or lead coefficient of the first-order differenced explanatory variables. The estimated DOLS coefficient is given by:

$$\hat{\beta}_{DOLS} = \sum_{i=1}^{N} \left(\sum_{t=1}^{T} z_{it} \, z'_{it} \right)^{-1} \left(\sum_{t=1}^{T} z_{it} \, \hat{y}_{it}^{+} \right) \qquad (10)$$

Where $z_{it} = \left[x_{it} - \overline{x_\iota}, \Delta x_{i,t-q}, \dots, \Delta x_{i,t+q} \right]$ is a vector of regressors of dimension 2(q+1)*1.

2.5 CAUSALITY TEST BETWEEN VARIABLES: POOLED MEAN GROUP (PMG) BY PESARAN ET AL. (1999)

Our final step is to use an alternative methodology to explore the causal direction among the panel data variables, specifically between inflation and economic growth. The causality link is estimated using the Pooled Mean Group (PMG) estimator by Pesaran et al. (1999). This estimator is an intermediate approach between Mean Group (MG) estimators and Dynamic Fixed Effects (DFE) estimators, as it involves both pooling and averaging. It also allows intercepts, short-term coefficients, and error variances to differ freely across groups, while constraining long-term coefficients to be the same. To this end, the following Error Correction VAR model can be specified:

$$\Delta y_{it} = \alpha_0 + \beta_1 y_{i,t-1} + \beta_2 x_{i,t-1} + \sum_{k=1}^{p-1} \varphi_i \Delta y_{i,t-k} + \sum_{k=1}^{q-1} \theta_i \Delta x_{i,t-k} + \omega \Delta x_{it} + \varepsilon_{it} \quad (11)$$

Where y_{it} represents the dependent variable, and x_{it} is a vector of potential variables in the long-term relationship. β_1 and β_2 are the respective long-term multipliers, and φ_i and θ_i represent the short-term dynamic coefficients. By interchanging y_{it} and x_{it} as necessary by interchanging the dependent and independent variables in the regression above, one can evaluate, under the null hypothesis of no long-term relationship (H0 : β_1 = β_2= 0) and the alternative hypothesis of existence (H1 : $\beta_1 \neq 0$ or $\beta_2 \neq 0$), the variable of interest.

3. DATA AND EMPIRICAL RESULTS

3.1 DATA

The dataset consists of a panel of observations for the 8 WAEMU countries over the period 1990-2021. Investment (INV) as a percentage of Gross Domestic Product (GDP) is the real sector indicator. In this paper, institutional quality is measured by the Global Governance Index (GOV), which is an arithmetic average of the six aggregated governance indicators (Kaufman, Kraay, and Mastruzzi, 2003) to capture the various channels through which governance can affect economic growth. These are: CCOR: Control of Corruption, EFIGOV: Government Effectiveness, EDROIT: Rule of Law, QUALREG: Regulatory Quality, STABAV: Political Stability and Absence of Violence, and VOIXCR: Voice and Accountability. We also use control variables: the overall budget deficit in billions of CFA francs (DEFB), trade openness as exports and imports divided by GDP (OUV), and human capital measured by the working population (POP). The aggregated governance indicators are drawn from the World Development Indicators (WDI, 2008) database. All other variables are extracted from the CBWAS data table.

Table 2 presents the properties of the data with descriptive statistics of the variables used.

TABLE 2: DESCRIPTIVE STATISTICS, 1990-2021

Variables	Observations	Mean	Standard Deviation	Minimum	Maximum
GDP Growth(%)	256	3.917	3.889	-15.096	15.69
Inflation Rate (average annual %)	256	4.47	9.9	-6.243	69.584
Overall Budget Deficit (in billions of CFA)	256	-136.226	277.023	-1965.86	1002.4
Trade Openness	256	31.009	10.184	10.882	58.906
Investment (as % of GDP)	256	19.172	6.177	6.689	48.397
Working Population	256	4106311	2379461	303485.7	10355728
Aggregated Governance Indicator	256	4.17	2.72	-0.606	8.664

