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The determinants of political instability: the role of mining resources

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Abstract. *This article examines the relationship between mining exports and political instability in the West African Economic and Monetary Union (WAEMU). The study covers the 2002-2019 period. Based on a panel data set, the empirical model is estimated using Driscoll and Kraay standard error estimation technique. Findings show that mining exports play a significant role in political instability. An increase in mining exports likely increases the risk of political instability. These findings suggest that controlling corruption and building human capital are channels through which mineral resource exports can mitigate the risk of political instability.*

Keywords: mining exports, political instability, Driscoll-Kraay, WAEMU.

JEL Classification: C23, E02, F14, H56, Q34.

1. Introduction

Political instabilities affect low-income countries and are an obstacle to economic development. Political instability is the set of violent or conflict phenomena that bring uncertainty and risks to economic development (Rodrik, 1991, pp. 229-242). Conflicts refer to civil wars, civil unrest, political violence, and terrorist violence. According to Gupta (1991, pp. 151-178) and Alesina and Peroti (1993, pp. 1203-1228), political instability has two dimensions: executive instability on the one hand, and social unrest (riots, strikes, demonstrations) and politically motivated violence on the other. In 2022, political instability accounted for 80% of humanitarian assistance needs. They are likely to worsen by 2030, affecting nearly 67% of people living in extreme poverty (World Bank, 2022). Sub-Saharan Africa is often unstable and characterized by conflict (Alesina et al., 1996, pp. 189-211; Kobbi and Eggoh, 2021, pp. 604–642). High risk of political instability negatively affects countries' quality of life, productive capacity, transactions, and economic growth (Dalyop, 2018, pp. 217–257).

Between 1990 and 2019, there were more than 38,100 conflict-related deaths in the WAEMU. In addition, nearly 90 coups were recorded in the region between 1960 and 2019 (Polity V, 2021). According to Fosu (1992, pp. 829-841), these coups and deaths are indicators of political instability. This instability can be explained by income inequalities that widen the gap between the rich and poor classes (Blanco and Grier, 2009, pp. 76-95; Gakpa, 2019, pp. 90-117). These inequalities are likely a source of violence and conflict. Added to this problem of inequality is the fragmentation of political systems into political parties. This political fragmentation often leads to unrest (Gyimah-Brempong and Traynor, 1999, pp. 52–86). In addition, the lack of control over corruption and democratic exercise is also a significant problem (Al-Shammari and Willoughby, 2017, pp. 196-217). For other authors, budget deficits and past conflicts are also problems that lead to political instability (Dalyop, 2018). Thus, the problem of political instability can be explained by several factors. In this context, a specific knowledge of the determinants of political instability in the WAEMU could help prevent and control the emergence of conflicts (Kobbi and Eggoh, 2021, pp. 219-263).

From a Theoretical point of view, the determinants of political instability are analyzed on the basis of conflict and crime theory (Becker, 1974). The basic hypothesis emphasizes the predatory behavior of individuals given their inability to achieve a Pareto optimum. The maximizing behavior of economic agents is seen as a source of political instability. In this sense, New Public Economics postulates that political parties and interest groups behave like political entrepreneurs seeking profit (Buchanan and Tullock, 1962). This theory helps to understand the behavior of politicians, interest groups, voters, and how democracy works. Indeed, these interest groups and political parties seek political power and influence government economic policy. An individual's motivation to join a rebel group depends on the opportunity cost between his productive activities and membership in that group. The emergence of instability thus depends on the likely gains of the rebels, the capacities of the state relative to its military strength, and the opportunity costs to individuals of joining or not joining a rebel group (Laville, 2018, pp. 1-57). Rodrick (1991, pp. 229-242) and Acemoglu et al. (2005, pp. 386-464) focus instead on institutional factors. They explain

that institutional quality allows conflicts to be managed at the lowest possible cost and prevents domestic and social conflicts from exacerbating an existing economic shock.

