Panel logit regression analysis of the effects of corruption on inflation pattern in the Economic Community of West African states

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ABSTRACT

It is widely believed that increase in money supply increases inflation rates in the long run. Dissenting evidences have later emerged to show that the inflation-money growth link has weakened over time. This study provides a political interpretation of inflation rates dynamics by investigating corruption as a potential risk factor associated with high inflation in the Economic Community of West African States (ECOWAS) using panel logit model. All 15 ECOWAS members were selected and studied between 1995 and 2019. Estimates revealed that, in the long run, ECOWAS inflation was significantly determined by past inflation shocks, level of corruption, real GDP and exchange rates; the link between inflation and money supply growth had indeed weakened over time. In particular, results showed that, other things given, a unit increase in the level of corruption increased the risk of high inflation by 82.6%. Results also indicated that seigniorage was not enough to explain the link between inflation and corruption, suggesting that some other channels exist through which corruption affects inflation. In addition, taking 0.5 as the benchmark for forecast probabilities, the logit model reconstructed all the high inflation episodes experienced in ECOWAS in spite of the outlying observations of Liberia and Guinea. The study therefore concludes that other things given, the more corrupt ECOWAS members are, the higher the likelihood to experience high inflation.

Keywords: Nonlinear regression; Transition probability; Corruption perception index; Money supply growth; Seigniorage; Developing countries; Statistics; Pricing; Macroeconomics; Econometrics; Public administration

1. Introduction

Corruption has several important implications for the economy: It discourages market efficiency, inhibits the development of infrastructure, slows the pace of economic development, discourages proper allocation of public spending, and casts aspersion on the credibility of contracts (Mauro, 1998). Despite all these negative consequences, corruption continues to thrive and flourish globally, especially in the West Africa. Consequently, several efforts have been made in the region to combat this menace; for instance, an ECOWAS Protocol A/P3/12/01 was signed in Dakar in 2001. However, it appears as if these efforts are not yielding the desired result. The 2019 corruption perceptions index released by the Transparency International painted a disturbing and worrisome picture for West African states. Out of 180 countries considered, only Cape Verde fell in the first quartile while just 5 additional countries made the top-half of the lot.

On the other hand, price stability has always been a subject of major concern for policy makers, practitioners and researchers owing to its important implications for the overall growth of an economy. Consequently, various theories have been developed to explain high inflation rates; see, for instance, Friedman (1970), Davidson and Weintraub (1973), Nordhaus (1975) and Barro (1978). The most popular theory in the nineties was the Friedman's which claimed that inflation is a monetary phenomenon in the long run. Later, some studies such as Stock and Watson (2006) and Lenza (2006) have sprung up with counter claims that the link between money growth and inflation has weakened over time. Consequently, a new line of reasoning emerged claiming that in recent times, with the rise in the rate of corruption, inflation dynamics may have some political undertone such that the indices of corruption may have some political undertone such that the indices of corruption may be employed to explain its movements (Yousefi, 2015). This reasoning follows Al-Marhubi (2000) who earlier studied the effect of corruption on inflation rates. We acknowledge that this new explanation may be very true, especially in less industrialized economies such as ECOWAS which is usually characterized by low income and high bureaucratic corruption.

In this study, we examined corruption as a leading indicator to signal movement from low to high inflation periods in ECOWAS. This study contributes to the literature in three major ways: First, despite various studies on the macroeconomic consequences of corruption, there are relatively very few on inflation. The few available ones have
concentrated on developed economies\(^1\). This study will therefore extend the results on the inflation-corruption nexus to the developing setting, especially Africa which is prone to high level of corruption; Second, previous studies such as Al-Marhubi (2000) and Piplica (2011) had employed the conventional approach which expresses inflation as a linear function of corruption level in a regression model. We divert from this approach and instead employed a logistic (or logit) regression in linear function of corruption level in a regression model. We divert from the conventional approach which expresses in

