

The Relationship between Inflation and Economic Growth: Time Series Analysis for Niger (1971-2014)

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Abstract

Since the 1940s, economists have investigated whether inflation is harmful to the economy or not, analyzing the relationship between inflation and economic growth. While most of researchers see inflation as a problem for the economy, some suggest that only beyond a certain level, can inflation hurt the economy. What is the relationship between inflation and economic growth in Niger, which has one of the least developed and fastest growing economies in recent times? To answer this question, we should also act as these researchers, by investigating the relationship between inflation and economic growth for Niger. Thus, in this study, using data for the 1971-2014 periods and by time-series analysis, the relationship between inflation and economic growth is examined. During the time series analysis, the ADF unit root test, Johansen co-integration test, and Granger causality test were performed. According to the results of co-integration test, a 1% increase in inflation in the long term, leads to a decrease of 1.91% of GDP, and therefore inflation affects economic growth negatively. This means that there exists in opposite long-run relationship between inflation and economic growth. The causality test results suggest that there is a unilateral causal relationship which is determined by inflation one economic growth. It was deemed appropriate for Niger, which shares the same central bank (BCEAO) with seven (7) UEMOA member countries but must setup its own monetary policy independently of BCEAO and, if necessary its own central bank because Niger is experiencing structural problems which are due to political and economic instability of the larger monetary union

Key words: Niger, inflation, economic growth, time series analysis.

1. INTRODUCTION

After the Second World War until today, various macroeconomic variables have been the subject of research. Inflation has been one of the most common issues investigated from among these variables. Since the Second World War, inflation has been the cause of financial crisis in many countries. Therefore, these countries have targeted inflation reduction in order to escape from such crisis. Inflation is defined by economists as the quick and permanent increase of the general price level. Inflation is measured by the consumer price index (CPI) which measures the price of a representative basket of goods and services purchased by the average consumer and is calculated based on periodic survey of consumer prices. Another measure of inflation is the GDP deflator which is available on an annual basis. When there is inflation, the currency loses purchasing power. Inflation is frequently described as a state where “too much money is chasing too few goods”. Even if the potato seller in the market or any person in the street may not know the exact meaning of inflation, he assumes that it is a problem for the market and the nation

Since the 1940s, researchers have investigated how inflation affects the economy. The question of whether or not inflation is harmful to economic growth has recently been the subject of intense debate among policy makers and among macroeconomists. Details and results of these investigations will be given in the Literature Review. While most researchers consider that inflation is harmful to the economy, some have concluded that it is not harmful at a certain level. However, they conclude and concur that the fact that excessive and continuous inflation harms the economic growth of a country. To investigate whether inflation is harmful or not it is necessary to note the relationship of economic growth with the inflation.

The Niger Republic, which obtained its independence in 1960, is endeavoring to stay below the 3% standard inflation level determined by UEMOA. Despite several crises in its economic history, Niger has recently been able to keep its inflation under the standard recommended. Niger has never had a 3-digit inflation rate; and the highest inflation rate experienced was 36%. So if the Niger government generally has been able to keep the inflation below 3% level, what can be the impact of inflation on economic growth? We could not find any study investigating the relationship between growth and inflation for Niger and set out to do one ourselves (AFRISTAT, 2007; Presidence du Niger, 2015).

Thus, the main objective of this study is to investigate the relationship between inflation and economic growth in (the West African country) Niger in the independence era, and to discuss and put forward the results of this relationship. In this context, our work is structured as follows. In the second part of this study, we provide a literature review concerning the relationship between inflation and economic growth. In section 3, the data and methodology are presented followed by the empirical results in section 4. In section 4, in order to investigate the relationship between inflation and economic growth, time series analysis is made with E-views 8.0 program using annual data of the 1960-2014 period. The ADF test and co-integration analysis results are presented in the same section together with the result of the Granger causality test. Results and suggestions are discussed in section 5 as a conclusion.

2. LITERATURE REVIEW

Numerous studies have been carried out to provide clear evidence on the relationship between inflation and economic growth. While some economists see inflation as a danger for a country's economy, some of them think that it has a positive effect on the economic growth of a country. Other studies yet state that the impact of inflation on economic growth could be positive up to a certain threshold level and beyond this level, the effect turns to be negative. In this section, we provide a brief review of these studies and analyze some of the related studies of African countries.

