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Inflation-Growth Nexus and Regional Integration in West Africa

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Abstract

In this paper, we test the existence of an optimal inflation interval within which, the inflation of the West African countries supports economic growth. Beside this objective, we seek to test the validity of the 5% inflation threshold not to be exceeded, proposed as a convergence criterion for the fifteen countries of the region called to form a monetary union by 2020. Our analysis covers the period 2007-2016. By adopting a nonlinear approach, our investigation reveals two (02) endogenous inflation thresholds estimated at 8.01% and 15.46%. The positive effect on growth begins when inflation is comprised between the two thresholds. Above this interval, inflation has no effect on economic growth. Our results invalidate hence the 5% inflation threshold proposed as a convergence criterion and for supporting economic growth within the future monetary union. For a high-performing monetary union, preferably it would be better to define an inflation threshold between 8.01 and 15.46% as convergence criterion.

JEL Classification: C24, E31, E61, O47

Keywords: Inflation, growth, endogenous threshold, convergence criterion, regional integration.

1. Introduction

The analysis of the effect of inflation on economic growth is not a new issue. It continues to be at the forefront of the economic debate (Fischer, 1983; Sarel, 1996; Ibarra and Trupkin, 2016; Arawatari et al. 2018). And it is obvious that prices influence economic activity. Over the years, the analysis of the effect of inflation on growth has shifted from a linear to a non-linear approach. Through the non-linear approach, the economic literature examines the optimal level of inflation that a geographical entity needs to sustain its economic growth (Ndoricimpa, 2017; Eggoh and Khan, 2014; Lopez-Villavicencio and Mignon, 2011). In addition to determining the level of inflation needed to support growth, another part of the literature focuses on determining the inflation threshold needed to bring more price and macroeconomic stability within a country or region. These studies focus on the European Monetary Union and the two monetary unions of the CFA franc zone[3] where inflation is targeted at 2% (Tenou, 2002; Nubukpo, 2007). In this study, we do not address the issue of macroeconomic stability and that of prices. We are seeking to determine the inflation threshold necessary to support economic growth in an economic region in transition to regional monetary integration. Indeed, in the process of forming an efficient and viable monetary union, the West African countries, at the fifth-second ECOWAS Conference of Heads of State, proposed an inflation threshold of 5% not to be exceeded, as a convergence criterion.

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[3] The two unions are the West African Economic and Monetary Union and the Central African Economic and Monetary Community.

According to the Conference of Heads of State, this proposed threshold should be reviewed /analyzed before its validity. Does this inflation threshold allow to support the economic growth of West African countries? This paper aims at providing an answer to this question. From the literature, it appears that to sustain economic growth, developed countries need a low level of inflation while developing countries need a high level of inflation. For developed countries, inflation must be between 1 and 5% on average (López-Villavicencio et Mignon, 2011; Eggoh et Khan, 2014). Above this 5% threshold, inflation in developing countries has a negative effect on economic growth. However, for developing and low-income countries, the inflation needed to sustain growth is between 9 and 20% (Ghosh et Phillips, 1998; Khan et Senhadji, 2001; López-Villavicencio et Mignon, 2011; Eggoh et Khan, 2014).

According to the literature, to support economic growth in the West African region which constitutes in developing countries, a high level of inflation is required. Is the 5% threshold proposed as the inflation limit sufficient to support the economic growth of West African countries and make the West African regional monetary union well performing? In this paper, we assume that there is a minimum level of inflation required to create and sustain growth. In addition, with reference to Baglan and Yoldas (2014), there is a maximum level of inflation not to be exceeded. As a result, there is an inflation interval within which inflation has a positive effect on economic growth.

To test this hypothesis, we choose the fifteen West African countries as our field of investigation and our analysis covers the period 2007-2016. We justify our field of investigation first, by the fact that these countries are seeking to form a regional monetary union in West Africa that should be effective by 2020. Then, determining this inflation threshold range allows us to test the validity of the price convergence criterion in terms of growth generation. Indeed, to our knowledge, no investigation has been undertaken on the one hand on the analysis of the validity of this proposed convergence criterion, and on the other hand on the analysis of the non-linear effects of inflation on economic growth of the West African countries. Our study fills this gap in the literature. An additional contribution of our study is to identify West African countries that benefit from their inflation to support economic growth.

The results obtained from our estimations based on Hansen's (1999) non-linear approach reveal two (02) inflation thresholds estimated at 8.01 and 15.46% and significant at 10%. The positive effect of inflation on economic growth is remarked when inflation is between 8.01 and 15.46%. Within this regime, when inflation increases by 1%, the economic growth increases by 0.26%. The countries concerned by this case are Nigeria, Ghana, Guinea and Liberia. When inflation is below 8.01%, inflation certainly has no significant effect on economic growth but is negatively correlated with it. This indicates that an inflation level below 8.01% for a West African country would not support economic growth; on the contrary, it would contribute to slowdown the economic growth. The countries concerned by this case are West African Economic and Monetary Union (WAEMU), Sierra Leone and the Gambia. For these countries, the level of inflation is not sufficient to sustain economic growth. It would be therefore necessary for these countries to be more flexible about targeting their inflation if they want to create and support more their economic growth. Finally, above the threshold of 15.46%, the inflation although slightly and positively correlated to growth, has no significant effect on the economic growth of West African countries.