## Concentrated on Developed Economies

The motivation for this alternative approach can be explained: Figure 1 below displayed the dot plot of inflation rates of ECOWAS. It is easily seen that Liberia and Guinea inflation rates fall in the category of natural outliers of observations when compared to those of other countries. Now, since these outliers are natural (i.e. not due to errors) they cannot be removed from the analysis if we must have a complete and comprehensive picture of the ECOWAS inflation-corruption link; hence, the need for a modeling approach which can handle outliers. As earlier mentioned, previous studies have employed some form of linear models. The use of such linear models in the presence of outliers, especially when the outliers are present in the dependent variable could yield misleading results. As a matter of fact, it may significantly change the magnitude and signs of the regression slopes; it may also reduce the precision and the power of the statistical tests (Choi, 2009).

Our second motivation for the adopted modeling strategy can be seen in Figure 2. Figure 2 showing the scatter plot of the inflation rates versus the level of corruption, as measured by the corruption perception index, uncovered a nonlinear (probably exponential or growth) relationship between the two variables. Previous studies have employed some form of linear model which could also distort the result of the modeling. The alternative approach employed here is robust to the form of relation between variables, linear or otherwise.

What is more, this alternative approach allows us to extract more information from the datasets than a linear model would; it also improves the interpretability of regression coefficients: (i) Regression coefficients represent odds rather than just numerical values; thus the **odds ratios** (OR) and consequently, the **relative risks** (RR) obtained from the coefficients directly measure the likelihood of transiting to high inflation state while accounting for certain selected variables. Clearly, this approach avoids ambiguity and is more consistent with people’s natural way of thinking (Simon, 2001); this therefore improves the interpretability of regression coefficients. (ii) Unlike the conventional linear regression which calculates some mean value, the outcome of the logistic regression computes the predicted probability of the occurrence of the two mutually exclusive events based on corruption level while controlling for other relevant factors. These forecast probabilities can be used to measure the risk of high inflation in ECOWAS relative to the selected factors. It can also be used to describe her inflation cycle and to delineate inflation turning points. In addition, conditional variances for the low and high inflation periods could be identified using the forecast probability and then employed to directly investigate the Friedman (1977) hypothesis whether or not the high inflation periods are also the highly volatile ones.

Finally, the third contribution of this paper is that we adopted a modeling approach which attempts to expose the channel through which corruption affects inflation. Prior to this study, it has been established that corruption induces inflation; however, the channel has not been thoroughly investigated. An empirical attempt has been made in Ali and Sassi (2016) to establish a link through seigniorage. We continue to explore this channel using a different measurement of seigniorage.

The motivation to study ECOWAS is easy to understand: There have, no doubt, been various studies on inflation in Africa, however many of them are country-specific. In the light of the recent proposal for the establishment of various monetary unions from various existing regional economic communities in Africa, it is now very important to embark on studies targeting regions, especially regional economic communities (RECs) such as ECOWAS, EAC, SADC, and so on. This is with a view to providing adequate information on and assessment of the preparedness of each REC before monetary unions are established in order to avoid a repeat of Brexit.

The rest of the paper is organized as follows: Section 2 discusses briefly why corruption and inflation should be linked; Section 3 describes the data and the panel logit model; Section 4 presents and discusses the empirical results while the last section contains the conclusion and some recommendations.

### 2. Why Corruption and Inflation should be Linked

Corruption, which was described by the Transparency International as “the abuse of entrusted power for private gain”, may be linked to inflation in the following ways: First, high level of corruption in an economy could discourage productivity and investment (Pellegrini and

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1 Notable exceptions are Smith-Hillman (2007), Ali and Sassi (2016).
A less productive state is essentially a net importer of goods and services. This could lead to imported inflation.

