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Tax Revenue and the informal sector in developing countries: the case of Côte d'Ivoire

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Abstract. *The informal sector is characterized by limited relations with the tax authorities, which reduces the tax base. As a result, governments are forced to resort to other sources of financing, including public debt policy. This study provides an opportunity to analyze the relationship between the development of informal activities, changes in the general price level, and tax revenues in the case of Côte d'Ivoire. To this end, we empirically address this issue with the help of a linear econometric time series model over the period 1987-2020, using cointegration techniques. On the basis of the prediction of the linear model, the empirical results reveal that the Ivorian state would be rational if the policy of financing the economy were based on increasing the general price level to the detriment of taxes because of the extent of the development of informal activities. In addition, the Ganger causality test shows two significant unidirectional causalities. One from the informal sector to tax revenues and the other from price increases to tax revenues.*

Keywords: Informal sector, Côte d'Ivoire, tax revenues, cointegration.

JEL Classification: E26, C32, E31, E6.

1. Introduction

The relationship between the expansion of the informal sector and taxation abounds in the economic literature. The informal sector occupies a considerable share of developing economies, i.e. over 40% of GDP (Schneider & Enste, 2000; Gërxhani, 2004 Schneider, 2005, 2007, La Porta & Shleifer, 2008; Hassan & Schneider, 2016; Schneider & Buehn, 2017; Oyibo & Schneider, 2022,). However, its macroeconomic impacts are mixed.

Indeed, for most theoretical and empirical work, it is important to formalize informal production units in order to reduce the perverse effects of the informal sector. Moreover, this sector represents a brake on growth in developing countries. However, some works give it the role of a job-creating sector. In his work, Lewis characterizes the informal sector as the coexistence of two distinct, non-dichotomous sectors, i.e. the "traditional" sector and the "modern" sector. For the author, the so-called traditional sector is characterized by the underemployment of surplus labor. The dualist approach considers the informal sector as a residual component of the labor market that has no relationship with the formal sector. The informal sector is then said to compensate for the inadequacy of the formal sector in the context of insufficient labor supply.

The structural approach states that the informal sector is composed of small enterprises and unregistered workers, subordinate to large capitalist enterprises. Indeed, there would be interdependence between the formal and informal sectors (Portes & *al,* 1989). For proponents of this theory, growth cannot eliminate the informal production relationships that are intrinsically linked to capitalist development (Bacchetta & Bustamante, 2009). Some thinkers believe that this sector improves the dynamism of the economy in terms of competitiveness and flexibility by promoting the expansion of the formal sector (Choi & Thum, 2005). They also argue that the formal sector improves welfare in its different components.

From this controversy, it emerges that the informal sector is characterized by a low level of taxation, yet taxation is an indispensable instrument for financing development policies. Thus, Kerrouch & *al* (2018) argue that there is a negative relationship between the size of the informal sector and the mobilization of tax revenues, which was demonstrated by Ihring & Moe (2004). Like other sub-Saharan countries, Côte d'Ivoire has experienced a period of great instability due to a politico-military crisis that favors the development of a large number of informal activities. However, in view of mobilizing more of the country's own resources for the financing of the national economy, this paper attempts to address the issue of the impact of the size of the informal sector on price trends and tax revenues in Côte d'Ivoire. More precisely, we test the hypothesis of the existence of a long-run relationship between these two economic variables. To do so, we use a time series econometric model with annual data covering the period 1987 to 2020, using cointegration techniques. In order to achieve our objective, the following assumptions are made:
H1: the informal sector reduces tax revenues;
H2: the rise in the price level improves tax revenue.

The remainder of the study is organized as follows. The next section describes the data and the econometric strategy used. The third section focuses on the presentation and the econometric and economic interpretations of the results. The fourth and final section will conclude and discuss our results before making policy implications.

2. The Theoretical Model

To describe the impact of the informal sector on the state budget, we consider a government that has to finance a given level of public expenditure G with two instruments, a flat tax on production with rate τ and seigniorage. On production with a rate τ , and seigniorage. However, the informal sector accounts for a share ϕ of the national GDP. As the output of this sector escapes taxation, the tax revenue on production is equal to $\tau(1-\phi)Y$. If we denote seigniorage revenues, the government's budget constraint is formalized as follows:

$$G = \tau(1-\phi)Y + Q \quad (1)$$

Variations of this budget constraint can be found in the work of Cukierman & *al* (1992), Edwards & Tabellini (1992), De Cavalcanti & Villamil (2003), Koreschkova (2006) or Prado (2011). These works verify the hypothesis that the informal sector reduces the tax base.