From our results, it appears that the 5% inflation threshold proposed, is not a valid convergence criterion in supporting growth within the region and for the future monetary union. For a well-performing monetary union, it would be necessary to define, concerning the price level convergence criterion, an inflation threshold between 8.01% and 15.46%. From these results, we can understand why Nigeria, the economic leader of the region, does not make effort to reduce its inflation level and keeps it above 8%. The rest of the paper is structured as follows: first, Section 2 presents the literature review. Section 3 then presents the methodology and data. After, section 4 presents and discusses the results. Finally, section 5 concludes our paper.

2. Non-linear effects of inflation on growth: a review

The literature on the effects of inflation on growth is varied and controversial. One of the most discussed issues is the desired inflation regime for an economy. For a long time, what was desired by policymakers and specialists was a low inflation for more price stability in relation to a strong economic growth. Thus, while inflation is a key determinant of growth, developed countries and countries in currency unions prefer to keep it low. This is possible through the introduction of an inflation target that should not be crossed.

Inflation targets are therefore considered as economic policy instruments necessary to control the price level (Ayres et al, 2014). For a monetary union, inflation targets stabilize countries' economic activity and facilitate nominal convergence. Although inflation must be targeted for a geographical entity, the most important thing for policymakers and specialists is the level of inflation needed to support economic growth. Several studies have undertaken this investigation by using non-linear econometrics (Khan and Senhadji, 2001; Bick, 2010; Seleteng et al., 2013; Baglan and Yoldas, 2014; Eggoh and Khan, 2014). The main conclusion to be drawn from these investigations is that the inflation threshold needed to support economic growth varies according to the countries, the period of analysis and the empirical methods used.

On a set of developed and developing countries, Sarel (1996) shows that below a threshold of 8%, inflation has a positive impact on economic growth and that above the threshold, the effect becomes negative. A criticism of Sarel's (1996) conclusion is the heterogeneity of the sample. Its analysis links together developing and developed countries that do not have the same economic structures and performance, the same level of monetary and fiscal discipline. Ghosh and Phillips (1998) address this problem by separating the sample of Sarel (1996) into two groups: a group of developed countries and another group of developing countries. They show that the level of inflation needed to generate growth is between 2% and 8% for developed countries. On the other hand, for developing countries, this level is revised upwards and inflation is between 5% and 10%. Thus, above the thresholds of 8% and 10% respectively for developed and developing countries, inflation has a negative effect on economic growth. The findings of Bruno and Easterly (1998) and Faria and Carneiro (2001) reinforce the conclusions of Ghosh and Phillips (1998), arguing that developing countries need a level of inflation approaching 10% to sustain growth. Khan and Senhadji (2001) find, over the period 1960-1998, by adopting Hansen's (2000) approach, that developed countries need a level of inflation between 1 and 3% while that of developing countries is between 7 and 11%.

More recently, in the aftermath of the 2007 financial crisis, studies have sought to minimize heterogeneities by grouping countries according to very specific features (income level, level of development, economic region). In this sense, López-Villavicencio and Mignon (2011) undertook investigations on a sample of 44 countries during the period 1961-2007 using the PSTR and GMM models. They found that to support growth, inflation must not exceed 1.23% for developed countries, 14.54% for emerging countries, 10.27% for middle-income countries and 19.64% for low-income countries. Using the same estimation techniques, Eggoh and Khan (2014) for a panel of 102 countries, over the period 1960-2009, find a threshold of 3.4% for high-income countries, 10% for upper-middle-income countries, 12.9% for middle-income countries and 19.5% for low-income countries, not to be exceeded. Thanh (2015) for five (05) Southeast Asian countries (ASEAN) over the period 1980-2011, finds through the PSTR model, the existence of a threshold of 7.84% of inflation above which this latter has a negative effect on economic growth. His analysis suggests that, in order to improve their macroeconomic performance, the central banks of the five (05) Asian countries reduce inflation or set an inflation target below this threshold. Ndoricimpa (2017) using a dynamic panel threshold model confirms the existence of a non-linear relationship between inflation and growth in African countries. It finds an inflation threshold of 6.7% for all African countries, 9% for a subsample of low-income countries and 6.5% for middle-income countries. Above these thresholds, inflation has a negative effect on growth.

Overall, empirical investigations suggest that the level of inflation needed to sustain growth is between 1 and 5% for developed countries and between 9 and 20% for developing and low-income countries. In this paper, we believe that economies like those in West Africa need a minimum level of inflation to create and sustain growth. Similarly, there is a maximum inflation threshold that should not be crossed. As a result, there is an inflation interval, within which inflation has a positive effect on economic growth. Indeed, according to Baglan and Yoldas (2014), inflation stops having a statistically significant effect on economic growth only at very high levels of inflation; i. e. above the maximum threshold of this inflation interval. We test our assumption on West African countries. Indeed, these countries are seeking to form a high-performing and viable regional monetary union by 2020. For this purpose, a price convergence criterion has been proposed and it limits inflation to 5%. Determining this inflation interval makes it possible to judge the validity of the 5% threshold proposed as a convergence criterion for the future regional monetary union. In addition, we seek to identify West African countries that benefit from inflation to support their economic growth. In our knowledge, no study has yet been carried out on this issue. Our study seeks to fill this gap in the literature.

To do this, we adopt Hansen's (1999) non-linear approach in panel data. This approach makes it possible to determine the endogenous inflation threshold(s) determining the nature of the relationship between inflation and growth.