Second, the literature identifies different ways by which corruption makes the government lose revenue, thereby making it difficult to finance public expenditures. In this case, one viable alternative is to explore seigniorage as a source of revenue, which has been severally associated with inflation (Marhubi, 2000). For instance, Blackburn and Powell (2011) posited that when bureaucrats embezzle public funds leading to budget deficits, the easiest option to generate revenue is through seigniorage. In addition, corruption reduces government’s proceeds from tax as it causes capital outflow to other countries thereby reducing taxable resources (Ghura, 1998). This may also cause the government to explore seigniorage as another option to generate revenue. Certainly, countries with less developed financial systems are prone to corruption and are more likely to explore seigniorage.

Aisen and Veiga (2006) had earlier reported that developing countries earned more income (precisely five times more) from seigniorage than the developed ones.

Further, lack of efficiency in taxation process is one of the reasons a government may strategically adopt inflation tax as a source of revenue (Cukierman et al., 1992). A country which could not institute an efficient and sophisticated structure to retrieve taxes is liable to tax evasion and high tax collection costs; such government may rely heavily on inflation tax to finance budget deficits.

In addition, Aisen and Veiga (2008) had earlier reported that political instability may induce high inflation. It is easy to explain why corruption may be responsible for political instability: Corruption prevents efficient allocation of scarce public resources among existing regions in a country. This could lead to prolonged civil unrests and terrorism in some parts of the country thereby inhibiting farmers from cultivating their farmlands. This may result in scarcity of household food items and consequently, huge spike in their prices.

Empirical studies on the inflation-corruption nexus are divided as to which variable causes the other. One line of argument is that inflation causes corruption. In this class are studies such as Getz and Volkema (2001), Akca et al. (2012) and Braun and Di Tella (2004). The other view is that corruption encourages inflation. Some studies in this category include Al-Marhubi (2000), Piplica (2011) and Ozsahin and Ucler (2017). By and large, regardless of the line of causation, all the above listed studies unanimously agreed that inflation rate increased with increasing level of corruption.

Figures 3 and 4 provide prima facie justification to assume that high corruption level induces high inflation episodes in ECOWAS. Ghana corruption perception level deteriorated by 70% from 3.7 in 2007 to 3.0 in 2008; interestingly, her inflation rates rose by 440% in 2007 and did not return to single digit until 2010. Sierra Leone’s corruption level rose by 20% in 2014; subsequently, her inflation rates rose from 4.6 in 2014 to 18.21 in 2017. In a similar development, the Niger 2008 high inflation came after her corruption perception level worsened by 60% in 2007 to 1.0 in 2008, her lowest since Transparency International started covering the country. In addition, consider the case of Cape Verde whose inflation rates had consistently been in the single-digit zone since 1995, her CPI score was never lower than 4.9 in those years. On the contrary, Nigeria had CPI score ranging between 0.7 and 2.8; incidentally, except for very few occasions, her inflation rates had been consistently >10% mark since 2000. In a nutshell, it appeared as if the rates of inflation rose with increasing level of corruption in ECOWAS between 1995 and 2019.

Further, Figure 2 earlier displayed suggested that the inflation rates increased with increasing corruption perception index. We recall that corruption perception index ranged from 0 to 10; with 10 denoting ‘most clean’ and 0 ‘most corrupt’. Thus a negative relationship as can be seen in Figure 2 really implied that as the level of corruption increased from 10 to 0, inflation rates also increased between 1995 and 2019.

3. Data and methods

Due to its complex nature, corruption, till date, is difficult to observe or measure; this explains why most research has relied on some perception-based measures. By and large, three popular major indices exist in the literature, all of them depending on perception of certain individuals: bribe payers’ index (BPI), global corruption barometer (GCB)
and corruption perceptions index (CPI). Each of these measures has its pros and cons. Here, we adopted the corruption perception index (CPI) of the Transparency International. The Transparency International defined corruption as the abuse of public power for personal gain. This definition is tagged government corruption in the literature (Collins et al., 2009). Accordingly, CPI is a measure of the level of perception of corruption among government administration and politicians. Its score is obtained from the assessment of businessmen and professionals of the country to be evaluated. It is noteworthy that the definition of corruption in the context of the Transparency International may be different from that of criminal law. Nonetheless, the former coincides nicely with our focus in this study and consequently can be used to make a valid investigation into the effect of corruption on inflation. At present, the Transparency International boasts of indices for 180 countries and territories around the world based on 13 credible sources. Every country/territory included in the ranking must have appeared in at least 3 of the sources. CPI score ranged from 0 to 10: A score of 10 represents very clean/cleanest while 0 represents most corrupt.