Another strand of theoretical and empirical literature addresses the role of natural resources in political instability. Collier and Hoeffler (1998, pp. 563-573), who use the sum of primary product exports to analyze the impact of natural resources on civil wars, conclude that the impact is ambiguous. In their work, civil war is used as a sufficient indicator to measure political instability. On the one hand, natural resources tend to reduce conflict because their dependence is a source of revenue for the state compared to other economic activities. On the other hand, according to Collier and Hoeffler (2004, pp. 63–95) and Rohner (2018, pp. 5-25), natural resources are likely to generate conflict risks. Laville (2018) explicitly sees natural resources as a financing opportunity for armed groups. Indeed, natural resource wealth financially motivates armed groups to wage war. For Dalyop (2018, pp. 563-573), the economy's dependence on natural resources may increase the propensity of political opposition and rebels to seek political power through conflict. On the other hand, lack of control over natural resources is an important cause of conflict. Governance is the set of processes, rules, and policies that determine how decisions are made and executed (Rohner, 2018, pp. 5-25). This governance can include the exercise of power, transparency, and accountability in natural resource management.

Sachs and Warner (1995, pp. 1-47) find a negative impact of natural resources on economic growth when total commodities are used. In contrast, Ouoba (2016, pp. 108-116) shows that natural resource rents (natural resource dependence) positively affect economic growth. While this research attempts to establish a link between natural resources and economic growth, it ignores the impact of mining resources on political instability. On the other hand, Barma (2021, pp. 1-9) highlights the positive impact of oil resources on conflicts in oil-producing countries in specific cases. For Lujala et al. (2005, pp. 538-562), primary diamonds that are difficult to mine reduce conflict, while secondary diamonds that are easy to mine increase conflict.

A review of this literature shows that indicators of political instability in most works are limited to one-dimensional parameters (Fosu, 1992, pp. 829-841; Alesina and Peroti, pp. 1203-1228, 1993; Krammer and Kafouros, 2022, pp. 604–642). However, political instability includes multiple dimensions that need to be considered. In addition, previous work considers natural resources without considering the specificities. Natural resources include forestry, gas, oil, and mining. Looking at WAEMU countries, attention must be paid to mining resources given their importance to individuals and national budgets. According to Laville (2018, pp. 1-57), the overall impact of natural resources on political instability is still not clearly understood. The scope of these various studies therefore remains limited, and their findings are poorly suited to the context of WAEMU countries.

The purpose of this study is to analyze the impact of mineral resource exports on political instability in the WAEMU. It completes the empirical literature by examining the impact of mineral resource exports on political instability. It differs from previous studies that consider the overall effect of natural resources without any specification. The WAEMU has experienced an increase in mineral resource exports from 2002 to 2019. Gold exports account for 98.25% of total mining exports (UN Comtrade, 2023). This shows that the

share of gold in mining exports is predominant in the WAEMU during this period. Moreover, the empirical application of the appropriation approach of Boschini et al. (2007, pp. 593-617) allows an analysis of appropriable resources to explain the risk of political instability in the WAEMU.

Another original feature of this study is the construction of a composite index of political instability. Based on 10 indicators and using principal component analysis, 2 composite indices, called "principal components," are constructed along two dimensions of political instability: Executive Instability and Violent Instability. In our analyses, we consider unrest within the government on the one hand and unrest outside the government on the other hand. These two main components allow for a more detailed analysis of the relationship between mining exports and political instability. The use of interaction terms between commodity exports and control of corruption, on the one hand, and between commodity exports and enrollment rates, on the other, is also a contribution of this paper. These interaction terms highlight the role of corruption control and human capital in reducing political instability.

In the following, the term "mineral resources" is used for the export of mineral resources. The remainder of the paper is divided into four sections. The first section reviews the economics literature on the determinants of political instability. The second section is devoted to stylized facts, and the third section presents the methodological approach. The last section presents and discusses the main findings.

