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Growth Effect of Inflation in Central African Countries: Does Security Situation Matter?

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Abstract
Despite the growing literature on the determinants of inflation on the one hand and the effect of inflation on economic growth on the other hand, little is known about the role of insecurity in these analyses, particularly in the Central African countries. This paper aims to contribute to the understanding of other neglected aspects of inflation by analyzing both its origins and its effects on the economy through the role of the security situation. The use of the system GMM on a panel of Central African countries during the period 2011–2017 reveals that, apart from traditional sources (money supply, economic growth, and oil rent), insecurity is also one of the origins of inflation. Moreover, inflation promotes economic growth while insecurity hinders it. Finally, the results also show that the coexistence of inflation and insecurity significantly constrains the production capacity of the economies of the subregion. Thus, the resolution of the various present conflicts (internal and border) and the anticipation of possible future ones will make it probably to control the level of inflation as well as to eliminate this constraint which limits the production capacity of the economies of Central Africa.

Keywords Inflation · Insecurity · Production capacity

JEL Classification D74 · E31 · F43

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Introduction

A work on the effects of inflation on economic growth might at first seem uninteresting and less relevant. In fact, many studies have already clarified this relationship (Arawatari et al., 2018; Fischer, 1983; Ibarra & Trupkin, 2016; Sarel, 1996). Accordingly, the general price level affects economic activity. Furthermore, recent work concerning the relationship between inflation and economic growth has focused on showing its nonlinearity. In this way, the effects of the inflation on economic activity are not linear and will even depend on the inflation rate. Therefore, it is up to monetary authorities to decide the optimal inflation rate compatible with the stimulation of economic growth. In the analysis of the relationship between inflation and economic growth, many recent works search for this threshold at both the national and regional context (Nubukpo, 2007; López-Villavicencio and Mignon, 2011; Eggoh & Khan, 2014; Ndoricimpa, 2017; Makiliwè & Leleng, 2018).

In the Central Africa region, the general price level has long been relatively stable. Until the end of the 2000s, the salient characteristic of the CEMAC countries, which include the majority of this economic grouping, was therefore enjoyed a certain degree of inflation control due to their membership in the franc zone. However, this controlled inflation has been severely tested since the end of the decade 2000. Indeed, the rise of terrorism and political instability in Central African countries since the beginning of the decade has been accompanied by an increase in the price of products traded within the zone. In fact, intra-regional trade, which is mostly conducted overland, has been disrupted by insecurity at the various borders, leading to a surge in the price of these products.

The correlation between civil unrest and rising food price seems to be an obvious fact. African countries, in the first decade of this millennium, have experienced recurring food crises due to food prices, the two most striking episodes being those of 2008 and 2010. In the first episode between January 2008 and December 2008, prices of food increased by 51%. This caused many political upheavals such as the 2009 overthrow of President Marc Ravalomanana of Madagascar. Also, on February 2008, Cameroonians took to the streets for a week to protest against the increase in the price of fuel and the cost of living. The second episode was characterized by increasing prices of food by 40% in January 2010 and in February 2011 and had led into famine into certain regions of Africa. The Arab spring episode that had shaken the regimes of Ben Ali in Tunisia and Mubarack in Egypt had, in part, been linked to spikes in the food prices (Ciezadlo, 2012). On April 11, 2019, another consequence of inflation has been the fall of the former South Sudanese President Omar El Bashir. Everything started with an increase in the price of bread and the formation of the protest movements that followed prompted the president to resign. All of the foregoing supports that inflation is one of the key determinants of insecurity. However, beyond its impact on political instability, inflation can worsen the security situation by encouraging terrorism. The increasing prices raise the risk of terrorism attacks in a country (Shahbaz, 2013).

In this study, we want to determine the influence of the security situation on the relationship between inflation and economic growth in Central African

countries. It appears that lower and more stable inflation has frequently been associated with better growth outcomes because of its role in reducing the uncertainty and the financial stabilization. However, in the countries of Central Africa, the resurgence of political instability and insecurity has reduced the transparency of relative price changes and has stimulated inflation in these countries. In addition, severe inflation will contribute to significantly more stunted growth (Kremer et al., 2013).

Insecurity is the state of being subject to danger or injury. The anxiety that is experienced when one feels vulnerable and unsecured. Ezemonye (2011) affirms the above definition of insecurity as "a state of being not secured, lack of confidence." The state of insecurity in one country is caused by the activities of different groups taking on alarming dimensions. Such activities include militancy, kidnapping, violent armed robbery, political assassination, ritual killings, and suicide bombings (Udeh & Okoroafor, 2013).

Regarding the security situation in Central Africa, apart from Gabon, Equatorial Guinea, and Sao Tome, the other countries of the sub-region have been plagued by multiple security crises in recent years. These are Cameroon (BOKO HARAM and the Anglophone crisis), Chad (BOKO HARAM), the Central African Republic (CPJP, SELEKA and LRA), the Democratic Republic of Congo (FDLR, CNDP, ADF-NALU, and M23), and Congo Republic (CNR). This situation is confirmed by the ranks that these countries occupy in the ranking effected by Global Peace Index (2019). According to this organization, some of these countries are qualified as being very unstable (Democratic Republic of Congo and Central African Republic) and others as unstable (Cameroon, Chad and Congo) since 2011. In this context of widespread insecurity, a re-examination of the inflation-economic growth relationship seems to be of particular interest. This interest is aroused by the fact that the literature claims that developing countries need a higher inflation rate than developed ones to sustain economic growth. Indeed, developing countries need an inflation rate between 9 and 20% to sustain economic growth (Ghosh & Phillips, 1988; Khan & Senhadji, 2001; Lopez-Villavicencio and Mignon, 2011; Eggoh & Khan, 2014). A low inflation rate relatively produces a negative effect on economic growth. The deterioration of the security situation by stimulating the previously stable price level in the countries in our study could therefore alter its relationship with economic growth.