3. Methodology and data

3.1. Methodology

To analyze the nonlinear effect of fiscal balance on growth, we adopt the Hansen's (1999) nonlinear approach. The starting point of Hansen's (1999) approach is the specification of the linear model which is presented as follow:

$$y_{i,t} = \mu_i + \beta' X_{i,t} + u_{i,t} \quad (1)$$

with $y_{i,t}$ the dependent variable of countries i at period t; $\mu_{i,t}$ the country-specific fixed effects, and $X_{i,t}$ the vector of explanatory variables of countries i at period t; $u_{i,t}$ the idiosyncratic errors. From this model, a linear test is performed. If the assumption of a nonlinear relationship is validated, then a nonlinear specification model is adopted.

Based on Hansen's (1999) approach, we can relate our two variables from Equation 1 by a nonlinear model with one (01) threshold as follows:

$$y_{i,t} = \mu_i + \beta_1' X_{i,t} I(q_{i,t} \leq \gamma) + \beta_2' X_{i,t} I(q_{i,t} > \gamma) + u_{i,t}, \quad (2)$$

where $I()$ is an indicator function, $q_{i,t} \in X_{i,t}$, the threshold variable and source of the nonlinearity, γ the threshold separating the regimes; and β_1, β_2 the model parameters. This nonlinear relationship with one threshold above can be rewritten in system as follows:

$$y_{i,t} = \begin{cases} \mu_{1i} + \beta_1' X_{i,t}(q_{i,t},\gamma) + u_{1i,t}, & q_{i,t} \leq \gamma \\ \mu_{2i} + \beta_2' X_{i,t}(q_{i,t},\gamma) + u_{2i,t}, & q_{i,t} > \gamma' \end{cases}$$

or again $y_{i,t} = \mu_i + \beta' X_{i,t}(q_{i,t},\gamma) + u_{i,t}$, with $X_{i,t}(\gamma) = \begin{pmatrix} X_{i,t} I(q_{i,t} \leq \gamma) \\ X_{i,t} I(q_{i,t} > \gamma) \end{pmatrix}$ and $\beta = (\beta_1', \beta_2')$.

In Equation 2, our data are divided into two distinct regimes based on the threshold value and the threshold variable. Each regime is characterized by a linear relationship. In the first regime, $q_{it} \leq \gamma$ and the relation between our two variables is linked by the parameter β_1. In the second regime,$q_{it} > \gamma$ and the relation is linked by the parameter β_2.

In our Equation 2, by subtracting from the vector $X_{i,t}$ our transition variable which is also the variable source of the nonlinearity, we obtain the following specification:

$$y_{i,t} = \mu_i + \beta' X_{i,t} + \alpha_1 q_{i,t} I(q_{i,t} \leq \gamma) + \alpha_2 q_{i,t} I(q_{it} > \gamma) + u_{it}, \quad (3)$$

where $q_{i,t}$ is the transition variable and variable source of the non-linearity; γ is the threshold, $X_{i,t}$ the explanatory variables without transition and threshold variables. μ_i,β, α_1, α_2 and γ are the parameters to estimate.

Estimation procedure

Let's go back to Equation 2:

$$y_{i,t} = \mu_i + X_{i,t} I(q_{i,t} \leq \gamma)\beta_1 + X_{i,t} I(q_{i,t} > \gamma)\beta_2 + u_{i,t}.$$

In the reduced form, we can write this equation as follows:

$$y_{i,t} = \mu_i + \beta' X_{i,t}(q_{i,t},\gamma) + u_{i,t} \text{ , where } X_{i,t}(\gamma) = \begin{pmatrix} X_{i,t} I(q_{i,t} \leq \gamma) \\ X_{i,t} I(q_{i,t} > \gamma) \end{pmatrix} \text{ and } \beta = (\beta_1', \beta_2').$$

We use this two-regimes model in the above form to show the estimation procedure of regression coefficients $\beta = (\beta_1', \beta_2')$ and the threshold value γ. Given γ, the estimator of the least ordinary squares of β is obtained as follows:

$$\hat{\beta} = \{X^*(\gamma)' X^*(\gamma)\}^{-1} \{X^*(\gamma)' y^*\}.$$

To estimate γ, we can search on a subset of the threshold variable q_{it}. Instead of searching on the whole sample, we limit the range in the interval $(\underline{\gamma}, \bar{\gamma})$, which are quantiles of q_{it}. The estimator of γ is the value that minimizes the sum of residual squares S_1, i.e.:

$$\hat{\gamma} = arg\min_{\gamma} S_1(\gamma).$$

$\hat{\gamma}$ being obtained, we can estimate the real/precise values of the regression coefficients of the model using the least squares method computed under $\hat{\gamma}$.

Inference

Before adopting the non-linear approach presented above and interpreting the coefficient values, it is necessary to perform a linearity test to be certain of the existence of a non-linear structure/relationship first, then to determine the number of regimes, to obtain confidence intervals on the thresholds and finally to test the significance of the thresholds.

Linearity test

The linearity test tests the absence of a nonlinear relationship between two variables, compared to the alternative hypothesis of the existence of a nonlinear relationship. The aim is to check whether a nonlinear effect exists and whether this latter is significant in a model with $r \geq 2$ regimes. Starting from the following model:

$$y_{i,t} = \mu_i + X_{i,t} I(q_{i,t} \leq \gamma)\beta_1 + X_{i,t} I(q_{it} > \gamma)\beta_2 + u_{i,t},$$

we test

$$\begin{cases} H_0 : \beta_1 = \beta_2 \\ H_1 : \beta_1 \neq \beta_2 \end{cases} \Leftrightarrow \begin{matrix} y_{i,t} = \mu_i + \beta' X_{i,t} + u_{it} \\ y_{i,t} = \mu_i + X_{i,t} I(q_{i,t} \leq \gamma)\beta_1 + X_{i,t} I(q_{it} > \gamma)\beta_2 + u_{i,t} \end{matrix}.$$

The validation of the null hypothesis means that Equation 1 is that of a linear model. However, the validation of the alternative hypothesis means that Equation 1 is a nonlinear model.