2. Literature on the economic and institutional determinants of political instability

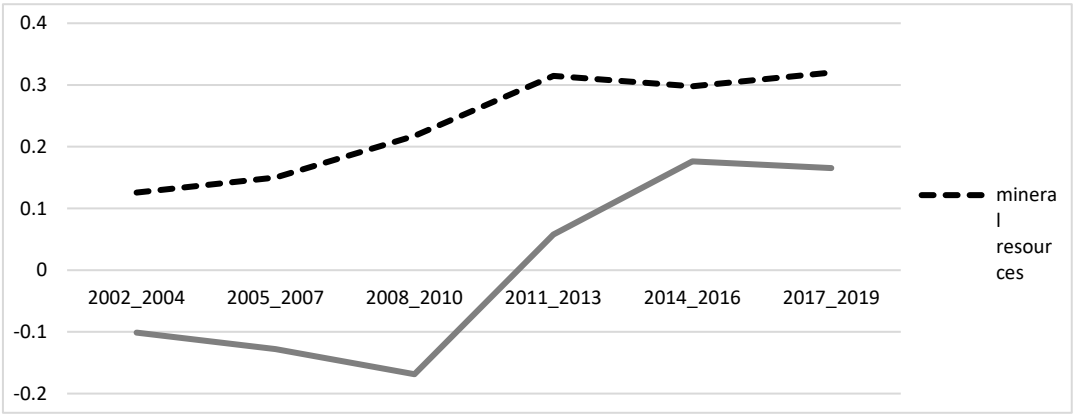
This section empirically examines the economic and institutional determinants of political instability. Gakpa (2019, pp. 90-117) shows that democracy significantly reduces the risk of political instability. However, the mechanism by which democracy affects political instability has not been demonstrated. Collier and Hoeffler (1998, pp. 563-573), using a Probit and Tobit model find that ethnolinguistic fractionalization significantly increases the risk of civil war outbreak. Subsequently, using a simultaneous equation model, Gyimah-Brempong and Traynor (1999, pp. 52–86) find that political instability depends not on ethnolinguistic fractionalization but on regime fractionalization. Thus, their work confirms the New Public Economy theory, which postulates that the behavior of political parties or politicians, and interest groups, affects government economic policy and makes government unstable (Buchanan and Tullock, 1962). Kobbi and Eggoh (2021, pp. 219-263) are at odds with the earlier results. They find that political fractionalization has no significant influence on political instability. On the other hand, the influence of the forms of government can also lead to constitutional unrest. For instance, the problem of property rights and the lack of political freedom tend to increase political instability in a country (Al-Shammari and Willoughby, 2017, pp. 196-217). These authors also note that regime permanence tends to significantly increase political instability. However, they underline that the impact of democracy on political instability remains difficult to determine. They also find that political instability in the previous year influences current instability (Al-Shammari and Willoughby, 2017, pp. 196-217).

Gyimah-Brempong and Traynor (1999, pp. 52–86) and Dalyop (2018, pp. 217–257) shows that an increase in economic growth significantly reduces political instability, while economic deterioration increases it. Gakpa (2019, pp. 90-117) finds that income inequality increases political instability. Collier and Hoeffler (1998, pp. 563-573), using a Probit and Tobit model for the period 1960 to 1992, find that an increase in initial per capita income reduces the probability of civil war. In contrast to these results, Kobbi and Eggoh (2021, pp. 219-263) based on a sample of 103 countries find that economic growth is not significant. Al-Shammari and Willoughby (2017, pp. 196-217) conclude that food prices significantly increase political instability.

3. Political instability in the WAEMU: Some stylized facts

The graph shows the relationship between political instability and the export of mining resources. Most mining resources are gold-bearing. More specifically, 98.25% of mining exports are gold resources (UN Comtrade, 2023). The shape of these two curves in the graph seems to indicate that there is a relationship between mining resources and political instability in the WAEMU. Both curves show an increasing trend over the 2002 to 2019 period.

Figure. *Trends in political instability and mineral (mining) resources, from 2002 to 2019*



Source: Authors

4. Methodological approach

This section first presents the specification of the theoretical model. It then describes the estimation methods. Finally, it presents the variables used and the data sources.