Many studies have proved that inflation is linked with security situation. These studies find that inflation and security have a bilateral relationship. For instance, inflation can cause important political instability (Deaton & Miller, 1995). Inflation can also contribute to insecurity by predicting and precipitating civil wars (Besley & Persson, 2008) or by reducing the level of political democracy of a country.

Against this background, this paper carries out an empirical explanation of the following main question: does the upsurge of the insecurity affect the relationship between inflation and economic growth in the Central African countries? The main objective of this study is to investigate the impact of insecurity on the growth-inflation nexus. The study contributes to existing growth-inflation literature by incorporating the variable insecurity in the analysis of the relationship between inflation and economic growth.

Three main results emerge from this work. The first reveals that insecurity is an important source of inflation in Central Africa because a 1% increase in insecurity leads to an increase in inflation of 33.21%. The second shows that inflation has a positive impact on economic growth while insecurity is an obstacle to this growth. Finally, the interaction between inflation and insecurity significantly limits the production capacity of Central African countries.

The paragraphs below are intended to describe the evolution of the main variables of this study in the panel of Central African countries during the period 2011–2017. The average evolution of inflation, growth, and the level of insecurity in each country in the panel is shown in Fig. 1.

The analysis of Fig. 1 reveals three important information: the first shows that the Central African Republic (CAR) and Equatorial Guinea recorded negative average growth rates while the other countries of the sub-region achieved positive average growth with higher value observed in the Democratic Republic of Congo (6.79). The second information is related to the level of inflation. Only Cameroon recorded an average annual inflation rate below 3% while the other countries exceeded this community threshold with a higher value observed in the Central African Republic (23.17) during the study period. The latest information is related to the level of insecurity in the countries of the sub-region. The average level of insecurity is 5.8 in Sao Tome, 8.42 in Equatorial Guinea, 9.6 in Gabon, 17.74 in Congo, 29.84 in Cameroon, 39.36 in Chad, 57.18 in DRC (57.18), and 71.88 in CAR.

The average evolution of these variables in the Central Africa panel is presented in Fig. 2. It emerges from this graph that the average level of insecurity in Central Africa increased by 64.31% during the period 2011–2017, because among the 8 countries of this sub-region, only Gabon, Equatorial Guinea, and Sao Tome are classified as stable countries and the rest have been classified and are currently classified by the Global Peace Index (2019) as being unstable countries since 2011. During the same period, the inflation rate increased by

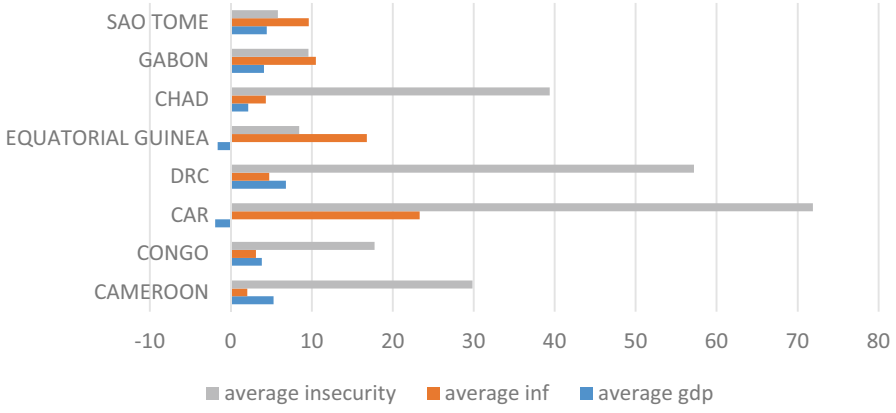

Fig. 1 Representation of the average rate inflation, growth, and average insecurity rates in each Central African country during the 2011–2017 period. Source: Authors based on data from African Development Bank Group, 2019

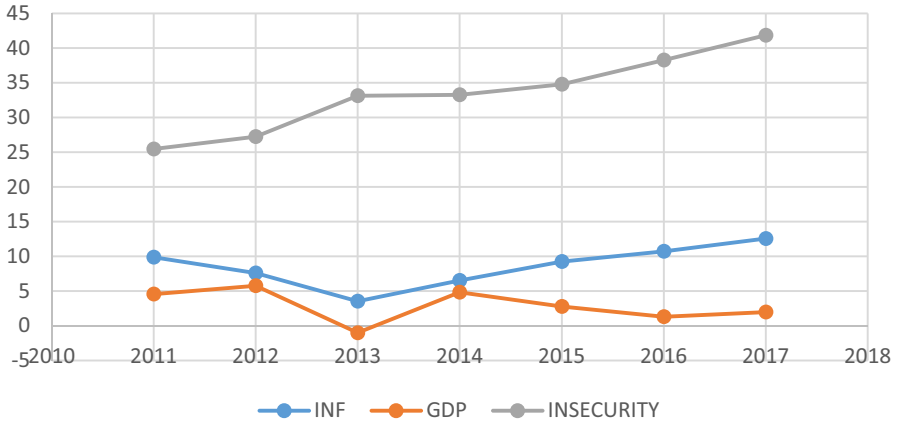

Fig. 2 Representation of average rates of inflation, growth, and the average level of insecurity in Central Africa during the period 2011–2017. Source: Authors based on data from African Development Bank Group, 2019

27.25% in the sub-region. However, this sub-region recorded a loss of the average economic growth rate of around 56% during the same period.