Source: Author's investigations

3.2. UNIT ROOT AND COINTEGRATION TESTS

Table 3 presents the results of three panel unit root tests: IPS (2003), LLC (2002), and Fisher ADF (1932). The variables—economic growth, measures of institutional quality, and all control variables—are tested both in levels and first differences. As can be inferred from Table 3, the null hypothesis of unit roots for the panel data cannot be rejected in levels. However, this hypothesis is rejected when the series are in first differences (Table 4). These results clearly indicate that the variables are not stationary in levels but become stationary in first differences. The results of our stationarity tests are consistent with those obtained by Apergis et al. (2007). Thus, our series are integrated of order 1 (I(1)). These results allow us to perform a panel cointegration test on our study variables.

TABLE 3. UNIT ROOT TEST (LEVEL VARIABLES), 1990-2021

Variables	LLC (2002) t-statistic	LLC (2002) P-value	IPS (2003) t-statistic	IPS (2003) P-value	FISHER (1932) t-statistic	FISHER (1932) P-value
GDP Growth(%)	0.264	0.789	-1.403	0.069	25.406	0.078
Inflation Rate (average annual %)	-0.206	0.526	-1.487	0.0724	22.658	0.121
Overall Budget Deficit (in billions of CFA)	0.056	0.522	0.127	0.551	37.795	0.0016
Trade Openness	-0.2	0.421	-1.451	0.0734	22.661	0.123
Investment (as % of GDP)	-1.094	0.137	-1.405	0.081	25.128	0.741
Working Population	1.604	0.946	2.737	0.997	22.453	0.129
Aggregated Governance Indicator	0.363	0.642	-1.417	0.078	25.44	0.062

Source: Author's investigations

TABLE 4. UNIT ROOT TEST (FIRST DIFFERENCE VARIABLES), 1990-2021

Variables	LLC (2002) t-statistic	LLC (2002) P-value	IPS (2003) t-statistic	IPS (2003) P-value	FISHER (1932) t-statistic	FISHER (1932) P-value
GDP Growth(%)	-10.187	0.000	-9.849	0.000	101.331	0.000
Inflation Rate (average annual %)	-5.893	0.000	-9.201	0.000	130.189	0.000
Overall Budget Deficit (in billions of CFA)	-8.946	0.000	-10.954	0.000	133.19	0.000
Trade Openness	-8.971	0.000	-9.439	0.000	102.366	0.000
Investment (as % of GDP)	-10.306	0.000	-11.129	0.000	129.437	0.000
Working Population	6.16	1.000	-2.7585	0.003	32.235	0.009
Aggregated Governance Indicator	-11.732	0.000	-11.487	0.000	160.601	0.000

Source: Author's investigations

TABLE 5. PANEL COINTEGRATION TESTS

	Real sectorial indicators		Foreign sectorial indicators	Indicator of capital human capital and governance	
Variables	**Investissement**	**Inflation**	**Trade Opennes**	**Population**	**Governance**

Panel statistics					
Panel v-stat	-0.590	-2.895***	-2.763***	-2.779***	-3.050***
Panel rho-stat	-9.670***	-8.722***	-9.079***	-8.873***	-9.900***
Panel pp-stat	-15.938***	-13.913**	-15.906***	-17.070***	-15.539***
Panel ADF-stat	-15.065***	-13.346***	-14.711***	-13.389***	-14.798***
Group-statistics					
Group rho-stat	-6.870***	-5.712***	-6.767***	-6.378***	-6.631***
Group pp-stat	-19.450***	-16.829***	-15.056***	-18.242***	-16.359***
Group ADF-stat	-15.608***	-12.87***	-14.241***	-12.285***	-14.268***

Source: Author's investigations

Notes:** Test statistics are standardized so that the asymptotic distribution is normal. *** indicates the rejection of the null hypothesis of no cointegration at the 1% significance level, based on a critical value of 2.326.