4.1. Specification of the theoretical model and presentation of the empirical model

The various theoretical arguments on the determinants of political instability have led us to propose a model. To analyze the impact of mining resources on political instability, the theoretical model uses the political instability equation from the model of Alesina et al. (1996, pp. 189-211). This equation is modified to fit this research. In the original model,

political instability, as measured by the probability of a change in government, is determined by economic and political variables.

$$C^* = \beta X + \varphi \quad (1)$$

Where C^* is the dependent variable. $C \succ 0$ means that government change is observable. $C \prec 0$ means that change is unobservable. X represents economic and political factors in government change propensity. φ is the error term. The variable X can be split into X_e (economic factors) and X_p (political factors) with δ and θ as parameters to be estimated.

$$C^* = \delta X_e + \theta X_p + \varphi \quad (2)$$

For model specification, this paper uses the previous equation, replacing the dependent dummy variable (government change) of Alesina et al. (1996, pp. 189-211) with a score variable (index of political instability). Then, the variable of interest (mining resources) and the control variables are integrated into the equation. The empirical model then aims to determine the impact of mining resources on political instability.

$$InstaP_{i,t} = \omega_0 + \omega_1 MinRess_{i,t} + \sum_{k=2} \omega_k X_{i,t} + \varepsilon_{i,t} \quad (3)$$

i represents the country, t the time dimension. $InstaP_{i,t}$ denotes political instability. $MinRess_{i,t}$ represents mining resources and X_{it} represents a matrix of country control variables.

The empirical model includes other control variables designed to explain political instability:

$$InstaP = f\,(\,MinRess,\ Infla,\ GovExp,\ Corrup,\ Democ,\ DurableR, EDUC) \quad (4)$$

Specifically, the empirical model is specified as follows:

$$InstaP_{i,t} = \omega_1 + \omega_2 MinRess_{i,t} + \omega_3 Infla_{i,t} + \omega_4 GovExp_{i,t} + \omega_5 Corrup_{i,t} + \omega_6 Democ_{i,t} + \omega_7 DurableR_{i,t} + \omega_8 EDUC_{i,t} + \varepsilon_{i,t} \quad (5)$$

4.2. Rationale for PCA and data presentation

4.2.1. Rationale for Principal Component Analysis (PCA)

In the case of political instability involving several indicators, the problem of weighting each indicator and the problem of loss of information may arise. To avoid any subjectivity, the PCA approach, which is one of the multivariate data analysis techniques, is proposed (Gakpa, 2019, pp. 90-117). PCA consists of a linear transformation or combination of the original, related variables into new, uncorrelated variables called "principal components." PCA makes it possible to reduce the number of variables, extract common information between variables, and make information less redundant. Reducing the number of variables tends to lose information, and PCA attempts to minimize this loss.

4.2.2. Description of independent and dependent variables

The variables used to construct the index of political instability are as follows:

- Executive Constraints (Xconst) correspond to the binding effects of government decisions or policies on individuals (Polity V, 2021).
- Participatory Competitiveness (Parcomp) represents competition in the political arena with some degree of civil interaction (Polity V, 2021).
- Participatory regulation (parreg) corresponds to the degree to which national political life is organized according to laws or the absence of clan-driven rules (Polity V, 2021).
- Competition in leadership recruitment (Xrcomp) reflects the climate of competition (by vote, arbitrary election...) regarding the appointment of leaders or the head of state (Polity V, 2021).
- Openness in leadership recruitment (Xropen) indicates the accessibility to the polling station or the freedom to vote (Polity V, 2021).
- The regulation of executive recruitment (Xrreg) reflects the manner in which the head of state is appointed by coup or imposed appointment (Polity V, 2021).
- Political violence (PViolen) indicates the probability of political instability and/or political violence, including terrorism. It is calculated from (100 - p), where p indicates the probability of stability (WGI, 2021).
- Internal conflicts (InTinstab) indicate the level of political violence within a country. It includes threats to the state, wars and riots, political and terrorist violence. It is determined using the previous method (12 - p) and ranges from 0 to a maximum risk of 12 (ICRG, 2021).
- Anti-government demonstrations (GovInstab) reflect the weakness of the state through its programs contested by the population. It is obtained from 12 - p (12 minus the corresponding value for no anti-government demonstrations) (ICRG, 2021).
- State repression (secleg) indicates state or police action against individuals. Minimum and maximum repression are coded 1 and 5, respectively (Polity V, 2021).