Analysis of Fig. 2 reveals that inflation and insecurity are moving in the same direction. This suggests that there is a positive correlation between the two variables. On the other hand, insecurity is inversely linked to economic growth. Hence, the presumption of a negative relationship between the two variables is possible. Overall, the security situation of the countries of Central Africa may be as well as the origin of the inflationary propensity as it would also constitute a constraint for the production capacity of the economies of the countries of this sub-region as shown in Fig. 2.

After this introduction, this work is organized into six sections. The second section is devoted to the literature review, the third section highlights the methodological approach, the fourth section presents the results obtained, the fifth section discusses the emperical results and the sixth section concludes.

Literature Review

According to the literature, many variables affect economic growth. Some of these variables are foreign investment, domestic investment, human capital, general price level, institutions, trade, etc. Based on theoretical and empirical works, this study has selected two variables which are inflation and insecurity to examine their interaction effect on growth in Central Africa countries.

Determinants of Inflation

Existing literature provides various determinants of inflation in developed as well as in developing countries. Theoretically, the determinants of inflation are either monetary or non-monetary. According to the non-monetarism conception, the inflation can be explained by the demand-pull paradigm and the cost-push theory. To the demand-pull paradigm, inflation exists when the gap between demand and supply cannot be filled neither by existing stocks nor by the import and export regulations. The cost-push theory considers that prices rise via the production costs. The rising cost of production is mainly due to such random non-monetary shocks such as crop failure, commodity shortage, vagaries of weather, and increase in the price of oil (Onwioduokit, 2002). This non-monetarist conception contrasts with the view of monetarist theory which opined that "inflation is always and everywhere a monetarist phenomenon resulting from and accompanied by a rise in the quantity of money supply relative to output." Finally, inflation can also be imported by transiting through international trade from one country to another. However, the causing factors of inflation remain inconclusive by both non-monetarism and monetarism perceptions.

Empirical studies have identified possible determinants of inflation. They find that inflation is mainly explained by money supply, exchange rate, interest rate, imported inflation, oil price shocks, and GDP. For instance, Kahn and Gill (2010) supported that depreciation of exchange rate and increase in the value of imports have contributed to shoot up the different indicators of inflation. His study also showed that budget deficit does not play any role on the indicators of inflation. Lim and Sek (2015) examined the determinants of inflation in high inflation group of countries and low inflation group of countries. They argued that in low inflation countries, GDP growth and imports of goods and services affect inflation. Conversely, inflation is determined in the high inflation countries by money supply, national expenditure, and GDP growth. Similarly, Anfofum et al. (2015) opined that in addition to fiscal deficit, money supply, exchange rate, and imports of goods and services, agriculture output also has a long-run positive influence on inflation. In return, Akinbobola (2012) has shown that in the long run, the money supply and exchange rate have an inverse effect on inflation. However, money supply does not also affect inflation (Altowaijri, 2011; Berry et al., 2001). Imimole and Enoma (2011) examined the effect of exchange rate depreciation on inflation and reported that exchange rate depreciation, money supply, and real GDP are the main determinants of inflation in Nigeria. Apart from that, Choi et al. (2018) identified a similar positive vanished effect of oil price on domestic inflation in developed and developing economies. Their results also supported that the effect of positive oil price shock is larger than negative ones. Caceres et al. (2013) also examined the impact of commodity prices shocks on inflation in Central Africa and found that price controls play an important role in Central Africa. The comparison of these results to the ones of Zoli (2009) on emerging Europe permits to note that the response of domestic inflation to global oil prices shocks in developing countries can be influenced by region-specific factors. Similarly, Yildirim and Arifli (2021) confirmed the finding of Caceres et al. (2013) by pointing out that

negative oil price shock increases inflation. This result was also found by Su et al. (2021) and cited by Gong et al. (2021).

In case of Central Africa countries, Portillo (2009) finds that fiscal shocks have been a major source of inflation volatility in CEMAC. Taking the example of Chad and using the quarterly data from 1983: Q1 to 2009: Q3, Kinda (2011) puts forward as determinants of inflation: rainfall and foreign price fluctuations, the combined effects of which would persist for six quarters. Using a VAR model over the period 1960–2007, they find that an increase in the money supply leads to an increase in economic growth, which in turn causes inflation. Caceres et al. (2013) use a panel VAR of Central African countries (CEMAC) during the period 1996–2010, to show that the prices of food products and oil affect the dynamics of non-monetary inflation for four or five quarters and their impa ct decreases substantially over time. Indeed, for these authors, past inflation influences current inflation due to the slow adjustment of economic agents' expectations. Nguyen et al. (2015) also identify as predominant determinants of inflation in the CEMAC: domestic supply shocks, exchange rate shocks, and monetary variables. By paying particular attention to the monetary dimension in their analysis of the sources of inflation in CEMAC, Bikai et al. (2016) used an autoregressive vector approach during the period 1990–2014. The results of this study show that the money supply and imported inflation are the two main sources of inflation in the CEMAC zone. Ntita et al. (2017) analyzed the determinants of inflation in CEMAC during the period 1996 to 2016. The estimation of a fixed effects panel reveals that the money supply has a positive effect on inflation. However, they found that political stability had a rather negative effect on the level of inflation in CEMAC. Tékam (2018) examined the determinants of inflation in Cameroon during the period 1980–2016. Using the Autoregressive and Distributed Lags estimation technique, the author finds that monetary policy, fiscal policy, and the exchange rate have a significant impact on inflation in Cameroon. Ngambo and Biligil (2019) analyzed the impact of debt dynamics on economic growth and inflation in Cameroon during the period 1987–2015. By using an error correction model, the result shows that debt dynamics have no effect on short-term inflation. However, it would explain in the long term, the variation of the inflation rate to more than 10%.