The Pedroni (1999) cointegration tests are presented in Table 5. We use four within-group tests and three between-group tests to check if the panel variables are cointegrated. The within-group statistics (panel statistics) provide the calculated values of statistics based on estimators that pool the autoregressive coefficient across different countries for unit root tests on the residuals. The between-group statistics (group statistics) report the calculated values of statistics based on estimators that average the individually estimated coefficients for each country.

Except for the v-statistic test, the results of the within-group and between-group tests show that the null hypothesis of no cointegration cannot be rejected at any 1% significance level. Thus, economic growth, inflation, and a set of control variables are cointegrated across the WAEMU countries.

Given that our variables are cointegrated, we estimate the long-term relationship using Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS) approaches.

3.3. LONG-TERM ESTIMATION OF THE INFLATION-GROWTH RELATIONSHIP: DOLS AND FMOLS ESTIMATORS

As mentioned above, the strategy used to estimate the long-term relationship between inflation and economic growth relies on two error-correction estimators: Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS).

Tables 6 and 7 present the results of the FMOLS and DOLS estimations of the cointegration relationship, respectively. The estimated coefficients for real sector indicators (Inflation and Investment) and human capital and governance indicators (Labor Force and Governance) are all positive and significant, except for the Labor Force and Budget Deficit, which are negative. Only inflation and the labor force are found to be significant in both estimations (FMOLS and DOLS). These results from FMOLS and DOLS confirm the existence of a long-term relationship between inflation and economic growth in the WAEMU countries. However, the negative sign of the labor force coefficient indicates that the labor market in the WAEMU zone is still poorly organized to further enhance the economic growth of member states. This highlights the relative importance of inflation on long-term economic growth. Our results are consistent with most first-generation studies that emphasize a long-term relationship between inflation and economic growth, although the short-term relationship is debated (see for example Baharumshaha et al., 2016 ; Ozdemir, 2010). It is worth noting that some existing research has attempted to analyze the long-term relationship between inflation and economic growth, but our contribution diverges from these studies. Indeed, our results highlight a strong positive long-term relationship between inflation and economic growth in the WAEMU countries.

TABLE 6. LONG-TERM ESTIMATION OF THE INFLATION-GROWTH RELATIONSHIP (FMOLS ESTIMATOR)

Explanatory Variables	Coefficients	t-statistic
Inflation Rate (average annual %)	0.100	3.535***
Overall Budget Deficit (in billions of CFA)	-0.002	-1.642
Trade Openness	0.047	1.272
Investment (as % of GDP)	0.215	2.358**
Working Population	-3.03^{E}-6	-2.051**
Aggregated Governance Indicator	0.366	2.126**

Note: *** and ** indicate coefficients significant at the 1% and 5% levels, respectively.

TABLE 7. LONG-TERM ESTIMATION OF THE INFLATION-GROWTH RELATIONSHIP (DOLS ESTIMATOR)

Explanatory Variables	Coefficients	t-statistic
Inflation Rate (average annual %)	0,289	3,262***
Overall Budget Deficit (in billions of CFA)	-0,003	0,748
Trade Openness	-0,132	-1,080
Investment (as % of GDP)	0,085	0,610
Working Population	-8,91^{E}-6	-2,246**
Aggregated Governance Indicator	0,478	1,105

Note: *** and ** indicate coefficients significant at the 1% and 5% levels, respectively.

3.4. RESULTS OF THE INFLATION-GROWTH CAUSALITY

Having established that economic growth is long-term related to inflation, we need to examine the causality between these two variables. The specification used to test the causality between inflation and growth is as follows:

$$y_{it}= \alpha_{0i}+\alpha_{1i}I_{it}+\alpha_{2i}X_{it}+u_{it} , \qquad (12)$$

where y_{it} is economic growth for country *i* and year *t*, I_{it} is the annual average inflation for country *i* and year *t*, X_{it} is the vector of control variables, $\alpha_{0i}, \alpha_{1i}\ et\ \alpha_{2i}$ are model constants, and u_{it} is the error term.