The independent variables are:

- Mining Resources (MinRess): this variable represents gold export revenues in U.S. dollars divided by current GDP in U.S. dollars (UN Comtrade, 2023).
- Global Mining Resources: this variable represents mining resources export revenues in U.S. dollars divided by current GDP in U.S. dollars (UN Comtrade, 2023).
- Inflation Rate (Infla): This variable represents the increase in the general price level or GDP deflator (WDI, 2021).
- Government Expenditure (GovExp): This variable represents government consumption expenditures by public administrations (WDI, 2021).
- Corruption Control (CCorrup): This variable indicates the degree of corruption when public power is exercised for private purposes. High values indicate a high degree of control and a decline in corruption (WGI, 2021).
- Durability of the regime (DurableR): This variable indicates the number of cabinet changes within a single political regime (Polity V, 2021).
- Democracy (Dmoc): This indicator measures the degree of democratization of a country's institutions (Polity V, 2021).
- Education (EDUCsec): This variable indicates the completion rate of lower secondary education. It is used as a variable to measure human capital formation (WDI, 2021).

4.2.3. Data sources

Data are from the World Development Indicators (WDI, 2021), the World Governance Indicator (WGI, 2021), the Country Risk Indicators (ICRG, 2021), Polity V (2021), the World Bank Good Governance Database (2022), and UN Comtrade (2023). The analysis covers WAEMU countries from 2002 to 2019. Given the lack of data for Benin and Guinea-Bissau on the political instability indicators and the mining resources variable, 6 WAEMU countries were selected. To reduce seasonal fluctuations or macroeconomic cycles and expect robust results, the data are transformed into moving averages (Blanco and Grier, 2009, pp. 76-95). These 3-year moving average data reduce the volatility of some variables influenced by time (Ouoba, 2016, pp. 108-116).

4.3. Construction of the political instability index and data analysis

4.3.1. Principal Component Analysis (PCA)

Using the 10 variables, a composite index of political instability is constructed using PCA. The determinant of the correlation matrix, which is not zero, corresponds to an acceptable level of multicollinearity. The Kaiser-Meyer-Olkin (KMO) index measures the adequacy of the factorial solution. KMO has a high value of 0.806, indicating the suitability, consistency, and relevance of the selected variables. Bartlett's test for specificity tests the null hypothesis that all correlations equal 0. Therefore, its p-value is equal to 0.000. As for the inertia measure, the first component extracts 65.588% of the total variance, while the second component extracts 18.65%. The inertia component is the sum of the two eigenvalues, which together account for 84.238% of the total variance.

The spatial representation of the components shows two groupings of the 10 variables along the axes. In addition, the PCA rotation matrix also shows these two groupings, referred to in this paper as "executive instability" (instability 1) and "violent instability" (instability 2). The first group refers to regime disorders (regime or executive instability) in line with the work of Alesina et al. (1996, pp. 189-211) and Slinko et al. (2016, pp. 26-5). The second group refers to social disorders in line with the work of Chauvet (2002, pp. 545-556) and Akinlo et al (2022, pp. 47-58).

Table 1. *PCA construction of the "political instability" index*

Indicators of political instability	Components	
	1	2
Xconst: Executive constraints (Polity V)	0.989	
Parreg: Participation rules (Polity V)	0.987	
Xrcomp: Competitiveness of executive recruitment (Polity V)	0.987	
Parcomp: Competitiveness of participation (Polity V)	0.986	
Xropen: Executive recruitment opens (Polity V)	0.986	
Xrreg: Executive recruitment rules (Polity V)	0.986	
PViolen: Political violence (WGI)		0.863
InTinstab: Internal conflict (ICRG)		0.767
GovInstab: Anti-government demonstrations (ICRG)		0.659
Secleg: State or political repression (Polity V)		0.654
Extraction method: Principal component analysis. Rotation method: Varimax with Kaiser normalization.		

Source: Authors, based on PCA method.

4.3.2. Data statistics

Table 2 shows the descriptive statistics for the variables studied. Overall, the statistical analysis shows that violent instability reaches a higher risk level (2.068) than executive instability (0.594). A cross-country comparison shows that Ivory Coast has the lowest risk of political instability, while Mali has the highest. In terms of the highest risk of violent instability, Mali ranks first. Niger has the highest level of executive instability. In terms of mining exports, Mali has the highest score (0.164).