With this in mind, we can formulate the hypothesis 1 about the determinants of inflation in Central Africa countries:

Hypothesis 1 The inflation is mainly influenced by the economic growth, the level of insecurity, the previous rate of inflation, the money supply, the oil rent, and the budget deficit.

The investigation model of inflation is given as follows:

$$\text{Inflation} = f(\text{economic growth}, \text{level of insecurity}, \text{previous rate of inflation}, \text{money supply}, \text{oil rent}, \text{and budget deficit}).$$

Economic Growth Evolution: Does Inflation Matter?

Many studies have empirically explored the inflation-economic growth nexus. These studies have mainly analyzed the effect of inflation on economic growth in many countries. For instance, in the specific case of African countries, the review of international literature on macroeconomics determinants of economic growth made by Chirwa and Odhiambo (2016) has shown the inflation carrying out a great role for the explanation of economic growth in Africa.

Thus, the inflation rate is negatively and significantly associated with economic growth because economic growth is enhanced by lower inflation (Barro, 2003; Chen & Feng, 2000). This negative effect of inflation on economic growth has moreover been found in Bangladesh by Rao and Hassan (2011). They show in their study that inflation is negatively and significantly associated to economic growth in this country. On the other hand, additional studies adopting linear models have concluded that inflation exerts a positive effect on economic growth. The study by Anyanwu (2014) found that inflation measured by the metal price index exerts a positive effect on economic growth in Africa. In addition, the work of Ramzi and Wiem (2016) demonstrated that there is a causality between inflation and economic growth in a sample of 25 countries in the world.

The relationship between inflation and economic growth is not always a linear. Pollin and Zhu (2006) presented a new non-linear regression estimates of the relationship between inflation and economic growth for 80 countries over the 1961–2000 period, using middle-income and low-income countries. They found that higher inflation is associated with moderate gains in GDP up to a roughly 15–18% inflation threshold. However, the results diverge according to the income level countries.

In Central Africa, many works have tried to determine this rate of inflation. Bikai and Kamga (2011) used a smooth transition threshold panel model also called panel smooth threshold regression (PSTR) over the period 1987–2008 to find a threshold of 6% above which the correlation between inflation and economic growth is negative in CEMAC countries. Based on BEAC experience, Mondjeli and Tsopmo (2017) determined the optimal inflation rate compatible with economic growth. The application of a PSTR model using data from BEAC countries over the period 1985–2013 shows that (i) the optimal inflation rate is around 4.3%; (ii) below this threshold, any 1% increase in inflation induces that of economic growth by about 0.28%; but beyond the threshold, economic growth is reduced by 0.26% when inflation increases by 1%. Nganga (2018) estimated the inflation threshold in the relationship between inflation and growth in the Economic and Monetary Community of Central Africa more specifically in Cameroon and Congo-Brazzaville during the period 1986–2015. The analysis made on the basis of the threshold model, made it possible to show the existence of a non-linear relationship between inflation and economic growth in Cameroon and Congo-Brazzaville. Put differently, there is an inflation threshold in Cameroon and Congo-Brazzaville which is 5% and 10% respectively, below which any measure of expansionary monetary policy would promote economic growth. Thus, these results also indicate the monetary authorities of the CEMAC can somewhat relax the constraints of the Community rules of the

inflation rate below 3%. By carrying out a comparative study between Cameroon and the Ivory Coast on the relationship between inflation and economic growth during the period 1980–2014, Ngouhouo and Nkemgha (2018) found through the application of OLS that inflation has no effect on economic growth in Cameroon. However, it causes a negative and significant effect on economic growth in Ivory Coast. Moreover, economic performance is also influenced by innovation capability (Lopes et al., 2021). We can therefore draw the hypothesis 2 about the impact of inflation on economic growth in the Central Africa:

Hypothesis 2 Ceteris paribus, inflation can stimulate economic growth in the Central African countries.

Conceptual Linkages Between Inflation, Insecurity, and Economic Growth

Existing literature provides various studies on the impacts of insecurity variables on economic growth. These studies support that there is an uninterrupted relationship between insecurity situation and economic deprivation. There are several opinions regarding the impacts of relationship between GDP growth and terrorism. On one hand, Li and Schaud (2004) and Collier and Hoeffler (2004) have found that this relationship is negative and inverse. Several other studies (Muller & Weede, 1990; Bravo & Dias, 2006; Lai, 2007; Blomberg and Hess, 2008; Campos & Gassebner, 2008; Dreher & Fisher, 2010; Çinar, 2017) also find the similar results regarding negative nexus between terrorism and GDP growth. On the other hand, studies performed by Tavares (2004), Lai (2007), Patra and Ray (2010), Caruso and Schneider (2011) found positive association between economic growth and terrorism activities. Apart from that, out of terrorism, social unrest and poor governance also have negative relationships with economic growth (Okafor & Shaibu, 2016). These results corroborate the findings of Alesina et al. (1996) that political instability negatively affects per capita GDP growth. Moreover, Dunne and Tian (2014) supported that either at home or in neighboring states, the insecurity situation like civil war negatively impacts the economic growth in a country and his neighbors.