The ARDL (1,1,1) model associated with equation (12) is:

$$y_{it} = \delta_{0i} + \delta_{1i} I_{it} + \delta_{2i} I_{i,t-1} + \delta_{3i} X_{it} + \delta_{4i} X_{i,t-1} + \lambda_i y_{i,t-1} + \varepsilon_{it},$$

and (13)

$$I_{it} = \delta'_{0i} + \delta'_{1i} y_{it} + \delta'_{2i} y_{i,t-1} + \delta'_{3i} X_{it} + \delta'_{4i} X_{i,t-1} + \lambda'_i I_{i,t-1} + \varepsilon'_{it},$$

The error correction equations are thus:

$$\Delta y_{it} = \phi\left(y_{i,t-1} - \theta_0 - \theta_1 I_{it} - \theta_2 X_{it}\right) - \delta_{2i} \Delta I_{it} - \delta_{4i} \Delta X_{it} + \varepsilon_{it},$$

and (14)

$$\Delta I_{it} = \phi'\left(I_{i,t-1} - \theta'_0 - \theta'_1 y_{it} - \theta'_2 X_{it}\right) - \delta'_{2i} \Delta y_{it} - \delta'_{4i} \Delta X_{it} + \varepsilon'_{it}$$

Table 8 presents the results of the error correction equations.

The null hypothesis of no causality is rejected. The error correction coefficients are negative and statistically significant only in the context of equation (14), which implies that economic growth indeed causes inflation, while the reverse relationship does not hold. This suggests a unidirectional causality from inflation to economic growth in the WAEMU countries. Our results are consistent with those of Nell (2000) and Ghosh and Phillips (1998), who show a unidirectional relationship between inflation and growth. However, our empirical results contrast with the findings of Loubassou et al. (2018) and Shan et al. (2001), who find little evidence of a long-term relationship in WAEMU countries due to high capital mobility.

Most notably, our empirical results provide additional evidence that, in the long term, the effect of inflation on growth is not significant. This suggests the existence of a Threshold Effect in Economic Theory. This can be explained by the resilience of household purchasing power and the new techniques developed by households to adapt to inflationary crises in the WAEMU zone. Economic growth, therefore, becomes a primary channel through which economic policy can affect inflation in WAEMU countries. These results confirm previous work by Faria et al. (2001), which shows that inflation does not impact economic activity in the long term. We thus find that economic growth influences inflation, confirming the cyclical fluctuations of the WAEMU economy and the necessity for counter-cyclical policies as proposed by John Maynard Keynes.

Therefore, the inflation-growth relationship in WAEMU countries can be described as follows: economic growth leads to inflation.

TABLE 8. PANEL CAUSALITY TESTS

Null Hypothetis	F-statistic
INFLATION→GROWTH	0,800
GROWTH→INFLATION	12,324***

Source : Author's investigations

Note : *** indicates coefficients significant at 1%.

CONCLUSION AND POLICY IMPLICATIONS

In this paper, we examine the causal and cointegration relationships between inflation and economic growth in the 8 WAEMU countries. We used panel unit root tests and panel cointegration analysis to conclude that there is strong evidence of a long-term relationship between inflation and economic growth. Our results show that economic growth, inflation, and auxiliary variables are cointegrated

Our data also highlight a unidirectional causality between inflation and economic growth in WAEMU countries and confirm the view that, although inflation may have short-term adverse effects on growth, in the long run, only economic growth drives inflation. Economic growth thus becomes the main channel through which economic policy can affect inflation.

Moreover, the active population could also serve as a transmission channel between economic growth and inflation. Finally, the results highlight a positive impact of GDP growth on inflation. The inflation-growth relationship can thus be described as follows in WAEMU countries : economic growth causes inflation, and the reverse is not feasible.

This implies that policies aimed at improving human capital and its functions will have a significant effect on economic growth in the long run. In this regard, several labor market reforms need to be undertaken. The relationship between economic growth and inflation is therefore unequivocal.

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