However, modeling seigniorage will be based on the work of Mankiw (1987). Thus, we assume that the demand for money is formalized as follows:

$$\frac{M}{P} = kY \quad (2)$$

where M represents the quantity of external money, P the price level and k a constant. Equation (2) can be rewritten as follows:

$$\frac{M}{M} = \pi + g \quad (3)$$

where π denotes the inflation rate and the growth rate of GDP. From equations (1) and (2), the real revenue from seigniorage can then be reformulated as follows:

$$\frac{M}{P} = \frac{M}{M}.\frac{M}{P} = (\pi + g)kY \quad (4)$$

It is assumed that the costs of taxes and inflation increase with their level and that the marginal costs are increasing. The cost of taxes is given by$f(\tau)Y$, with $f' > 0$and $f'' > 0$. The cost of inflation is given by $h(\pi)Y$, with $h' > 0$ and $h'' > 0$. The government has to finance public expenditure, ut wishes to minimize the total cost of this financing. It is important to specify that these are costs as opposed to deadweight losses, in order to keep the model as general as possible. The model can therefore be applied to a benevolent social planner who minimizes welfare losses, as well as to a corrupt dictator who seeks to minimize the cost to his regime of taxation and seigniorage. As a reminder, the mechanism at work is more general than the mechanism assumed by Nicolini (1998), Cavalcanti & Villamil (2004), and Koreschkova (2006), who all assumed a benevolent social planner. What matters for the argument is that the cost to the government is increasing and convex

with tax rate and inflation, either because of the shape of the social welfare function or because of the dictator's tax technology and his own utility function.

Replacing seigniorage given by equation (4) with its value in equation (1), the cost to government becomes:

$$\begin{cases} Minf(\tau)Y + h(\pi)Y \\ s.t.\, G = \tau(1-\phi)Y + (\pi + g)kY \end{cases} \quad (5)$$

The first-order condition of this optimization problem is as follows:

$$kf'(\tau) - (1-\phi)h'(\pi) = 0 \quad (6)$$

Applying the implicit function theorem to the above condition, and recalling the assumption concerning the second derivatives of f and h, we obtain the following result:

$$\frac{\delta\pi}{\delta\phi} > 0 \quad (7a)$$

$$\frac{\delta\pi}{\delta\phi} < 0 \quad (7b)$$

As a result, the inflation rate is an increasing function of the share of shadow economy, while the share of taxes in GDP is a decreasing function of the share of informal sector, while the share of taxes in GDP is a decreasing function of the share of the informal sector. The intuition of this result is that the increase in the share of unobservable sector hampers the tax base. As a result, the marginal cost of collecting a monetary unit of tax revenue increases, which induces the government to substitute inflation tax revenue for income tax revenue. Therefore, an expanding informal sector results in both a higher inflation rate and a lower tax share in GDP. We test this hypothesis in the rest of our investigation.

3. Data and Econometric Methodology

According to the literature, the relationship between the size of the informal sector and the tax burden is linear and may be influenced by various structural variables. Thus, this study uses a linear regression model. The estimation procedure will depend on the nature of the variables used in the model. Thus, the multiplicative equation of the seven variables is linearised using the logarithms of the variables in the empirical model and introducing an error term ε.

In functional form, the equation to be estimated can be written as follows:

$$TAX = f(IS, GDPC, GFCF, P, X, URB, CORR)$$

After taking the log of all variables, we can then express the tax equation in the following econometric form:

$$LTAX_t = \alpha_0 + \alpha_1 LIS_t + \alpha_2 LGDPC_t + \alpha_3 LGFCF_t + \alpha_4 LP_t + \alpha_5 LX_t + \alpha_6 LURB_t + \alpha_7 LCORR_t + \varepsilon_l \quad (8)$$

With, *LTAX*: logarithm of tax revenue; *LGDPC*: logarithm of real GDP per capita; *LGFCF*: logarithm of gross fixed capital formation used as a proxy for private investment *LX* logarithm of the export rate of goods and services used as a proxy for trade openness *LP*: logarithm of the Consumer Price Index; *LSI*: logarithm of informal sector; *LCORR*: logarithm of the corruption perception index used as a proxy for the quality of institutions; *LURB*: logarithm of the share of the urban population in the total population used to capture urbanization; α_i: Coefficients to be estimated and ε: the error term.