Firstly, let us start with the studies which conclude that there is a negative effect of inflation on economic growth. In its study of 53 countries in the 1961-1981 period, Fischer (1983) concluded that inflation negatively affects economic growth. Fischer (1993) found evidence for a negative relationship between inflation and growth in pooled cross-section time series regressions for a large set of 93 countries. In the same context, De Gregorio (1991) investigated the long-term relationship between growth and inflation by taking data of 12 Latin American countries for the 1951-1985 period. He found a negative long term relationship between inflation and economic growth. Using panel estimation for industrial and developing countries, Burdekin et al. (1994) found significant negative impacts of inflation on economic growth. However, they stated that the magnitude of these effects is much larger for the industrial countries than for the developing countries. Faria and Carneiro (2001) examined the link between inflation and economic growth of Brazil, which is a country facing continuous, permanent high inflation. In this context, they found that there is no effect of inflation on real output in the long-term. However, there is a negative effect of inflation on output. Their results also support Sidrauski's Super Neutrality Concept of Money in the long run. However, as shown by Fischer (1979), there is doubt about the short-term effects of the model for the divisible utility functions in the consumption and real money balances. Saaed (2007), who explored the relationship between inflation and economic growth of Kuwait for the period 1985-2005 found a long-run and strong opposite relationship between inflation and growth in Kuwait. In the same context, Yap (1996) investigated the link of inflation and economic growth in the Philippines and concluded that inflation is harmful for economic growth due to the lack of macro-economic policy towards inflation. Berber and Artan (2004) also did the same investigation for Turkey and found that inflation causes economic growth but that increases of inflation by 10% lead to a decrease of growth by 1.9%.

Now let us analyze the studies arguing that there is a positive effect of inflation on economic growth. In this framework, Tobin (1965) concluded that there is positive link between inflation and growth. The Tobin's model states that during inflationary periods, individuals hold their assets as interest-earning securities. This leads to greater capital intensity and therefore promotes economic growth (Sindano, 2014, p. 18). Mallik and Chowdhury (2001) investigated the short and long run dynamics of the relationship between inflation and economic growth for four (4) South Asian countries (Bangladesh, India, Pakistan, and Sri Lanka) using cointegration and error correction models. Their results concluded

that there is a significant positive link between inflation and economic growth, and that the sensitivity of growth to changes in inflation rates is smaller than that of inflation to changes in growth rates. In his thesis related to the relationship between inflation and economic growth of the Chinese economy for the period of 1978-2007, Xiao (2009) employed cointegration and error correction models as well as correlation matrix and the Granger Causality Test in order to investigate the inflation-growth relationship. The results show that in the long run inflation positively affects the economic growth in a bi-direction. Umaru and Zubairu (2012) investigated the impact of inflation on the economic growth of Nigeria for the period of 1970-2010 through Augmented Dickey-Fuller test and Granger causality test of causation between inflation and GDP. The results suggest that a uni-directional causality relationship exists from GDP to inflation and that inflation affects positively the economic growth by encouraging productivity or/and output levels and on evolution of total factor productivity. In the same context, Osuala et al. (2013) also found the same results.

As we said previously, some policy makers or researchers state that the impact of inflation on economic growth could be positive up to a certain threshold level and that beyond this level the effect turns to be negative. In other cases results have been uncertain. In this context, Mubarik (2005) used annual data from the period of 1973-2000 to estimate the threshold level of inflation in Pakistan. His estimation of the threshold model suggests that inflation rate beyond 9% is damaging for the economic growth of Pakistan. Sweidan (2004) also found that the relation between inflation and growth in Jordan is approximately positive and significant below an inflation rate of 2% and there is structural breakpoint effect at inflation rates of 2% in the period studied. According to the result, inflation affects economic growth negatively beyond this threshold level. Lucas (1973) investigated relationships between real output and inflation by using the Ordinary Least Squares (OLS) method and annual data of 18 countries for the period 1951-1967. He found that in the countries where the prices are stable such as USA, there is a positive relationship between inflation and economic growth. However, in countries where the prices are volatile such as Argentina, it is rare to find this kind of positive relationship between inflation and economic growth. In the same framework, Grimes (1991) investigated the relationship between inflation and economic growth in 21 industrialized countries using annual data for the period 1961-1987. The findings suggest that while there is a positive correlation between the two variables in the short term, the relationship is negative in the long term. Christina (1996) investigates the inflation - output relationship for USA. The findings argued that in the 1884-1994 periods, particularly in the beginning of 1930s, an increase of 0.10 per cent in inflation led to an increase of the economic growth by 1%. Nell (2000) examines the effect of inflation on economic growth in South Africa with data for the period 1960-1999 using the Vector Auto Regressive (VAR) technique. He found that inflation may be positive for economic growth in the single-digit zone, while inflation appears to impose costs in terms of slower growth in the double-digit area. Barro (1995) also research the inflation-growth relationship by using a large sample of more than 100 economies in the 1960-1990 period. According to the results of his study, there is a significant negative relationship between inflation and growth if some countries' characteristics (education, fertility rate etc.) are held constant. More precisely, an increase of the average inflation by 10% points per year decreases the economic growth by 0.3 to 0.4 percentage points per year. Furthermore, if this situation continues over a 30 year period, growth will be reduced by 6 to 9 percent.