Table 2. *Descriptive statistics for variables*

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
Political Instability	108	-0.061	0.857	-2.930	0.920
Executive Instability	108	-0.064	1.066	-3.769	0.594
Violent Instability	108	-0.046	1.058	-2.020	2.068
Mining Resources	108	0.039	0.056	-0.028	0.163
Global Mining Resources	108	0.040	0.056	0.000	0.165
Inflation	108	3.150	5.976	-7.594	42.521
Government Expenditure	108	14.615	2.211	8.742	19.470
Corruption Control (CCorrup)	108	32.924	13.996	8.780	61.616
Durability of the regime	108	8.306	6.826	0.000	26.000
Democracy	108	3.115	0.861	1.250	5.000
Education	108	27.151	11.873	4.445	52.584

Source: Authors.

4.3.3. Correlation analysis between independent variables

High correlation between explanatory variables carries the risk of multi-correlation, which complicates econometric estimates (Goaied and Sassi, 2012). For this purpose, a correlation matrix is constructed. All coefficients are below 0.7, indicating that there is no multi-correlation. The correlation matrix shows a positive relationship between mining resources and political instability. To check the results of the correlation matrix, the variance inflation factor (VIF) test is performed for all variables. This test gives an average value of 1.73 for the whole regression. Diendéré and Wadio (2023, pp. 1-18) shows that there is no multicollinearity when the VIF is < 5. In our research, each explanatory variable has an inflation factor VIF < 5 and a tolerance value (1/VIF) greater than 0.4.

4.3.4. Dependence and heteroskedasticity tests

The dependence test is used to check the correlation of interindividual errors. The test of Pesaran (2004) is suitable for panels with N > T. In contrast, the dependence test of Breusch-Pagan does not consider this condition. The null hypothesis allows for the independence of individuals in the cross-section. The results do not allow us to reject the null hypothesis. The results show individual independence. The Breusch-Pagan test was also performed. It detects the presence of heteroskedasticity in the equation. The p-value is greater than 5%. Therefore, the null hypothesis of homoscedasticity is not rejected. Thus, the results show that there is no heteroskedasticity.

4.3.5. Endogeneity test

Empirically, there may be a dual causality between political instability and economic growth. The Durbin-Wu-Hausman (DWH) and Nakamura-Nakamura tests are used to

determine the presence of endogeneity in the model. The results are based on the two-stage Nakamura-Nakamura and Durbin-Wu-Hausman (DWH) tests. Any variable assumed to be endogenous is regressed. The resulting residuals are then substituted into the overall equation. If the coefficients of the jointly introduced residuals are significant, there is an endogeneity problem. However, the results show that there is no endogeneity problem.

4.4. Estimation methods

When estimating panel data, problems with heteroskedasticity and interindividual dependence often arise. Therefore, standard methods such as OLS, fixed effects, and random effects are less efficient and subject to estimation bias. White's covariance matrix estimator is considered a suitable estimator that yields conclusive results. However, this method does not consider the problem of heteroscedasticity and may lead to biased results in small samples. Therefore, the panel method with corrected standard errors (PCSE) can overcome the shortcomings of the White method. It considers the problems of heteroskedasticity, error autocorrelation, and serial correlations (Beck and Katz, 1995, pp. 634-647). It provides accurate and efficient estimates. However, the PCSE method is less effective when the time dimension is smaller than the number of countries. Studies have shown a double causal relationship between natural resources and political instability, and between political instability and economic growth. In these cases, endogeneity problems arise, making the above estimation procedures less effective.

Another method attempts to overcome the shortcomings of the previous methods. The standard error estimation technique of Driscoll and Kraay (1998, pp. 549–560) is an estimator that effectively handles heteroscedasticity and autocorrelation in the errors. This technique is efficient regardless of the number of countries (N) and the time period (T) chosen. Driscoll and Kraay's technique provides convincing empirical results, even with the problem of interindividual and/or spatial and temporal dependence (Joshi et al., 2021, pp. 1-12). This estimation technique accounts for the shortcomings of other techniques that result in less appropriate estimates.

For this paper, the data are considered as 3-year moving averages, resulting in 6 periods. These moving average data are intended to provide robust results that address the problem of high variability in some variables. In addition, these data allow to address the problem of measuring outliers (Blanco and Grier, 2009, pp. 76-95).