Other determinants of inflation which have received most attention in the literature are also included in our model as control variables. These include the (broad) money growth rates, real gross domestic product, trade openness and exchange rates (USD/local currency unit). All indices were differenced to achieve stationarity. Data source for all indices except the corruption perception index was the database of the World Development Indicators. The corruption perception index was extracted from the website of the Transparency International.

In addition, data involve the inflation rates, also obtained from database of the World Development Indicators. A variable to measure a potential channel through which corruption affects inflation was also included in the model. Earlier in section 2, we claimed that when a less developed economy facing corruption losses revenue such that it becomes difficult to finance government expenditures, a viable tool to exploit is the seigniorage. In order to understand the role of seigniorage in the relationship between corruption and inflation, we include a measure of seigniorage, denoted s. We interpret seigniorage as the revenue the government generated by issuing new fiat money, and measure it as follows (Walsh, 2010):

\[
s = \frac{M_t - M_{t-1}}{P_t},
\]

where \(M_t\) represents the broad money at time \(t\), and \(P_t\) represents the price level.

The 15 ECOWAS members to be studied include Benin, Burkina Faso, Liberia, Togo, Guinea, Niger, Cabo Verde, Gambia, Nigeria, Senegal, Mali, Ghana, Cote d’Ivoire, Guinea-Bissau and Sierra Leone. In general, data span 1995, the beginning of the coverage by the Transparency International for ECOWAS members, to 2019; however, there were some missing data; for instance, the broad money data were only available up till 2018.

Denote inflation rates as \(\pi\). If it is assumed that the ECOWAS system experiences high inflation when inflation rate attains double digit, then a new variable \(y\) can be constructed as

\[
y = \begin{cases} 
1, & \pi \geq 10 \\
0, & \text{otherwise}
\end{cases}
\]

for country \(i\) at time \(t\).

Consider the following representation (Gujarati and Sangeetha, 2004),

\[
P_{\theta} = E(y = 1|X_{i}) = \frac{1}{1 + e^{-\theta}}
\]

where \(X\) represents the predictors, and

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Figure 4. Corruption perception index of ECOWAS members (1995–2019).

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2 For empirical evidences see Cukierman et al. (1992), Lane (1997), and Al-Marhubi (2000).
where $0 \leq P \leq 1$, and $T$ varies according to available data for each country, $P$ is assumed to be conditioned on the level of corruption ($cor$), and control variables such as the broad money growth rates ($Mgr$), real GDP ($rgdp$), trade openness ($tr$), exchange rates ($exch$), seigniorage ($s$) (where $\beta$ are the coefficients of these variables); and some lag terms of variable $y$ included to avoid serial correlation:

From modeling viewpoint, a better representation for Eq. (3) is

$$L_0 = Q.$$  

(5)

where $L_0 = \log \frac{P}{1-P}$ is the log of odds ratio in favour of transiting to high inflation state. The odds can, of course, be computed by taking the exponent of the corresponding coefficients $a$ and $b$. Further, the risk associated with each odd can be obtained using Eq. (3).

4. Results and discussion

Statistical analysis usually begins with data description. Table 1 referred the summary statistics for the common sample of all the macroeconomic variables and CPI.