The statistic of this linear test corresponds to a Fisher test. The threshold not being defined under the null hypothesis (linear relation), it will be considered as being equal to its estimated value. Thus, we have:

$$F = \frac{S_0 - S_1(\hat{\gamma})}{\hat{\sigma}^2},$$

S_0 being the sum of residual squares of the linear model under the null hypothesis H_0, $S_1(\hat{\gamma})$ the sum of the residuals squares of the nonlinear model and $\hat{\sigma}^2 = \frac{1}{n(T-1)} S_1(\hat{\gamma})$. The Boostrap method on the critical values of F statistic is used to test the significance of the threshold effect.

Number of regimes r

We have presented above, a model testing the presence of one threshold and therefore a two-regimes model. Now, let'sconsider a model with$r$ regimes, $r > 2$:

$$y_{i,t} = \mu_i + X_{i,t} I(q_{i,t} \leq \gamma_1)\beta_1 + X_{i,t} I(\gamma_1 < q_{i,t} \leq \gamma_2)\beta_2 + X_{i,t} I(\gamma_1 < q_{i,t} \leq \gamma_2)\beta_3 + \cdots + X_{i,t} I(q_{i,t} > \gamma_{r-1})\beta_r + u_{i,t}.$$

At this step, we test the number of regimes allowing to describe the dynamics of a given relationship. We will therefore first test the presence of two (02) regimes against the presences of three (03) regimes. The hypothesis are the following:

$$\begin{cases} H_0 : \beta_3 = 0 \\ H_1 : \beta_3 \neq 0 \end{cases}.$$

Thus, the corresponding Fisher statistic is given as follow:

$$F' = \frac{S_1(\widehat{\gamma_1}) - S_2(\widehat{\gamma_1}, \widehat{\gamma_2})}{\hat{\sigma}^2},$$

with S_2 the sum of residual squares for a three-regimes model. The null hypothesis H_0 is rejected if the value of F' is higher that simulated critical values.

To find therefore the optimal number of thresholds, we proceed sequentially. We first test the presence of three (03) thresholds. Second, if we do not distinguish regimes, then we test the presence of two (02) thresholds. If, similarly, we do not distinguish regimes, we test the presence of one threshold. Otherwise, the presence of regimes leads us to estimate a two-threshold nonlinear model.

3.2. Data

3.2.1. Choice of variables

To achieve our objectives, we consider a panel of fifteen (15) West African countries and the analysis covers the period 2007-2016.We choose this period for a better understanding of the nature of the relation between inflation and growth since the 2007 financial crisis. Indeed, the 2007 financial crisis has created a break/disruptionin the behaviour of macroeconomic variables. Our endogenous variable is the real GDP growth rate (ΔY_{it}) of the fifteen (15) West African countries. It is computed as the percentage change in the real gross domestic product.

Interest variable: inflation

The inflation rate in this paper is computed as the percentage change in the consumer price index of the fifteen (15) West African countries. On average, inflation is estimated at 5.27% for the West African countries over the period 2007-2016.

Others variables

Both theoretically and empirically, it has been shown that economic growth is determined by economic, social and institutional factors. In this paper, the factors retained are(1) the public investment, (2) the human capital, (3) the trade openness, (4) an institutional variable and (5) an external macroeconomic shocks to ECOWAS countries. According to Keynesian theory, public investment has a positive effect on economic growth. In this paper, it is approximated by the gross fixed capital formation ($GFCF$). This variable is expressed as a percentage of GDP. When public investment is coupled by human capital, there is a more pronounced positive effect on economic growth (Zahonogo, 2016; Ogundari and Awokuse, 2018). Human capital is a very important channel, used to support domestic demand. The effect of human capital can be captured by using two variables: the secondary or tertiary enrolment rate, and the population growth rate. In our paper, we approximate human capital by the population growth rate (POP) as in Zahonogo (2016) because of the lack of data on education in West African countries.

Besides, human and physical capital, trade openness ($Open$) is an necessary economic policy to increase a country's productivity and economic growth through learning (Lucas, 1988). According to Frankel and Romer (1999), countries that are more open to the rest of the world have a greater ability to growth faster, through the technology transfer available in the rest of the world. Thus, any outward-oriented economies will have a high level of growth compared to closed economies (Capolupo and Celi, 2008). Trade openness in this paper is approximated to total trade in goods as a percentage of gross domestic product, as in Kebalo (2017).

Concerning the institutional quality, it allows capturing the effect of good governance on economic growth. With reference to Acemoglu and Robinson (2012), and Zahonogo (2016), an environment of a good governance has a positive effect on economic growth. In this paper, we seek to capture the effect of political stability ($STAB$) on economic growth in West African countries. To quantify the political stability, we use the Political Stability and Absence of Violence/Terrorism Index, which measures perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism. This index is obtained from the Worldwide Governance Indicators proposed by Kaufmann et al (2010). The choice of this index is motivated by the fact that the last decade has been marked by political instability in West Africa with the political crisis in Côte d'Ivoire in 2010-2011, that of Togo in 2010 and 2015 (elections) and since 2014 with an increase in terrorism in West Africa at the level of G5 Sahel (Mali, Mauritania, Burkina Faso, Niger and Chad) and Nigeria with the Boko Haram[4] group.