The literature on how insecurity influences relationship between inflation and economic growth is still underdeveloped in the Central Africa context. All the previous studies analyze the non-linear and linear relationship between inflation and economic growth. They do not consider the role of variables that affect security situation like terrorism, and political instability on this relationship. However, Boujelbene (2021) analyzed the role of institutions quality measured by political instability and level of democracy on the inflation-growth nexus. Their results show that in terms of economic growth, the cost of inflation increases with the quality of institutions. However, the dynamic threshold panel method used by the author is inappropriate to capture this role. The author does not also crossed inflation with the political variable to determine interactive effect of these two phenomena.

Some studies have looked at the relationship between insecurity and economic growth. It has been exposed that insecurity predominantly affects economic growth negatively. Some studies have concluded the negative effects are more

pronounced in developing countries where the reallocation of resources across different sectors of activity is less evident (Blomberg et al., 2004; Sandler & Enders, 2004; Gaibulloev & Sandler, 2009). Similarly, much other work has naturally asserted that terrorism has a negative effect on economic activity (Choi, 2015; Tahar et al., 2018). These findings are also confirmed by work on African countries (Olusegun, 2016; Shuaibu & Lawong, 2016). Most of these countries are still in a condition of uncontrolled vulnerability (Ngouhouo & Nchofoung, 2021). Against this background, we draw the hypothesis 3 about the inflation-growth nexus in a context of insecurity:

Hypothesis 3 The interaction between inflation and insecurity hampers economic growth ceteris paribus.

Despite the abundant literature on the determinants of inflation on the one hand and the effect of inflation on economic growth on the other, little is known about the role of insecurity in this relationship. However, most of the countries of Central Africa (Cameroon, Congo, Central African Republic, Democratic Republic of Congo, and Chad) have been classified since 2011 by the Global Peace Index as being politically instable countries. Thus, the aim of this article is to fill this gap in the literature by incorporating the variable insecurity in the analysis of the relationship between inflation and economic growth.

Referring to the above, we formulate the following growth model:

$$\text{Economic growth} = f(\text{lagged growth variable, inflation, level of insecurity, money supply, oil rent, and budget deficit}).$$

Methodological Approach

Specification of Equations and Estimation Technique

To study the importance of insecurity on the relationship between inflation and economic growth, we specified the following models:

Specification 1

The inflation equation used in this work is inspired from the work of Diop et al. (2008). The specification of this model is given by the following equation:

$$\begin{aligned} \text{Inf}_{it} = {} & \gamma_0 + \gamma_1 \, \text{Inf}_{i,t-1} + \gamma_2 \, \text{Insecurity}_{i,t} + \gamma_3 \, \text{M2}_{i,t} + \gamma_4 \\ & \text{Gdp}_{i,t} + \gamma_5 \, \text{Oilrent}_{i,t} + \gamma_6 \, \text{Budef}_{i,t} + \mu_i + \delta_t + \varepsilon_{it} \end{aligned} \tag{1}$$

where *Gdp*, *Insecurity*, *Inf*, *M2*, *Oilrent*, and *Budef* represent respectively economic growth, the level of insecurity, the rate of inflation, the money supply, the oil rent, and the budget deficit while μ_i, δ_t, and ε_{it} represent respectively the specific effect not observed in each country, the time effect not observed in each country, and error term.

Specification 2

The specification of the growth model is derived from that of Mankiw et al. (1992) as shown in the equation below:

$$\begin{aligned} Gdp_{it} = {} & \beta_0 + \beta_1\, Gdp_{i,t-1} + \beta_2\, Inf_{i,t} + \beta_3\, Insecurity_{i,t} + \beta_4\, Oilrent_{i,t} \\ & + \beta_5\, M2_{i,t} + \beta_6\, Budef_{i,t} + \beta_7\, Inf_{i,t} * Insecurity_{i,t} + U_i + V_t + E_{it} \end{aligned} \tag{2}$$

where $Inf_{i,t} * Insecurity_{i,t}$ represents the interaction variable between inflation and insecurity.

Given the fact that there may be a two-way causality in the first equation (between insecurity and inflation) and in the second equation (between inflation and economic growth) on the one hand and on the other hand, our econometric model being dynamic and according to the work of Nickell (1981), this lagged variable ($Gdp_{i,t-1}$) is correlated with the error term and thus generates the endogenity problem. To address this endogeneity issue, we apply the system generalized method of moment (GMM) proposed by Arellano and Bond (1991); Arellano and Bover (1995); Blundell and Bond (1998). The GMM technique is increasingly used in the literature on the relationship between inflation and economic growth (Ekinci et al., 2020; Junankar & Wong, 2020). GMM is useful for several advantages. First, GMM estimator has been widely used to address the endogeneity problem that appears in panel data estimation (Arellano & Bover, 1995; Blundell & Bond, 1998). Second, GMM estimator also takes into account the biases that appear due to country-specific effects. Third, GMM also avoids simultaneity or reverse causality problems. Moreover, it should be added that the GMM on panel has another advantage; it generates the instruments from the explanatory variables, which is not the case with other traditional methods of instrumental variables such as (2SLS and 3SLS), which require the choice of theoretical instrumental variable correlated with the explanatory variables and not correlated with the residual, which is difficult to find. The consistency of the GMM estimator depends on two tests: the validity of the assumption that the error term does not exhibit serial correlation (AR (2)) and the validity of the instrument's (Hansen test). Too many instruments can severely weaken and bias the Hansen over-identifying restrictions test, and therefore, the rule of thumb is that the number of instruments should be less than the number of countries (Roodman, 2009).