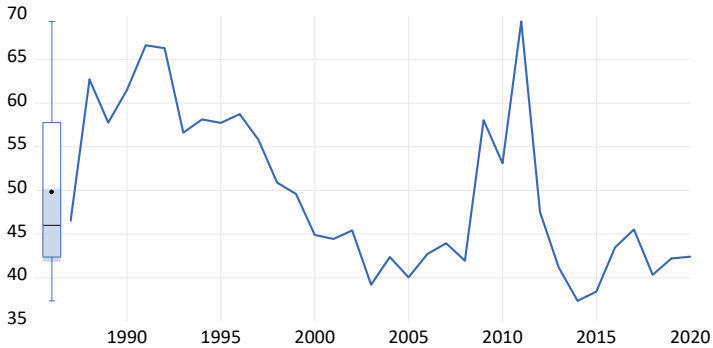
To analyze the effect of the size of the informal sector on tax revenue, annual data on all our variables are extracted from several databases: the site of the Central Bank of West African States (BCEAO, 2021). Tax revenue series is extracted from. We also use the International Country Risk Guide (ICRG) held by Political Risk Services, from which the institutional variable (corruption perception index) is extracted. Another database used is the World Development Indicator (WDI, 2021). Our main estimate of the informal sector is that provided by Oyibo & Schneider (2022). They estimate the contribution of the informal sector to the national economy from 1987 to 2020 using the multiple causes, multiple indicators (MIMIC) model. This method provides the size of the unobservable sector from variables such as tax burden, inflation, corruption, real GDP per capita, and currency circulation. In order to calibrate the absolute figures of the size of the informal sector from the relative results of the MIMIC estimation, our authors used previous estimates. The latter contains normally long-series data on the other variables of the model. This study covers the period 1987-2020.

Table 1. *Description of variables*

Variable	Expected sign	Label	Source
TAX	-	Tax revenue	BCEAO (2022)
IS	Sign (-)	Informal sector	Oyibo and Schneider (2022)
GDPC	Sign (+)	GDP per capita	WDI (2022)
GFCF	Sign (+)	Gross fixed capital formation	WDI (2022)
X	Sign (+)	Export rate of these goods and services	WDI (2022)
CORR	Sign (+)	Corruption Perception Index	WDI (2022)
P	Sign (-)	Consumer price index, based 2010	WDI (2022)
URB	Sign (+)	Share of the urban population in the total population	WDI (2022)

Source: Authors.

Graph 1. *Size of the informal sector of Côte d'Ivoire from 1987 to 2020*



Source: Oyibo P.V., & Schneider F., (2022). How large is the size of Côte d'Ivoire's informal sector? A MIMIC approach.

From 1987 to 1994, there was an increase in the size of the informal sector. This trend took a different turn after the devaluation of the local currency in 1994 and continued until 2003. This figure highlights the negative relationship between the informal sector and political stability. The peak of informal activities was reached in 2011 during the post-election crisis. Indeed, the decade of crisis favored an expansion of the informal sector as the country was occupied in the north by an armed rebellion and in the south by a legitimate government. Thus, the development of informal activities in the north, which was without tax administration, led to a decrease in tax yields. According to our results, the informal sector occupies, on average, 50% of the national wealth from 1987 to 2020. In general, the results indicate a general downward trend marked by a succession of peaks and troughs in line with the macroeconomic performance of Côte d'Ivoire since the aftermath of the decade-long political and military crisis.

4. Results and Discussion

This section focuses on the empirical estimation, presentation and economic interpretation of the regression results carried out using the methodology highlighted in the previous section.

4.1. Descriptive statistics and correlation matrix

Before any econometric analysis, it is necessary to measure the level of linkage between the variables and also to check for the presence of outliers in each chronic series.