As we did not find any case study of Niger about the relationship between these two variables, we looked into the case of countries sharing the same continent with Niger, i.e. African countries. However, there is one study about UEMOA countries. As we stated previously, Niger is a West African country, which is a member of regional economic organizations like UEMOA and CEDEAO. In this framework, Kouame (2010) examined the relationship between inflation and economic growth for West African Economic and Monetary Union (UEMOA), which targets a standard inflation rate of 3%. To do so, he estimated the optimal inflation rate at 8% by using Hansen's (1999) threshold model. He argued that if the inflation rate in UEMOA countries stays below optimal inflation rate, inflation would not harm the economic growth. Motande and Christian (2015), performed the same investigation for BEAC countries by using the Panel Smooth Transmission Regression (PSTR) model. He found that when the 4.28 percent optimal inflation rate is below the threshold, an increase of 1% of inflation enhances growth by 0.287 point. Over the threshold, a one percent increase in inflation leads to a decrease of 0.257 point in growth. Bittencourt et al. (2014) made the same type of study for 15 Southern African Development

Community (SADC) members' countries, and their findings show that there is negative effect of inflation on growth. Fabayo and Ajilore (2006) found that there is a significant positive relationship between inflation and growth of Nigeria, while, above a 6% threshold level, inflation begins to hurt economic growth. In the same framework, Salami and Kelikume (2010) used data of the 1970-2008 period to investigate the inflation-growth link in Nigeria. They found that there is an 8% threshold. Seleteng (2004) also concluded that when the inflation in Lesotho is above 10%, it harms economic growth. In Burundi, Ahishakiye (2011) found that there is no co-integration relation between the two variables and there is unidirectional causality from growth to inflation. Kigume (2011) argued that there is no causality between inflation and economic growth in Kenya for the 1963-2000 period. Hodge (2002) and Ogbokor (2004) investigated relationships between inflation and growth for South Africa and Namibia respectively. All of them found a negative relationship between the two variables.

3. Methodology

3.1 Research Questions

In this study, we examine the relationship between inflation and economic growth by using data for the 1971-2014 period using time-series analysis.

3.2 Estimation Techniques

Time series are statistics data observed and recorded in a certain period. These numerical data can be weekly, monthly, 3-monthly, or by year. Time series has deterministic (the presence or absence of fixed, trend and seasonal component within the series) and stochastic (whether the variables are stationary or not) characteristics. Recently time series analysis has been used in economics or other scientific researches. Generally, during time series analysis causality and co-integration relationship, and interaction between the variables are investigated (Sevüktekin & Nargeleçekenler, 2010, pp. 1-11; Köksal, 2003, pp. 443-445).

Before starting our investigation, our variables must be stationary. Non-stationarity has often been seen as a problem. It is not prudent to work with non-stationary series data during empirical analysis because working with them leads to spurious regression results. Several tests are used to test for stationarity. The most popular is Augmented Dickey Fuller Tests (ADF). Thus, we firstly have to test for stationarity of the variables under investigation by applying the ADF. The ADF test is based on rejecting a null hypothesis of unit root in favor of the alternative hypotheses of stationarity. The tests are conducted with and without a deterministic trend (t) for each of the series. The general form of ADF test is estimated by the following regression:

$$\Delta Y_t = b_0 + b_1 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^m \Delta Y_{t-i} + u_t \quad (1)$$

Where: Y is a given time series, t is a linear time trend, Δ is the first difference operator, b_0 is a constant, n is the optimum number of lags in the dependent variable and u is the random error term (Dikmen, 2012, pp. 308-310; Gujarati, 1995).