Data and Sources

This study uses annual data covering 2011 to 2017 taken from all the height countries of Central Africa. The choice of the period of the study is related to the availability of data on interest variables like insecurity. All the variables of this study come from African Development Bank Group (ADBG, 2019), except fiscal policy variable which comes from UNCTAG (2019). The dependent variable in Eq. (1) is inflation while that of Eq. (2) is economic growth. Inflation variable is measured by the consumer price index (Inf) and the economic growth variable is measured as the rate of the gross domestic product (GDP). According to the fiscal policy, it is appreciated in this work by the budget deficit (Budef). The budget deficit here is captured by the primary deficit which is the difference between public revenue and public expenditure, apart from servicing the external debt. The money supply is captured in this work as the share of M2 on GDP. The variable oil rent represents the share of oil rent on GDP. The insecurity variable is obtained from a subcomponent of one of the five headings which constitute Mo Ibrahim's African governance index. The rubric in question is that of safety and security, of which the first component (national security) and the second component (public safety) have the weight 2/3 and 1/3 respectively (Saisana et al., 2009). The national security subcomponent is a composite index of six elements, namely, government involvement in armed conflict, number of battle-deaths, number of civilian deaths, refugees and asylum seekers, internally displaced people, and ease of access to small arms and light weapons. The sum of the points of the six indicators that make up the national security subcomponent is established on a scale ranging from 0 to 100. Therefore, when the national security variable tends to 100, the country's security is reinforced and the country is qualified as stable. But on the other hand, when it moves away from 100, it is rather the insecurity which increases and the country is described as unstable. To measure a country's level of insecurity, we subtract from that country's national security value out of 100 (Insecurity value = 100 − National Security value).

The descriptive statistics of the variables used in our models are presented in Table 1.

The descriptive statistics reveal that the average insecurity of the countries of Central Africa during the period 2011–2017 is 29.98 while those of economic growth and the level of inflation are respectively 2.88% and 6.47%. The value of insecurity sufficiently

Table 1 Descriptive statistics

Variables	Obs	Mean	Std. Dev	Min	Max
Gdp	56	2.883062	6.6755	−36.7	8.97
M2	56	34.26726	12.89036	13.93879	62.96
Inf	56	6.472227	11.14972	−9.026025	50.674
Budef	56	−3.42463	8.625112	−49.63134	19.08102
Oilrent	56	16.73563	20.21045	0	65.60266
Insecurity	56	29.98393	24.96848	5.1	88.9

Authors, from the collected data

Table 2 Im-Pesaran-Shin (IPS) and Levin-Lin-Chu (LLC) unit root tests

Variables	IPS without trend		LLC without trend		Order
	Statistics	**Probabilities**	**Statistics**	**Probabilities**	
Gdp	−0.90467	0.1828	−0.30327	0.3808	I (1)
M2	0.90938	0.8184	−2.32939	0.0099	I (1)
Inf	−3.20000	0.0000	−0.67558	0.2497	I (1)
Oilrent	−6.50000	0.0000	−4. 01,787	0.0000	I (0)
Budef	−6.43436	0.0000	−11.3434	0.0000	I (0)
Insecurity	−2.40000	0.0000	−20.9093	0.0000	I (0)

Authors, from the collected data

demonstrates that the countries of the sub-region are not in a situation of security stability. In addition, there is a propensity for inflation and low growth.

Before running the estimation model, it is necessary to determine the properties of each of the variables. Subsequently, we apply Im-Pesaran-Shin (IPS) and Levin-Lin-Chu (LLC) panel stationary tests without trend because of the small size of T period. The results of this test are presented in Table 2.

Table 2 shows that the variables Insecurity, Budef, and Oilrent are stationary at level while the variables GDP, M2, and Inf are rather stationary in first difference. It is for this reason that we introduced lagged inflation and lagged growth in Eqs. 1 and 2 respectively. The results from the estimation of the two models are presented in the following section.

Results

The results of the estimation of the inflation equation and that of economic growth by the system GMM method are presented in Tables 3 and 4 respectively. The results of Tables 3 and 4 show that the Wald test is significant at 1%, which illustrates a good specification of the model. In addition, we observe an absence of second-order autocorrelation at the 5% threshold and the validity of the instrument identification test. The analysis of Table 3 reveals that the variables insecurity, money supply, economic growth, and the oil rent have a significant impact on inflation in the Central African countries while inflation, insecurity, the oil rent, the budget deficit, and the interaction variable between inflation and insecurity are explanatory factors of the economic growth model of this study as shown by the results reported in Table 4.