[4] Boko Haram is a Sunni terrorist group operating in Nigeria, Niger, Chad and Cameroon. It is an insurrectional and terrorist movement of Jihadist Salafist ideology, originating from northeastern Nigeria with the objective of establishing a caliphate and

Finally, the economic activity of developing countries and sub-Saharan Africa depends on global demand for goods and services from emerging and developed countries. Thus, global demand shocks have an impact on SSA economic activity (Hugon, 2009; Gurara and Ncube, 2013). Thus, the Great Recession caused by the 2007 financial crisis is a phenomenon that has influenced economic activity in many countries. Fosu (2013), for instance, found that the 2008 crisis reduced economic growth in sub-Saharan African countries by 60%. In this paper, we seek to capture the effect of this recession on the economic growth of West African countries by defining a dummy variable (D_{Rec}) taking the value 1 for the years 2008 and 2009 and, 0 otherwise. Definitions and data sources are presented in Table 4 in the appendix.

3.2.2. Data properties

Before proceeding to the estimation stage, we perform unit root tests by Levin et al (2002), Im et al (2003) and Maddala and Wu (1999) on the variables retained in this study. The results of the unit root tests summarized in Table 5 (see appendix) indicate that our selected variables are stationary. Thus, we can proceed to the specification and estimation of our model.

4. Estimation, findings, and discussions

The linearity test performed indicates for our model, the existence of a non-linear structure and two significant thresholds at 10% (see Table 8 in appendix). In addition, the Fisher specification test (Hsiao, 1986) presented in Table 7 in the appendices indicates that a panel data model is appropriate for analyzing the macroeconomic behaviour of West African countries. Based on the two thresholds identified, we express our model as follows:

$$\Delta Y_{it} = \mu_i + \pi_{it} I(\pi_{it} \leq \gamma_1)\alpha_1 + \pi_{it} I(\gamma_1 < \pi_{it} \leq \gamma_2)\alpha_2 + \pi_{it} I(\gamma_1 < \pi_{it} \leq \gamma_2)\alpha_3 + \beta' X_{i,t} + u_{it},$$

with $\Delta Y_{i,t}$ the real GDP growth, π_{it} the inflation rate, X_{it} our vector of explanatory variables; γ_1 and γ_2 the thresholds; $I()$ the indicator function; α_1, α_2, α_3, β the parameters to estimates and μ_i the country-specific fixed effects.

The results of our estimations are summarized in Table 1.

Effects of control variables

Our estimates first reveal that public investment and the demographics of West African countries are key determinants of growth in the region. Demography can contribute significantly to economic growth through the channel of domestic demand for both goods and services.

Secondly, even if it is not significant, trade openness within the region is positively correlated with growth. Thus, we can conclude that the economic openness of West African countries is not sufficient to support economic growth or the quality of exchanges (trade) does not significantly influence economic growth. Then, it appears from our results that a significant improvement of political stability within West African countries is needed to support economic growth. West African decision-makers must perform reforms to improve the institutional environment of countries.

Nonlinear effects of inflation on growth

Our results reveal two inflation thresholds estimated at $\gamma_1 = 8.01\%$ and $\gamma_2 = 15.46\%$. The two thresholds are significant at 10%. Inflation has a positive and significant effect on West African countries' economic growth when inflation is between 8.01 and 15.46%. Thus, when inflation increases by 1%, the economic growth increases by 0.26%. An important point to note from our results is that when the inflation rate is below 8.01%, it certainly does not have a significant effect on economic growth but is negatively correlated with the economic growth of West African countries. This reveals that a level of inflation below 8.01% in a West African country would not support growth but could deteriorate it. This level of inflation, for example, would not be sufficient for financing the economic activity of West African countries. This result is interesting and leads us to identify a problem of under-funding of some West African economies.

enforcing Sharia law. The group distinguished itself by kidnapping nearly 276 high school girls on April 14, 2014 in Chibok, Borno State, Nigeria.

This problem is raised by Nubukpo (2007) who, theoretically, argues that the economies of the West African Economic and Monetary Union (WAEMU), because of the 2% inflation targeting, are under-funded. In addition, Nubukpo (2007) argues that the level of inflation in these countries is not sufficient to generate economic growth and also to reduce the debt burden. It would therefore be necessary for West African countries with an inflation level below 8.01% to be a little more flexible in controlling inflation, if they want to support their economic growth more. Finally, above the 15.46% threshold, the inflation rate, although slightly correlated with growth, has no significant effect on economic growth. This result therefore confirms that the 15.46% threshold is the level of inflation not to be exceeded within the West African's region.