After the stationary test (ADF unit root test), we perform the co-integration test to examine whether there exists a long-run equilibrium relationship between the variables. Johansen (1991) procedure is applied in this study. Engel and Granger (1987) emphasized that a linear combination of two or more than 2 non-stationary variables may be stationary. If such a stationary combination exists, then we can say that the non-stationary time series are cointegrated. The vector auto-regression (VAR) is based on cointegration test by using the methodology developed in the Johansen (1991, 1995) studies. The methodology of Johansen's takes its starting point in the VAR (p) given by:

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + u_t \quad (2)$$

Where, Y_t is an nx1 vector of variables that are integrated of order commonly denoted (1) and u is an nx1 vector of innovations. In order to determine the number of cointegrated vectors, two statistic tests were suggested by Johansen (1988, 1989) and Johansen and Juselius (1990): the trace test statistic calculated by: TRACE STATISTIC = $-N \sum_{i=r+1}^n \ln(1 - \rho_i)$ (3)

Where, $i=(r+1), (r+2), \dots, n$ and $r=0, 1, 2$), and the maximum eigenvalue test determined with the following formula:

$$\tau_{\max} = -N \ln(1 - \rho_{r+1}) \quad (4)$$

After co-integration test, we performed the Granger causality test between the variables. The Granger test is used to answer the following questions. Is it GDP that “causes” Consumer Price Index - CPI (GDP→Inflation)? Or is it the Inflation - CPI that causes GDP (Inflation→GDP)? The Granger causality test assumes that the information relevant to the prediction of the respective variables, GDP and Inflation, is contained solely in the time series data on these variables. The test involves estimating the following pair of regressions:

$$Y_t = a_0 + \sum_{i=1}^m a_i Y_{t-i} + \sum_{j=1}^m b_j X_{t-j} + u_{1t} \quad (5)$$

$$X_t = b_0 + \sum_{j=1}^m b_j X_{t-j} + \sum_{i=1}^m a_i Y_{t-i} + u_{2t} \quad (6)$$

Here it is assumed that the disturbances u_{1t} and u_{2t} are uncorrelated and Y_t is Gross Domestic product, X_t is the Gross fixed capital formation. We have to note that since we have two variables we are dealing with bilateral causality. According to Johansen and Juselius (1988), the existence of co-integration implies the existence of the causality relation between Capital formation and GDP under the constraint $|\delta_1| + |\delta_2| > 0$ (Gujarati, 1995, pp. 653-654).

3.3 Data

The original data used in this study for the period 1971-2014, are the series of annual real GDP (Gross Domestic Product) and the 2008 = 100 based annual CPI (Consumer Price Index). While real GDP represents the economic growth, CPI represents inflation. All this data was obtained from the data distribution system of the Central Bank of West African States (BCEAO) in West African CFA franc currency. In order to solve the volatility problem, the real GDP calculated in constant prices of 2008 and (2008=100 based) CPI variables have been transformed to logarithms; then they became LGDP and LCPI.

4. RESULTS AND DISCUSSION

4.1. ADF Unit root test

In the first instance, we applied the Augmented Dickey Fuller -ADF- Test (Dickey, Fuller, 1979) to check for the stationarity of the variables under investigation. To do so, we needed to determine the appropriate lags length by using Akaike criterion. The ADF test results in levels (intercept; trend and intercept) are given in Table-1.

According to Table-1, all variables are non-stationary in level at 1%, 5% and 10% levels of significance.

Table-1: ADF test results at intercept, and trend and intercept level

Variables	Appropriate Lags (AIC)	Variable state	t-ADF Statistic	McKinnon Critical			conclusion
				%1	%5	%10	
LGDP	2	Intercept	1,53	-3,60	-2,935	-2,60	Non-stationary
		Trend and Intercept	0,040	-4,20	-3,52	-3,19	
LCPI	1	Intercept	-2,53	-3,60	-2,93	-2,60	Non-stationary
	4	Trend and Intercept	-4,34	-4,21	-3,53	-3,20	

We reconducted the test by differencing all variables and the results of ADF test after first differencing are in Table-2.

Table-2: Augmented Dickey Fuller (ADF) Test Results after first Differencing

Variables	Appropriate Lags (AIC)	Variable state	t-ADF Statistic	McKinnon Critical			conclusion
				% 1	% 5	% 10	
D(LGDP)	0	Intercept	-6,05	-3,60	-2,93	-2,60	Stationary *
	1	Trend and Intercept	-6,18	-4,20	-3,52	-3,19	
D(LCPI)	0	Intercept	-4,11	-3,60	-2,93	-2,60	Stationary *
	0	Trend and Intercept	-4,49	-4,19	-3,52	-3,19	

*Stationary at 1%, 5% and 10% level of significance

According to Table-2, all variables are stationary in levels at 1%, 5% and 10% level of significance.