To test the robustness of the above results (results of Table 4), we decided to capture the insecurity variable as a dummy variable. This dummy variable takes « 1» if a country is classified as «unstable country» and « 0» if a country is classified as « stable country». The estimation of this model will be by the system generalized moments of method of Blundell and Bond (1998). The results from the estimation of the growth model by the System GMM are reported in Table 5.

Table 3 Results of inflation model

Variables	(1)	(2)	(3)
Inf_{t-1}	1.0102*** (3.78)	0.1835 (1.03)	0.0345 (0.04)
Insecurity	0.3384*** (2.78)	0.2146* (1.72)	0.3321* (1.81)
M2	0.1476** (2.07)	0.3188** (2.26)	0.5223** (1.99)
Gdp	0.6037*** (3.01)	0.5000*** (2.87)	0.5646** (2.27)
Oilrent		−0.1346** (− 2.07)	−0.1814* (−1.67)
Budef			−0.2518 (−1.52)
Constant	−15. 7823*** (−4.94)	−11.9347* (−1.75)	−21.8918** (−2.08)
Wald chi2	77***	22.39***	33.33***
Prob(AR2)	0.952	0.545	0.714
Prob(Sargan test)	0.198	0.717	0.274
N. Countries	8	8	8
N. Obs	48	48	48

The values in parentheses represent the *t*-statistics

***$p < 0.001$; **$p < 0.05$; and *$p < 0.1$

Discussion of Results

This sub-section relating to the economic discussion is structured in three paragraphs. The first analyzes the determinants of inflation. The second, on the one hand, analyzes the determinants of economic growth on the one hand and, on the other hand, analyzes the effect of the coexistence of inflation and insecurity on economic growth. Finally, the robustness analysis is provided by the last paragraph.

Analysis of the Determinants of Inflation

The insecurity variable produces a positive and significant effect on inflation. Thus, an increase in the level of insecurity of a unit leads to an increase in inflation by 33.21%. This situation sufficiently demonstrates insecurity is one of the sources of inflation in Central Africa. The money supply has a positive and significant effect on inflation. Thus, an increase of one unit in the money supply leads to an increase in inflation by 52.23%. This result is compatible with theoretical and empirical evidence which stipulates the money supply is always a monetary phenomenon (Friedman, 1963; Chaudhry et al., 2015; Mohamed, 2016). Like the money supply, economic growth has a positive and significant effect on inflation. Unlike money supply and economic growth, oil rent has a negative and significant effect on inflation. Thus, an increase of one unit in oil rent leads to a drop

Table 4 Results of growth model

Variables	(1)	(2)	(3)	(4)	(5)
Gdp_{t-1}	0.1989** (2.07)	0.0465 (0.58)	1.4501* (1.81)	0.3382 (0.82)	8.9768* (1.76)
Inf	0.3654*** (6.16)	0.4165*** (11.0)	0.9412*** (4.94)	0.6700*** (3.28)	4.8595** (2.02)
Insecurity	−0.1772*** (−2.65)	−0.2482*** (−3.18)	−0.3285** (−2.12)	−0.2645* (−1.74)	−1.1930* (−1.83)
Oilrent		0.1877* (1.78)	0.4123* (1.84)	0.2542** (2.22)	3.6281* (1.86)
M2			0.8842 (1.57)	0.8065** (2.33)	−0.3848 (−0.92)
Budef				0.7979*** (3.50)	−13.5795* (−1.83)
Inf*Insecurity					−0.0484* (−1.78)
Constant	3.2372 (1.46)	3.8786 (1.43)	−36.1202 (−1.54)	−20.9462 (−1.43)	−99.2111 (−1.60)
Wald Chi2	728***	179***	40.60***	112***	46***
Prob(AR2)	0.128	0.140	0.190	0.325	0.568
Prob(Sargan test)	0.096	0.399	0.780	0.945	0.082
N. Countries	8	8	8	8	8
N. Obs	48	48	48	48	48

The values in parentheses represent the *t*-statistics

***$p < 0.001$; **$p < 0.05$; *$p < 0.1$

in inflation of 18.14%. The inverse relationship between the two variables also materializes that a drop in oil rent would lead to an increase in inflation through the tax channel, the aim being to find a balance between revenue and expenditure. This result is compatible with the work of Caceres et al. (2013). This result reveals that apart from the traditional origins of inflation (money supply, economic growth, and oil rent), insecurity is one of the sources of inflation in Central Africa. The analysis of the consequences of inflation on economic growth and the role of the security situation in this relationship is presented in Table 4. These results allow us to partially accept the hypothesis H_1.

Analysis of the Effect of Inflation on Economic Growth Through the Role of the Security Situation

The results of Table 4 show that economic growth lagged by one period (model 5) has a positive and significant effect at the 10% threshold on economic growth. This result corroborates the convergence theory of the growth model of Barro (1990) which states that the economic growth levels of different economies tend to be loser over time. The inflation rate has a positive and significant effect on economic growth. Thus, an increase in this rate by 1% leads to an increase in

Table 5 Results of growth model (insecurity variable is capture as a dummy variable)