Table 1: Results

	Coef.
$Intercept$	-8.1940*
	(-1.72)
$GFCF_i$	0.1658**
	(2.05)
$Open_i$	0.0065
	(0.32)
$STAB_i$	0.6630
	(0.66)
POP_i	3.2835*
	(1.94)
D_{reces_i}	-0.3663
	(-0.43)
$Threshold$s	$\gamma_1 = 8.01$
	$\gamma_2 = 15.46$
$\pi_i \leq \lvert\gamma_1\rvert$	-0.0763
	(-0.86)
$\lvert\gamma_1\rvert < \pi_i \leq \lvert\gamma_2\rvert$	0.2575**
	(2.25)
$\pi_i > \lvert\gamma_2\rvert$	0.00024
	(0.001)
$CI(\gamma_1)$	[7.947; 8.057]
$CI(\gamma_2)$	[15.23; 15.49]
$F - stat$	2.70***
$Prob > F$	0.0090
Nb. of countries	15
Observations	150

Note: the values in the parentheses (.) represent t-statistics. ***, **, and * indicates the rejection of the hypothesis of non-significance of the coefficients at 1%, 5%, and 10%. CI for the confidence interval.
Source: Authors.

What are the West African countries that benefit from inflation to support economic growth?

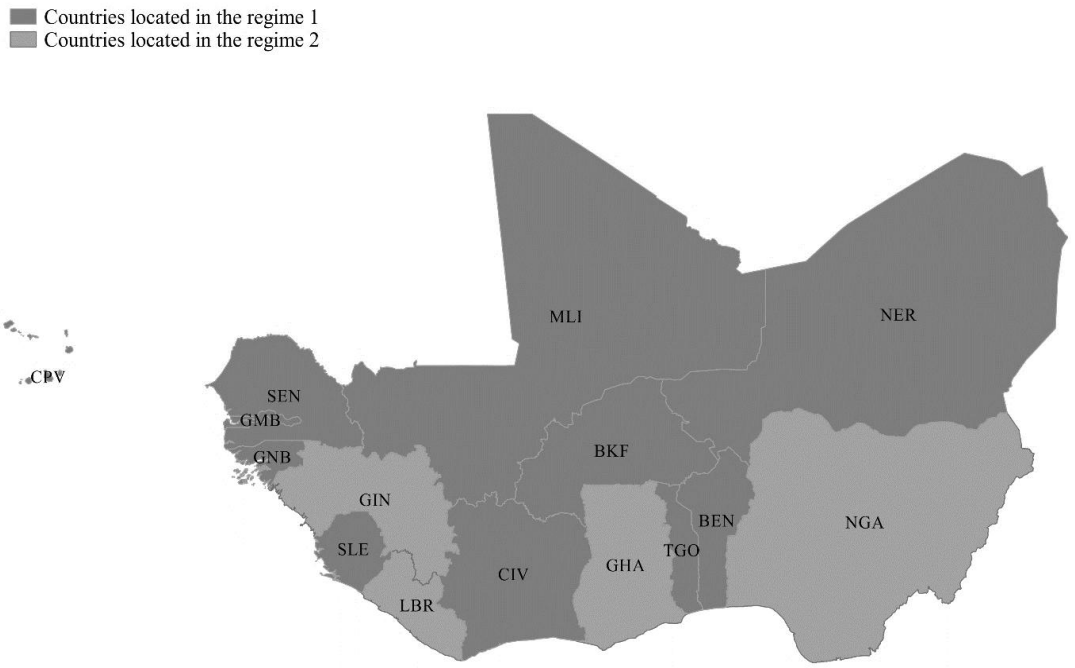
To determine the West African countries that benefit from the positive effect of inflation on economic growth, we calculate the average of each country's inflation rate over the period 2014-2016. The choice of this time interval is justified by the fact that it represents a period of return to stability and far from the 2008-2009 recession and the 2007 financial crisis. Table 2 presents the classification of ECOWAS countries according to the three regimes determined, while Figure 1 illustrates it. From Table 2, it appears that the West African countries that do not benefit from their inflation to support economic growth are the WAEMU countries, the Gambia and Sierra Leone. However, the countries that benefit from their inflation in supporting growth are Ghana, Nigeria, Guinea and Liberia.

Table 2: Classification of ECOWAS countries in function of the three determined regimes

Regime 1 $\bar{\pi} \leq 8.01$	Regime 2 $8.01 < \bar{\pi} \leq 15.46$	Regime 3 $\bar{\pi} > 15.46$
Benin (-0,57), Burkina-Faso (0,15), Cote d'Ivoire (0,80), Bissau Guinea (0,52), Mali (0,17), Niger (0.08), Senegal (-0,04), Togo (0,94), Cap-Vert (-0,51), Sierra Leone (7,12), the Gambia (6,45)	Ghana (15,44), Guinea (8,31), Liberia (8,44), Nigeria (10,32)	No country

Note: in (.), the average of the inflation rate.
Source: Authors.

Figure 1: ECOWAS map illustrating countries according to their inflation-growth relationship and the identified regimes



Source: Authors.

West Africa and the regional monetary union

Undoubtedly, West African countries are joining efforts to establish a single currency and form a monetary union. In this sense, the 5% threshold limiting inflation has been proposed as a convergence criterion. This criterion has not yet been validated. Regarding our study, it appears that this convergence criterion proposed for the future regional monetary union does not allow to support economic growth. On this point, this threshold is not valid. If the goal is to form a well-performing monetary union (more growth), countries should be encouraged, once within the union, to be more flexible concerning inflation. And the level of inflation need for supporting growth, is between 8.01% and 15.46%.

5. Conclusion

We test in this paper the existence of an inflation interval within which inflation supports economic growth. Our investigation field is the fifteen West African countries reunited in the ECOWAS and our analysis covers the period 2007-2016. The determination of such interval could allow decision-makers to define a convergence criterion on the price that allows supporting growth and building a well-performing monetary union by 2020. Indirectly, we seek to test the validity of the 5% inflation threshold proposed as a convergence criterion for the next regional monetary union in West Africa. By adopting the Hansen's (1999) nonlinear approach, the results obtained from our estimation reveal two thresholds of inflation estimated at 8.01% and 15.46%, all significant at 10%.