Average annual inflation rates for the entire sample stood at 19.2%, an indication that ECOWAS, on the average, had made impressive progress towards achieving the single-digit mark though she is not there yet. The country with the highest inflation rates between 1995 and 2019 was Guinea (in 2018); followed closely by Liberia in the same year. On the average, aggregate annual change in the CPI score was 6.0%. This relatively impressive mark was, of course, due to countries like Cabo Verde, Senegal, Burkina Faso, Mali and Benin. It is noteworthy that Cabo Verde in 2012 had the highest level of improvement with respect to the level of corruption perception. We observed further that ECOWAS, on the average, has not been very productive in the period under review as the mean annual real GDP was only 96.7%. This, of course, explains why all the 15 countries fall in either the low or the lower-middle income group. It is not a surprise either that the mean year-on-year change in trade openness for the 15 countries was negative. It is noteworthy however that the highest productivity level between 1995 and 2019 was recorded by Senegal in 2012. ECOWAS exchange rates appeared to be highly volatile between 1995 and 2019; followed by the real GDP. CPI was the least volatile in the period.

4.1. Corruption and the inflation transition process: a panel logit approach

Table 2 presented the logit regression estimation results. The following inferences can be drawn.

A negative and significant coefficient of corruption index indicated that, after adjusting for other variables, the level of corruption, as measured by the corruption perception index, was a significant predictor and indicator for increase in prices in the ECOWAS. Indeed, ECOWAS members with higher the level of corruption perception had higher chance of experiencing high inflation. Thus for each unit increase in the level of corruption, the odds were higher for inflation rates to transit from the low to high state, on the average, by 4.75, and the associated risk also increased by 82.6%. We note here that our result agreed with previous studies such as Al-Marhubi (2000), among others, which earlier reported that increase in the level of corruption encourages rise in prices.

In addition, bowhead insignificant, a positive coefficient $\beta_5$ indicated that seigniorage may enhance the movement of inflation rate system from low to high state. In other words, seigniorage may encourage high inflation. Cavalcanti and Villamil (2003) and Catao and Terrones (2005) have claimed that the link between corruption and inflation is manifested through seigniorage. However, since the corruption index remained significant after including a measure of seigniorage, it implied that some other channels exist through which corruption affects inflation. Ali and Sassi (2016) had suggested debt financing. Their suggestion was also supported by Elgin and Uras (2013) and Gonzalez-Fernández and González-Velasco (2014).

Logit results indicated that money supply growth was not a significant predictor for inflation rates among ECOWAS members. This lent support to studies such as Cheng and Tan (2002), Us (2004), Ogunmuyiwa and Francis (2010) and Amassoma et al. (2018) which claimed that the predictive power of the money supply growth on inflation has weakened over time. We note also that, other things given, the trade openness was not a significant predictor of ECOWAS inflation rates.

On the contrary, results indicate that real GDP and exchange rates are two other important predictors of inflation rates among ECOWAS members. As a matter of fact, a unit increase in real GDP reduces the risk of high inflation by 49.5%. This implies that the more productive a country gets, the less likely it is to experience high inflation. In addition, $\beta_5$, the coefficient of exchange rates showed that when the local currency unit appreciates against the US dollars, it reduces the risk of high inflation by 50.1%.

To buttress our results, we displayed the plots of each control variable alongside the inflation rates in Figures 7–10 in the Appendix. We observed that the magnitudes and the signs of the parameter estimates presented in Table 2 were consistent with what was shown in these Figures.

Inflation inertia was positive and significant; indicating that past high inflation increases the likelihood of more high inflation in the subsequent year. In other words, once price begins to rise, the risk of its continued increase, without any monetary or structural justification, was very high in ECOWAS between 1995 and 2019. We note further that the odds ratio of the inflation inertia with respect to other variables was very high; indicating that inflation inertia was the major determinant of high inflation in ECOWAS; followed by the level of corruption.