4.2. Co-integration results

To investigate long run and short run relationship between the variables, we applied the co-integration test. In this context, the Johansen co-integration test result is given in Table-3. Here the essence-hypothesis (H0) is, "There is no co-integration".

Table-3: Johansen co-integration test results

Unrestricted Cointegration Rank Test (Trace)

<i>Hypothesized</i>		<i>Trace</i>	<i>0.05</i>	
<i>No. of CE(s)</i>	<i>Eigenvalue</i>	<i>Statistic</i>	<i>Critical Value</i>	<i>Prob.**</i>
None	0.302220	15.17072	15.49471	0.0559
At most 1	0.001355	0.056966	3.841466	0.8113

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

<i>Hypothesized</i>		<i>Max-Eigen</i>	<i>0.05</i>	
<i>No. of CE(s)</i>	<i>Eigenvalue</i>	<i>Statistic</i>	<i>Critical Value</i>	<i>Prob.**</i>
None *	0.302220	15.11376	14.26460	0.0366
At most 1	0.001355	0.056966	3.841466	0.8113

Trace test indicates no co-integration at the 5% level

Max-eigenvalue test indicates 1 co-integrating eqn(s) at the 5% level

** denotes rejection of the hypothesis at the 5% level*

***MacKinnon-Haug-Michelis (1999) p-values*

According to Trace and Maximum Eigenvalue statistics given in Table-3, there is one co-integration vector in the long. Let us create and estimate the equation of co-integration vector that we found in the table above. The said equation is given in Table-4.

Tablo-4: Co-integration equation

Independent variable	Coefficient	Std. Error	t-statistic
LGDP	-1,9104	0,35716	-5,348853
C	0,355209		
<i>LGDP = 0,355 - 1,9104LCPI</i>			
Error Correction (∂z_{t-1})	-0,0347	0,013	-2,764

According to the co-integration equation given in Table-4, at the significance level of 1%, the inflation coefficient is statistically significant and inflation has a negative impact on economic growth in the long term. In this case, an increase of inflation by 1%, leads to a decrease of GDP by 1.91%. According to this, we can state that inflation affects economic growth in a negative way. On the other hand, the coefficient of error correction variable ∂z_{t-1} (indicating that imbalance between variables in the short-term disappear in the long term) is statistically significant at the 1% level.

4.3. Granger causality test results

After co-integration analyze we applied the Granger causality test to check the causality relationship between inflation and growth. The Granger causality test results are given in Table-5.

Table-5: Granger causality test results

Null Hypothesis:	Obs	F-Statistic	Prob.	Conclusion
LCPI does not Granger Cause LGDP	43	4.63444	0.0374	Rejected
LGDP does not Granger Cause LCPI		0.03065	0.8619	Accepted

* There is causality at 5% significance level

According to Table-5, there is unidirectional causality relationship from inflation to GDP at the 5% level of significance.

5. CONCLUSIONS AND RECOMMENDATIONS

The purpose of this study has been to investigate the relationship between inflation and economic growth in Niger from 1971 to 2014. The methodology employed in this study is the Johansen co-integration and Granger causality test after the ADF unit-root test. To examine this relationship, the consumer price index (CPI) was used as a proxy for inflation and the GDP as a perfect proxy for economic growth. In Niger, generally there is walking inflation (i.e. moderate rising inflation 3-10%). The highest inflation that Niger recorded was about 36% due to the devaluation of CFA Franc in 1994. We did not find any case study of Niger about the relationship between inflation and growth. However, several studies were performed to discover whether or not inflation harmed economic growth. Most of empirical studies argued that high inflation is harmful for an economy. On the other hand there is some work concluding that inflation accelerates growth. Others studies could not arrive at any definite conclusion relative to the effects of inflation on the economy.

Firstly, a stationarity test was carried out using the Augmented Dickey-Fuller test (ADF). The null hypothesis being that there is presence of a unit root was accepted at levels but rejected at first difference implying that the variables were found stationary at 1% and 5% levels of significance. We used the Johansen-Juselius co-integration technique in assessing the co-integrating properties of variables, especially in a multivariate context. The co-integration test result showed that one co-integration vector could be used for the 1971-2014 periods. According to the results obtained, a 1% increase in inflation in the long term, leads to a decrease of 1.91% in GDP growth. Therefore, there is a negative relationship between inflation and economic growth in Niger's long-term trends. In order to check the relationship between the two variables, the causality test was performed by employing the VAR-Granger causality test. According to the result of this causality test, a unidirectional causality from inflation to economic growth exists. This study suggested that Niger must design and implement its own monetary policy independently from BCEAO, and if necessary set up its own central bank.

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