Table 2. *Descriptive Statistic*

	LTAX	LIS	LGDPC	LGFCF	LP	LX	LURB	LCORR
Mean	7.1974	3.8919	3.2593	2.7071	4.3456	3.3973	3.7965	3.2145
Median	7.1279	3.8291	3.2515	2.6899	4.4331	3.4037	3.7979	3.1567
Maximum	8.3306	4.2391	3.3669	3.1563	4.7389	3.7319	3.9455	3.5835
Minimum	6.0760	3.6206	3.1925	1.9004	3.6652	3.0704	3.6466	2.9444
Std. Dev.	0.6527	0.1796	0.0516	0.3435	0.3582	0.1449	0.0909	0.2028
Skewness	0.0852	0.3596	0.4584	-0.7844	-0.6919	-0.0091	-0.0239	0.5639
Kurtosis	2.1058	1.8368	2.2659	3.0423	2.1179	3.3074	1.7818	1.9676
Jarque-Bera	1.1737	2.6495	1.9541	3.4893	3.8152	0.1344	2.1054	3.3117
Probability	0.5560	0.2658	0.3764	0.1747	0.1484	0.9350	0.3489	0.1909
Sum	244.7131	132.3278	110.8173	92.0422	147.7511	115.5099	129.0837	109.2952
Sum Sq. Dev.	14.0626	1.0651	0.0879	3.8955	4.2343	0.6930	0.2729	1.3583
Observations	34	34	34	34	34	34	34	34

Source: Authors, based on data from BCEAO (2021), ICRG (2021), and WDI (2021)

Table 2 provides information on the individual statistical information of the variables that will be included in our linear model. According to this table, all variables are normally distributed. Indeed, the probability of the Jarque-Bera statistic associated with each series is greater than 5%. In sum, these results indicate that the data do not suffer from any "outlier" problem. The next step in our investigation is to measure the strength and direction of the relationship between the variables in our model. To do so, we analyze the correlation matrix.

Table 3. *Correlation Matrix*

Correlation								
Probability	LTAX	LIS	LGDPC	LGFCF	LP	LX	LURB	LCORR
LTAX	1.0000							
LIS	-0.6599*	1.0000						
LGDPC	0.3229*	-0.1121	1.0000					
LGFCF	0.8656*	-0.6190*	0.2088	1.0000				
LP	0.9319*	-0.6503*	-0.0126	0.8478*	1.0000			
LX	-0.5455*	0.4837*	-0.6822*	-0.3609**	-0,3695**	1,0000		
LURB	0.9634*	-0.6331*	0.1614	0.7999*	0,9580*	-0,4825**	1,0000	
LCORR	0.7147*	-0.4166*	0.7027*	0.6601*	0.5332*	-0,6476*	0,6185*	1,0000

Note: * : P-value<0,01 ; ** : P-value<0,05 ; *** : P-value<0,1.
Source: Authors, based on data from BCEAO (2021), ICRG (2021), and WDI (2021).

Table 3 reveals that all variables are positively correlated with tax revenue except for the informal sector and exports which are negatively correlated with tax yields. In general, these correlation coefficients are all significant at the 5% level. However, this different correlation seems strong because overall, these coefficients are higher than 0.5.

4.2. Stationarity Tests

The study of stationarity is essential for the validity of a time series regression. For this study, we will use the Andrew and Zivot (AZ) test, which is used for a series that exhibits an endogenously identified structural break or regime shift. The results of this test are presented in the table below:

Table 4. *Results of the AZ stationarity tests*

Variable	Breakdown date	In level	Breakdown date	In 1st difference
LTAX	2012	>0,99	2007	< 0,01
LIS	2011	0,5632	2003	< 0,01
LGDPC	1977	0,734	1983	< 0,01
LGFCF	1981	0,7307	1984	< 0,01
LX	1992	0,0665	1998	< 0,01
LP	1993	0,7801	1994	< 0,01
LURB	1979	>0,99	1978	< 0,01

Source: Authors, based on BCEAO (2021) and WDI (2021) data.

According to the results of the AZ test, all variables are unit order stationary i.e. I (1). Thus, according to Keho (2011), the estimation of series with different integration orders is very complex. At a glance, the ordinary least squares (OLS) method does not seem to be adequate, as there is a presumed long-run relationship between the series. This leads us to determine the cointegration rank of the variables. However, before determining the cointegration rank, it is necessary to know the optimal number of lags.

4.3. Optimal number of lags and test for cointegration of variables

Cointegration analysis allows the true relationship between two variables to be clearly identified, by looking for the existence of a cointegrating vector and eliminating its effect where appropriate. According to Keho (2013), there are several tests for cointegration including the Pesaran et al (2001) test, the Johansen (1988) test, and Engle and Granger (1987). In the case where all time series are integrated in unit order, the most common tests are Engle and Granger (1987) (bivariate case) and Johansen (1988) (multivariate case). The

approach used in this study is the Johansen (1988) cointegration test. The application of this test requires the prior determination of the optimum number of lags to be considered.