Inflation has a positive effect on growth when the inflation rate is between 8.01% and 15.46%. Within this regime, when inflation increases by1%, then the economic growth increases by 0.26%. Countries concerned by this case are Nigeria, Ghana, Guinea and Liberia. When inflation is below 8.01%, this latter has no significant effect on economic growth, however, it is negatively correlated to economic growth. This reveals that an inflation level below to 8.01% within a country could not allow supporting growth but in contrast could allow to deteriorate it. Countries, in that case, are WAEMU countries, the Gambia and Sierra Leone. For those countries, inflation is not sufficient to support economic growth. It would be consequently needed, for these countries to become more flexible in the targeting of inflation, whether they want more to create and support economic growth. Above 15.46%, the inflation rate, however, is less positively correlated to growth but has no significant effect.

This result shows that 15.46% is the threshold of inflation rate not to be crossed by countries for supporting growth. With regards to the 5% inflation threshold proposed by decision-makers for the next regional monetary union, it results from our analysis that, it does not allow to support growth. For a well-performing monetary union, this proposed convergence criterion is not valid. For a well-performing monetary union in West Africa, an inflation level between 8.01% and 15.46% is required/needed.

References

Acemoglu, D. and Robinson, J. (2012). *Why Nations Fail: The Origins of Power, Prosperity, and Poverty*. Crown Publishers, Crown Publishing Group, a Division of Random House, pp. 1–571.

Amadou, A. and Kebalo, L. (2018). Fiscal discipline, Economic growth, and Regional integration in West Africa.

Arawatari, R., Hori, T. and Mino, K. (2018). On the nonlinear relationship between inflation and growth: A theoretical exposition. *Journal of Monetary Economics*, 94:79–93.

Ayres, K., Belasen, A. R. et Kutan, A. M. (2014). Does inflation targeting lower inflation and spur growth? *Journal of Policy Modeling*, 36:373–388.

Baglan, D. and Yoldas, E. (2014). Non-linearity in the inflation-growth relationship in developing economies: Evidence from a semiparametric panel model. *Economics Letters*, 125:93-96.

Balcilar, M., Gupta, R. and Jooste, C. (2017). The growth-inflation nexus for the US from 1801 to 2013: A semiparametric approach. *Journal of Applied Economics*, 20(1).

Bick, A. (2010). Threshold effects of inflation on economic growth in developing countries. *Economics Letters*, 108:126-129.

Bruno, M. and Easterly, W. (1998). Inflation crises and long-run growth. *Journal of MonetaryEconomics*, pages 3–26.

Eggoh, J. C. and Khan, M. (2014). On the non-linear relationship between inflation and economic growth. *Research in Economics*, 68:133–143.

Faria, J. R. and Carneiro, G. (2001). Does high inflation affect growth in the long and short run? *Journal of Applied Economics*, (1):89–105.

Fischer, S. (1983). *Inflation and growth*. National Bureau of Economic Research Cambridge, Mass., USA.

Fosu, A. K. (2013). Impact of the global financial and economic crisis on development: Whither Africa? *Journal of international development*, 25(8):1085–1104.

Frankel, J. and Romer, D. (1999). Does trade cause growth? *American Economic Review*, 89:379–99.

Ghosh, A. and Phillips, S. (1998). Inflation may be harmful to your growth. *IMF Staff Papers*, (December):672–710.

Gurara, D. Z. and Ncube, M. (2013). Global economic spillovers to Africa: A GVAR approach. *AfDB WP No. 183*.

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of Econometrics*, 93(2):345–368.

Hsiao, C. (1986). *Analysis of Panel Data, Econometric Society Monograph No. 11*. Cambridge UniversityPress.

Hugon, P. (2009). La crise mondiale et l'Afrique: transmission, impacts et enjeux. *Afrique contemporaine*, 4(232):151-170.

Hye, Q. M. A. and Lau, W.-Y. (2015). Trade openness and economic growth: empirical evidence from India. *Journal of Business Economics and Management*, 16(1):188–205.

Ibarra, R. and Trupkin, D. R. (2016). Reexamining the relationship between inflation and growth: Do institutions matter in developing countries? *Economic Modelling*, 52:332–351.

Im, K. S., Pesaran, M. H. and Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115:53–74.

Kaufmann, D., Kraay, A. andMastruzzi, M. (2010). *The Worldwide Governance Indicators: A Summary of Methodology, Data and Analytical Issues*.

Kebalo, L. (2017). *Extraversion et activité économique des pays de l'Afrique de l'ouest*. Editions Universitaires Européennes.

Khan, M. and Senhadji, A. (2001). Threshold effects in the relationship between inflation and growth. *IMF Staff Papers*, 48:1–21.

Levin, A., Lin, C. and Chu, C. (2002). Unit root test in panel data: Asymptotic and finite sample properties. *Journal of Econometrics*, 108(1):1–24.

Lopez-Villavicencio, A. and V. Mignon, V. (2011). On the impact of inflation on output growth: Does the level of inflation matter? *Journal of Macroeconomics*, 33:455–464.

Lucas, R. E. J. (1988). On the mechanics of economic development. *Journal of MonetaryEconomics*, 22(1):3–42.