Variables	(1)	(2)	(3)	(4)	(5)
Gdp_{t-1}	0.3762*** (5.01)	0.0086 (0.02)	−0.1018 (−0.24)	−0.6653 (−0.92)	−1.8026 (−1.52)
Inf	0.3323*** (3.01)	0.4962*** (4.99)	0.5349*** (3.69)	0.7694* (1.95)	3.1667** (2.02)
Dum	−4.4114* (−1.70)	−10.43** (−2.37)	−13.2638* (−1.84)	−20.4902* (−1.88)	−84.8059* (−1.90)
Oilrent		0.5236** (2.21)	0.5799** (2.32)	0.8774** (2.21)	1.1742** (1.98)
M2			0.0656 (0.72)	0.0068 (0.05)	−1.2318* (−1.82)
Budef				−0.12 (−0.45)	−0.6747 (−1.49)
Inf*Dum					−1.7541* (-1.72)
Cons	3.0127 (0.97)	−2.9721 (−1.62)	−5.1019 (−1.60)	−4.4443 (−0.97)	59.5333* (1.87)
Wald Chi2	61.90***	167.81***	101.23***	198.38***	54.34***
Prob(AR2)	0.241	0.914	0.837	0.549	0.531
Prob (Sargan test)	0.173	0.07	0.061	0.118	0.082
Nb. Obs	48	48	48	48	48

The values in parentheses represent the *t*-statistics

***$p < 0.001$; **$p < 0.05$; *$p < 0.1$

growth of 4.85% (model 5). This situation shows that inflation has a virtuous effect on economic growth in Central Africa. The work of Khan and Senhadji (2001) explains this result because, according to studies carried out by the latter, the threshold of inflation compatible with growth in developing countries fluctuates between 8 and 12%. Despite the establishment of the multilateral surveillance system, the average annual inflation rate of the Central African countries exceeds a threshold of 3% and it is less than 8% these recent years. This result is consistent with those of Gillman and Kejak (2002), who consider that low inflation has a positive effect on growth. This result is also consistent to the work of Anyanwu (2014). However, this result is not consistent to the works of Rao and Hassan (2011) who found that inflation hampers economic growth in Bangladesh. Regarding insecurity, it negatively and significantly impacts the economic growth of the countries of Central Africa. These findings are also confirmed by work on African countries (Olusegun, 2016; Shuaibu & Lawong, 2016).Thus, an increase in the level of insecurity of 1% leads to a drop in growth of 1.19%. Therefore, our hypothesis H_2 which states that inflation can stimulate economic growth is accepted. This table also reveals that inflation combined with insecurity or the coexistence between inflation and insecurity (Inf * Insecurity) negatively and significantly impacts economic growth. This result is explained by the fact that inflation combined with insecurity considerably constrains the productive capacity of Central African economies. In other words, inflation negatively impacts economic

growth through the channel of insecurity. This result confirms the hypothesis H_3 which states that the interaction between inflation and insecurity hampers economic growth. Concerning the oil rent, it has a positive and significant effect on economic growth. This means that the countries of Central Africa are not victims of the natural resource curse. This result corroborates with the work of Omrani and Toumache (2016). Regarding the budget deficit (model 5), it also has a negative and significant effect on economic growth. Thus, an increase of 1% of budget deficit causes a decrease of 13.57% in growth. This situation can be explained perhaps because these deficits have been unoriented towards profitable investments. This result is contrary to those of Iyeli and Azubuike (2013).

Analysis of the Sensitivity of the Results

The results of the robustness test are recorded in Table 5. Regarding the significance of the main variables of our model (Inf, Dum, and Inf*Dum), we found the same result as that of Table 4 (model 5). Therefore, inflation has a positive and significant effect on economic growth. The insecurity variable captured here as a dummy variable negatively and significantly impacts the growth of the Central African countries. Table 5 also reveals that inflation combined with insecurity or the coexistence between inflation and insecurity (Inf *Dum) negatively and significantly impacts economic growth. This result confirms that inflation combined with insecurity significantly constrains the production capacity of the economies of Central Africa.

Conclusion

Remember the Purpose of the Study

This article aimed to verify whether the security situation influences the relationship between inflation and economic growth in Central Africa. More specifically, it investigated the insecurity as a source of inflation on the one hand, and on the other hand, it assessed the effect of inflation combined with insecurity on economic growth in Central African countries.

Main Findings

Robustly, the use of the system GMM estimation reveals that insecurity is also one of the origins of inflation in Central Africa. This result also shows that the coexistence of inflation and insecurity significantly constrains the production capacity of the economies of the sub-region. This result reminds us that the prosperity of the economic fabric of a country or group of countries depends on its level of security.

Theoretical Implications

These results theoretically imply that insecurity must be considered an explanatory factor of inflation on the one hand and on the other hand as an explanatory factor of the contraction of production in African countries in general and in Central Africa in particular.

Practical Implications

In practical terms, it is urgent for the countries of Central Africa to further integrate security (national and cross-border) into their development programs. This integration of security requires political negotiation between established governments and various rebel groups.

Social Implications

A return to peace not only will be beneficial for growth but will also make it possible to control the level of inflation for the greatest happiness of the populations. Moreover, the States must diversify their economies in order to no longer depend on the oil rent, the fall of which is a source of inflation.

Originality of the Study

This study contributes to existing growth-inflation literature by incorporating the variable insecurity in the analysis of the relationship between inflation and economic growth. Moreover, two indicators of insecurity were used in this study.

Limitations of the Study

However, this study does not take into account another structural characteristic of African countries: governance.

Future Lines of Research

Given that the countries of sub-Saharan Africa are going through a crisis of governance, we will strive in the future works to analyze the role of governance in the transmission of the effects of insecurity on inflation on the one hand and on the other hand on economic growth in these countries.

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Declarations

Conflict of Interest The authors declare no competing interests.

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