An important step in the framework of dynamic models is the determination of the optimum number of lags to consider. To determine this, different criteria are often used, the most common of which are: Akaike Information Criterion (AIC) and Schwartz Information Criterion (SIC). In our study, the determination of the optimal delay reveals satisfactory results. Indeed, all criteria indicate the existence of two delays. Thus, the number of delays 2 is retained.

Table 4. *Determining the optimal delay*

Lag	LogL	LR	FPE	AIC	SC	HQ
0	278.8672	NA	6.14e-18	-16.9292	-16.5627	-16.8077
1	631.6879	507.1799	1.01e-25	-34.9805	-31.6825*	-33.8873
2	741.1918	102.6599*	1.36e-26*	-37.8244*	-31.5951	-35.7596*

Note: *indicates the order of the delay selected by the criteria considered. (Each test is at the 5% threshold); LR: Likelihood ratio; AIC: Akaike criterion; SC: Schwarz criterion; HQ: Hannan-Quinn criterion; FPE: Final Prediction Error.
Source: Authors, based on BCEAO (2021) and WDI (2021) data.

Table 5. Johansen cointegration test

Null hypothesis	Eigenvalue	Stat of theTrace	Critical value (5%)	Probability
None *	0.9547	326.8661	125.6154	0.0000
At most 1 *	0.9456	230.9152	95.7536	0.0000
At most 2 *	0.8051	140.6532	69.8188	0.0000
At most 3 *	0.7082	89.9457	47.8561	0.0000
At most 4 *	0.6484	51.7533	29.7970	0.0000
At most 5 *	0.4596	19.3485	15.4947	0.0125
At most 6	0.0085	0.2667	3.8414	0.6055

Source: Authors, based on BCEAO (2021) and WDI (2021) data

The results of the Johansen cointegration test reported in this table show that there are five (5) cointegrating relationships as the probability is greater than 5% from more than 5 cointegrating relationships. Thus, the estimation of a long-run relationship involving integrated variables has been the subject of much recent literature (Keho, 2011). The literature proposes three methods for estimating integrated time series of unit order. The choice of the appropriate method depends not only on the presence of cointegrating relationships but especially on the number of cointegrating relationships considering all the variables of the model to be estimated (Keho, 2013; Schoeman and Heerden, 2009).

4.4. Long-term estimation

As mentioned above, we analyze the relationship between tax yields and the development of informal sector in Côte d'Ivoire using cointegration methods. To do so, we use the FMOLS (Full Modified Ordinary Least Squares) technique proposed by Phillips and Hansen (1990), and DOLS (Dynamic Ordinary Least Square) proposed by Stock and Watson (1994) to overcome some of the limitations of the OLS method, and also the Canonical cointegrating regression (CCR) technique. Indeed, when the presence of a long-term relationship has been confirmed, these three methods can then be applied to analyze the long-term relationship between the cointegrated variables. The results are reported in the table below:

Table 6. *FMOLS, DOLS, and JRC estimation results*

Variable	FMOLS	DOLS	CCR
The logarithm of the informal sector	-0.2423* (0.0021)	-0.5484 (0,1455)	-0.2522* (0.0032)
The logarithm of GDP per capita	5.2541* (0.0000)	9.3592** (0.0170)	5.2460* (0.000)
The logarithm of private investment	0.0852 (0.1735)	-0.9298 (0.1377)	0.0778 (0.3902)
The logarithm of the Consumer Price Index	1.2330* (0.0000)	3.7499** (0.0369)	1.2517* (0.0000)
The logarithm of exports of Goods and Services	0.5175* (0.0001)	1.3689 (0.1382)	0.5507 (0.0035)
The logarithm of urbanization	2.0710* (0.0001)	-5.9746 (0.1026)	1.9953* (0.0003)
The logarithm of corruption	-0.3457* (0.0008)	0.1471 (0.6543)	-0.3229** (0.0178)
Constant	-23.0824* (0.0000)	-12.3666 (0.2230)	-22.9808 (0.0000)
R adjusted square	0.9862	0.9957	0.9861
Conclusion of the Jarque Bera normality test on the residuals	Oui	Non	Oui

Note: * : P-value<0,01 ; ** : P-value<0,05 ; *** : P-value<0,1.
Source: Authors, based on BCEAO (2021) and WDI (2021) data.