4.2. Model diagnostics for panel logit

Along the line of the conventional linear model, a test of model adequacy can be constructed for a logit model by comparing the deviance of Eq. (4) with that of the constant-only model. Fitting the constant-only model yields a loglikelihood value of -139.2020. The deviance is computed as follows (Hosmer and Lemeshow, 2000):

\[
Q = c + \beta_1 cor_{it} + \beta_2 Mgr_{it} + \beta_3 rgdp_{it} + \beta_4 tr_{it} + \beta_5 exch_{it} + \beta_6 s_{it} + \sum_{t=1}^{T} a_{it} \cdot i; i = 1, 2, \ldots, 15; t = 1, 2, \ldots T
\]

(4)

Table 1. Summary statistics of selected macroeconomic variables and corruption.

| Statistic | Inflation | CPI | Mgr growth | RGDP | Trade Open | Exchange rates |
|-----------|-----------|-----|------------|------|------------|----------------|
| Mean      | 0.192148  | 0.060000 | 0.964506   | 0.966921 | -0.471460  | 43.76735        |
| Maximum   | 2.402010  | 1.900000 | 9.072846   | 186.7457 | 39.39674   | 1474.199        |
| Minimum   | -0.030998 | -1.300000 | -13.51991  | -169.8838 | -132.2331  | -950.9980       |
| Std. Dev. | 0.449823  | 0.413687 | 2.722345   | 30.36199 | 13.88904   | 210.1787        |
| Observations | 205         | 205         | 205         | 205         | 205         | 205       |

Inflation rates and Real GDP (RGDP) were scaled down by $10^4$ and $10^9$, respectively, for uniformity.
Table 2. Panel logit model estimates.

| Correspondence | Coefficient | Estimate | Odds | Risk |
|----------------|-------------|----------|------|------|
| Constant       | c           | -3.162450 (0.449457) | 23.62841 | 0.959396 |
| Corruption perception index | $\beta_1$ | -1.558598 (0.658524) | 4.752154 | 0.826152 |
| Seigniorage     | $\beta_2$  | 0.168550 (0.153269)  | 1.183587 | 0.542038 |
| Broad money growth rates | $\beta_3$ | -0.355054 (0.269164) | 1.426258 | 0.587843 |
| Trade openness  | $\beta_4$  | -0.041542 (0.026695)  | 1.042417 | 0.501384 |
| Real GDP        | $\beta_5$  | -0.019911 (0.009842)  | 0.980286 | 0.495022 |
| Exchange rates (LCU/$) | $\beta_6$ | 0.003363 (0.001289) | 1.003369 | 0.500841 |
| Inflation (-1)  | a           | 5.141546 (0.684947) | 170.9799 | 0.994185 |
| Deviance        | D           | 96.74208               |
| Standardized Residual at lag 1 | Q(1) | 0.1815 [0.670] |
| Squared Standardized Residual at lag 1 | $Q^2(1)$ | 0.0263 [0.871] |
| Hosmer-Lemeshow goodness-of-fit | $H - L$ | 4.3347 [0.8257] |

Standard errors in parentheses.

- Not significant at 5%.
- * p-values.
- a Since the negative sign only implies that the corresponding variable has a negative effect, to convert from log odds to the odds, we ignored the sign and used only the magnitude.

\[
D = -2 \log L, \quad \text{where } L \text{ is the likelihood.}
\]

We compared the deviance corresponding to Eq. (4) and given in Table 2 with that of the constant-only model using the following equation (Hosmer and Lemeshow, 2000):

\[
G = D_{\text{const. term only}} - D_{\text{Model with predictors}}.
\]

Under $H_0$, the statistic G follows $\chi^2_6$. We obtained $G = 181.661$, with an associated p-value of $8.68 \times 10^{-36}$. Clearly, this is significant at the 5% level; therefore, we conclude that at least one of the 7 partial regression slopes is different from zero. Thus the model is adequate for the ECOWAS data.