Maddala, G. and Wu, S. (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxf. Bull. Econ. Stat.*, 61:631–652.

Ndoricimpa, A. (2017). Threshold effects of inflation on economic growth in Africa: Evidence from a dynamic panel threshold regression approach. Rapport technique, AfricanDevelopment Bank Working Paper.

Nubukpo, K. (2007). Politique monétaire et servitude volontaire. La gestion du franc CFA par la Bceao. *Politique africaine*, 1(105) :70–84.

Ogundari, K. and Awokuse, T. (2018). Human capital contribution to economic growth in Sub-Saharan Africa: Does health status matter more than education? *Economic Analysis andPolicy*, 58:131–140.

Sarel, M. (1996). Nonlinear effects of inflation on economic growth. *IMF Staff Papers*, pages 199–215.

Seleteng, M., Bittencourt, M. and van Eyden, R. (2013). Non-linearities in inflation-growth nexus in the SADC region: A panel smooth transition regression approach. *Economic Modelling*, 30:149–156.

Smyth, D. J. (1994). Inflation and growth. *Journal of Macroeconomics*, 16(2):261–270.

Thanh, S. D. (2015). Threshold effects of inflation on growth in the ASEAN-5 countries: A panel smooth transition regression approach. *Journal of Economics, Finance and AdministrativeScience*, 20:41–48.

Zahonogo, P. (2016). Trade and economic growth in developing countries: Evidence from sub-Saharan Africa. *Journal of African Trade*, 3: 41–56.

Appendix

Table 3: List of countries in the sample and corresponding acronyms

List 1	Acronym	List 2	Acronym
Benin	BEN	Liberia	LBR
Burkina Faso	BKF	Mali	MLI
Cap-Vert	CPV	Niger	NER
Côte d'Ivoire	CIV	Nigeria	NGA
The Gambia	GMB	Senegal	SEN
Ghana	GHA	Sierra Leone	SLN
Guinea	GIN	Togo	TGO
Guinea-Bissau	GNB		

Source: Authors

Table 4: Data definition and sources

Variables	Label	Sources
ΔY_i	Real GDP growth (%)	IMF
π_i	Inflation rate (consumer price index)	IMF
$GFCF_i$	Gross fixed capital formation (% of GDP)	WDI
$Openness_i$	Trade (% of GDP)	WDI
$STAB_i$	Political stability and absence of violence/terrorism	WGI
POP_i	Population growth rate (%)	WDI
D_{Reces}	Great Recession, 1 for 2008-2009, 0 otherwise.	

Note: IMF: International Monetary Fund (2017); WGI: Worldwide Governance Indicators, (2017); WDI: World Development Indicators (2017).
Source: Authors.

Table 5: Unit root tests

Variables	LLC	IPS	MW
ΔY_i	7.7374	-4.8926	80.0315
	(0.0000)	*(0.0000)*	*(0.0000)*
π_i	-7.8568	-4.4892	70.3541
	(0.0000)	*(0.0000)*	*(0.0000)*
$GFCF_i$	-3.0981	-5,0012	45.6218
	(0.0010)	*(0.0000)*	*(0.0643)*
$Open_i$	-3.2805	-1.2309	40.3550
	(0.0005)	*(0.1092)*	*(0.0982)*
$STAB_i$	-6.3429	-2.1607	50.0135
	(0.0000)	*(0.0154)*	*(0.0124)*
POP_i	-7.6259	-3.8765	86.7689
	(0.0000)	*(0.0001)*	*(0.0000)*

Note : LLC= Levin et al. (2002), IPS= Im et al. (2003), and MW= Maddala and Wu (1999). In (.)the probabilities associated with the statistics. ***, **, and * indicates the rejection of the hypothesis of the presence of a unit root at the 1%, 5%, 10%.
Source: Authors.

Table 6: Correlation coefficients

	ΔY_i	π_i	$GFCF_i$	$Open_i$	$STAB_i$	POP_i
ΔY_i	1.0000					
π_i	0.0481	1.0000				
$GFCF_i$	0.1176	-0.1231	1.0000			
$Open_i$	0.1039	0.1497	0.1490	1.0000		
$STAB_i$	0.0331	-0.2069	0.4698	0.1306	1.0000	
POP_i	0.1451	-0.0900	-0.0065	-0.0861	-0.2694	1.0000

Source: Authors.

Table 7: Descriptive statistics

Variables	Mean	Std. Dev	Min	Max
ΔY_i	4.5537	4.0069	-20.4908	20.716
π_i	5.2738	6.4074	-35.8367	22.844
$GFCF_i$	21.573	8.8521	5.2256	46.732
$Open_i$	74.585	30.886	17.7616	311.355
$STAB_i$	-0.5397	0.7738	-2.4002	0.8822
POP_i	2.6788	0.6010	1.0600	4.1829
D_{reces}	0.2000	0.4013	0.0000	1.0000

Source: Authors.

Table 8: Panel specification Fisher-test

Tests	Statistics	P-value
1	F1(98, 45) = 0.36232 SCR1 = 1268.5205	0.99998
2	F2(84, 45) = 0.31635 SCR1C = 2269.4511	0.999997
3	F3(14, 129) = 1.15014 SCR1CP = 2017.6105	0.321665

Source: Authors.

Table 9: Non-linear test

Threshold value	Confidence interval
$\gamma_1^* = 8.0144$	[7,9473; 8,0574]
$\gamma_2^* = 15.4620$	[15,2246; 15,4932]

Source: Authors.