Recall that the estimated equation is:

$$LTAX_t = \alpha_0 + \alpha_1 LIS_t + \alpha_2 LGDPC_t + \alpha_3 LGFCF_t + \alpha_4 LP_t + \alpha_5 LX_t + \alpha_6 LURB_t + \alpha_7 LCORR + \varepsilon_l$$

A remarkable observation of these results is that regardless of the estimation technique (FMOLS, DOLS, or CCR), the coefficient of the log of the estimated informal sector is negative. This means that in the long run, the expansion of the informal sector undermines the internal resource mobilization capacity of the state. However, this coefficient is significant through the FMOLS and CCR methods. Moreover, the explanatory power of the model estimated by the FMOLS method is higher than that obtained by the CCR method. Thus, in the case of this study, the results provided by the FMOLS technique will be retained.

The estimated equation is therefore:

$$\widehat{LTAX_t} = -23.0824 - 24.23 LIS_t + 5.2441 LGDPC_t + 0.0852 LGFCF_t + 1.2330 LP_t + 0.5175 LX_t + 2.0710 LURB_t - 0.3457 LCORR \quad (9)$$

As the results of the FMOLS estimation indicate, several factors determine the ability to mobilize tax revenues in Côte d'Ivoire. Thus, GDP per capita, the informal sector, the export of goods and services, inflation, corruption, investment, and urbanization account for about 98.62% of the variations in tax yields. The remainder is attributable to other factors outside the model, which are taken into account by the error term.

The development of informal activities negatively and significantly affects tax revenue collection at the 1% threshold. In other words, a 1% increase in the informal sector leads to a decrease in tax revenue of 0.24%. This could be explained by the fact that the development of informal activities reduces the tax base. The long-term results also show that a price increase has a positive and significant impact on the mobilization of the state's

own resources. In addition, a 1% increase in the level of price leads to a 1.23% increase in tax revenue. Moreover, the long-term results show a positive and significant effect on tax revenues at the 1% threshold of GDP per capita, urbanization, and trade openness. However, institutional quality such as corruption is harmful to tax revenue collection as it discourages tax compliance.

4.5. Analysis of Granger Causality

The Granger causality test is carried out to examine the pattern of existing relationships between the logarithm of tax revenues and these determinants, which are the logarithm of the consumer price index and the logarithm of the size of the informal sector. The table below shows the results of this test. The results show, firstly, the existence of a significant unidirectional causal relationship at the 1% level between the logarithm of the informal sector and the logarithm of tax revenues, and secondly, a significant unidirectional causal relationship at the 10% level between the logarithm of the consumer price index and the logarithm of tax revenues.

Table 7. *Causality test results*

	Obs	F-Statistic	Prob.
DLIS does not Granger Cause DLTAX	31	2.42898	0.0079
DLTAX does not Granger Cause DLIS		0.21512	0.8079
DLP does not Granger Cause DLTAX	31	2.93738	0.0708
DLTAX does not Granger Cause DLP		0.96544	0.3941
DLP does not Granger Cause DLIS	31	1.24859	0.3035
DLIS does not Granger Cause DLP		4.44873	0.0218

Source: Authors, based on BCEAO (2021) and WDI (2021) data.

5. Conclusion and Policy Implication

This study allowed us to analyze the relationship between informal sector and tax yield from 1987 to 2020, using cointegration techniques such as DOLS, FMOLS, and CCR. The results reveal the existence of long-run relationships between the variables. The results suggest that in the long run, tax revenues are negatively impacted by the development of informal activities and positively by inflation. Furthermore, the dynamism of the national economy, its openness to the outside world, and the quality of national institutions are factors to be taken into account by the tax administration. In addition, the Ganger causality test shows two significant unidirectional causalities. One from the informal sector to tax revenues and the other from price increases to tax revenues.

These results imply that the degradation of the tax base by informal activities is a powerful driver of tax resource mobilization and price variations. Faced with an expansion in undeclared activities, the Ivorian government is moving from taxation to seigniorage. This was confirmed in the literature review. The present work provides confirmation for the case of Côte d'Ivoire through econometric evidence.

Another implication is that monetary arrangements in the West African region, which limit the ability of the Ivorian state to stimulate increases in the general price level, can cause significant tensions in the face of the expansion of the informal sector. This is particularly

the case with monetary integration in the WAEMU zone, whether through a fixed exchange rate regime or a monetary union. Thus, the informal sector can compromise the viability of the State budget and/or the credibility of the State's commitments. The Ivorian government would be rational if its policy for financing the economy were based on raising prices at the expense of taxes, given the scale of development of informal activities. Our two hypotheses are thus verified.

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