In addition, we tested the significance of each of the slopes using the Wald's test. Under the null hypothesis that

\[
H_0 : \beta_i = 0, \quad i = 1, 2, \ldots, 6.
\]

Wald's statistics follow the normal distribution. Wald's test results have been indicated in Table 2: The * sign denotes that the corresponding Wald's statistic was not significant at the 5% level. Accordingly, we conclude that the level of corruption, real GDP, exchange rates and the inflation inertia are the significant predictors of the inflation rates in ECOWAS.

The last 2 rows but one of Table 2 contained the Ljung Box standardized and squared standardized residuals. The fact that the p-values were not significant at 5% implied that there is no left-over serial correlation or excess heteroscedasticity in the series. Thus the model was not mis-specified. In addition, Hosmer-Lemeshow ($H - L$) statistic provides useful goodness-of-fit test to measure the performance of the logit model. A p-value of 0.8257 implied that the actual and the predicted values are close for quartiles; that is, the model provided a good fit for the ECOWAS data.

4.3. Inflation turning points

In line with the business cycle literature, we estimated the turning points of inflation rates in SSA to delineate high and low inflation phases. Figure 5 plots the actual inflation rates versus the predicted probabilities. It is easily seen that in spite of the outlying observations of Liberia and Guinea, the logit model captured all the high inflation episodes.

A clearer view of Figure 5 can be achieved using the following rule: In line with the switching regression literature, we could assume that the ECOWAS system transists to the high inflation state (i.e. $y = 1$) when the probability exceeds 0.5, that is, $P_a > 0.5$ for country $i$ at time $t$. Thus to obtain the transition probability for the high inflation state, the computed predicted probabilities can be coded as follows:

\[
P = \begin{cases} 
1, & P_a > 0.5 \\
0, & \text{otherwise}
\end{cases}
\]

for country $i$ at time $t$.

Figure 6 below displayed the (coded) inflation rate series (top panel) together with the (coded) predicted probabilities (bottom panel). It is very obvious that the forecast probabilities coincided nicely with the high inflation rates except only one case of Niger (2008). A closer look at Figure 5 above revealed that the logit model was able to capture this episode; however, its predicted probability was <0.5 hence was not reflected in Figure 6.

4.4. Friedman’s hypothesis

This section analyzes the Friedman’s (1977) hypothesis. We tested the claim that the high inflation periods are also the highly volatile ones. To achieve this, we divided the entire sample into two groups (the high and
low inflation) using Eq. (7), and computed the variances of the high (σ²) and the low inflation (σ²) groups. Then using the Snedecor's F test we decided as appropriate. We obtained the estimates as \( \hat{\sigma}^2 = 0.4850 \) and \( \hat{\sigma}^2 = 0.0189 \). The high inflation period was approximately 26 times more volatile than the low inflation with p-value, \( p = 2.25 \times 10^{-29} \). Thus it can be concluded that the high inflation periods in ECOWAS were also the highly volatile ones.

4.5. Robustness check

For robustness, we employed one other alternative of inflation commonly used in the literature, the GDP deflator. We re-estimated Eqs. (2), (3), and (4) using GDP deflator as the metric for inflation. The corresponding estimate of corruption index was \( -1.6717 \) (\( p = 0.0016 \)). Further, the deviance of the estimated equation was \( D = 143.5492 \). Again, comparing this value with the deviance of the constant-only model (See Eq. (7)), we obtained \( G = 160.794 \) (\( p = 2.18 \times 10^{-31} \)). This clearly indicates that the inflation-corruption nexus is robust to the measure of inflation used.\(^3\) Thus we conclude that other things given, the more corrupt ECOWAS members are, the higher the likelihood to experience high inflation.

5. Conclusion and recommendations

Given the high level of corruption in Africa, the present paper studied its effect on inflation dynamics and investigates its suitability as a warning indicator for transiting from a low to high inflation state in the ECOWAS. To achieve these objectives, all 15 countries were selected and were studied between 1995 and 2019. The model adopted was the panel logit regression.

Empirical results showed that the corruption level (measured by corruption perception index) and inflation rates moved in the same direction. The relationship was robust to the effects of selected determining factors of inflation such as seigniorage, money supply growth, inflation inertia, trade openness, real GDP and exchange rates. It was also robust to the metric of inflation employed. This implied that, other things given, ECOWAS members with higher level of corruption had higher chance of experiencing high inflation. Specifically, for each unit increase in the level of corruption, the risk of experiencing high inflation increased, on the average, by 82.6% within 1995–2019. Our findings also indicated that seigniorage enhanced the movement of inflation rate system from low to high state. However, it was not enough to explain the link between inflation and corruption as the coefficient of corruption remained significant even after including a measure of seigniorage in the model. This implied that some other channels exist through which corruption affects inflation. Some studies such as Ali and Sassi (2016) had suggested debt financing.

Our findings also indicated that money supply growth and trade openness did not significantly influence inflation rates in the ECOWAS; whereas real GDP and exchange rates were two other important predictors of inflation rates. Further, we observed that the odds ratio of the inflation inertia with respect to other variables was very high; indicating that inflation inertia was the major determinant of high inflation in ECOWAS. This implied that once price begins to rise, the risk of its continued increase, without any monetary or structural justification, was very high in ECOWAS between 1995 and 2019.

In addition, the predicted probabilities were used to delineate high and low episodes of inflation in ECOWAS. A plot of these probabilities against the inflation rates revealed that in spite of the outlying observations of Liberia and Guinea, the logit modeling captured all the high inflation episodes. We also utilized the predicted probabilities in verifying the Friedman’s hypothesis. Results revealed that the high inflation periods in ECOWAS were also the highly volatile ones.

A major implication of the study is this: If inflation remained a monetary phenomenon, then money growth could be used to track its movement; however, with the level of corruption on the rise, this relationship is weakened so that it will be difficult for relevant stakeholders to understand let alone predicting inflation pattern through any of its conventional macroeconomic determinants. In addition, price stability reforms may not have a long-term effect (or be effective at all) in the ECOWAS if corruption is not eradicated or, at least, significantly reduced. The signing of the ECOWAS Protocol A/P3/12/01 is certainly a step in the right direction; however, it is more important for public administrators in the region to jointly and rigorously pursue transparency and accountability in the region to enhance credibility of the ECOWAS institution before a monetary union is constituted. Further, several anti-graft agencies have been constituted in member states to complement the regional efforts; however, these agencies would appear toothless and ineffective if they are not fully integrated into the governance structure and adequately funded (Badet et al., 2016). In addition, it is important to harmonize all anti-graft agencies in the region for effective operations. According to Christophe Dabire, the Prime Minister of Burkina Faso, corruption in the region has gone beyond national borders; all members must unite to tackle it if the region must develop.

Finally, our results also revealed that creating enabling atmosphere for investment and production will increase the level of productivity, stabilize exchange rates and consequently help in keeping inflation rates at single digit level. In simple terms, if the menace of corruption is not tackled, it will be difficult to make any meaningful progress in ECOWAS.

Declarations

Author contribution statement

I.O. Ayodeji: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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The authors declare no conflict of interest.

Appendix

Figure 7. Plots of Inflation and Money Supply Growth Rates for ECOWAS Excluding Liberia and Guinea (1995–2019).

Figure 8. Plots of Inflation and Real GDP growth Rates for ECOWAS Excluding Liberia and Guinea (1995–2019).

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4 Liberia and Guinea excluded in the plot due to outlying observations, but are included in the main analysis presented in Section 4.
Figure 9. Plots of Inflation Rates and Trade Openness for ECOWAS Excluding Liberia, Guinea, Togo and Niger (1995–2019).

Figure 10. Plots of Inflation and Exchange Rates for ECOWAS Excluding Niger, Sierra Leone, Liberia and Guinea (1995–2019).
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