5. Results and discussion

5.1. Effects of mining resources on political instability

The results of the model, obtained using the standard error estimation technique of Driscoll and Kraay, are shown in Table 3. As expected, the coefficient of the mining resources variable is significant and positive. The results show that as mining resources increase, the risk of political instability also increases. This result can be explained by the dependence on natural resources (Dalyop, 2018). Such GDP dependence on these resources, as is the case in WAEMU countries, can lead to political parties and rebel groups seeking to capture

executive power (Laville, 2018). Thus, dependence on mining resources can lead to conflict.

Another explanation for the results is based on the new public economy. Indeed, political parties and interest groups behave like political entrepreneurs bent on profit (Buchanan and Tullock, 1962). The increase in mining resources is likely to lead to "potential predators" interested only in their own interests. These predators, referred to as "political entrepreneurs," may be multinational corporations or local private companies. According to Rohner (2018, pp. 5-25), the production of natural resources and the reinforcement of asymmetries between groups regarding the possession of these resources can trigger wars. Following Laville (2018, pp. 1-57), natural resources are therefore seen as a funding opportunity for armed groups and a motivation for warfare. Thus, mining resources partly determine the risk of political instability in the WAEMU.

A third explanation for the results relates to the external effects of mining resources in artisanal and industrial mines. These impacts may involve risks. Artisanal and industrial mining poses the risk of political instability, which manifests itself in conflicts between locals and miners, terrorist attacks, and the formation of rebel groups that take ownership of mining sites. These situations usually lead to revolts or demonstrations by residents who suffer from negative externalities. These externalities are often explained by the fact that the chemicals used to mine minerals pollute the water, denature the environment, and drive children away from mining sites.

The results of the political instability equation also show that the interaction term between the variables mining resources and secondary school enrollment has a significant and negative coefficient at 1% threshold. This result shows that a higher enrollment rate reduces the impact of mining resources on the risk of political instability. Human capital in WAEMU countries is thus a channel through which mining resources reduce the risk of political instability. Indeed, the increase in enrollment rates is a sign of human capital formation in a country. On the one hand, by highlighting skills, knowledge and know-how in the mining sector, this formation of human capital can help improve control over mining resources and consequently reduce political instability. On the other hand, the mining resources of a country that experiences an increase in its human capital are a "boon" and tend to reduce the risk of political instability. Finally, if mining resources are used to strengthen the education sector, this strengthening can help reduce the demands of interest groups and thus reduce the risk of political instability.

According to the results with cross-tabulated variables, the interaction term between mining resources and corruption control variables shows a significant and negative coefficient at the 1% threshold. This result suggests that an increase in corruption control reduces the impact of mining resources on the risk of political instability. Thus, corruption control is a channel through which mining resources mitigate the risk of political instability. Such results can be explained by institutional theory, which emphasizes the regulatory role of institutions (Rodrick, 1991, pp. 229-242; Acemoglu et al., 2005, pp. 386-464). This regulatory role ensures better use of mining resources. The application of standards in the mining sector is likely to prevent claims and the emergence of rebel groups. It leads to transparency and traceability in the mining sector. Indeed, controlling corruption prevents

mining resources from being diverted for private purposes. Conflict is significantly reduced when anti-corruption measures are implemented in the mining sector. Thus, according to North's (1990) institutional theory, the absence of norms and laws in a country is likely to lead to unrest in mining areas. Thus, anti-corruption is a channel through which mining resources can reduce the risk of political instability.

Table 3. *Estimation of political instability*

VARIABLES	Political Instability	Political Instability	Political Instability	Political Instability
Mining Resources	21.879***	14.185***	7.635	1.173*
	(5.032)	(2.827)	(4.424)	(0.529)
Mining Resources*Education	-0.494**	-0.474***		
	(0.135)	(0.116)		
Mining Resources*CCorrup	-0.214*		-0.194	
	(0.086)		(0.133)	
Inflation	0.019	0.020	0.012	0.014
	(0.012)	(0.012)	(0.015)	(0.016)
Corruption control	0.017**	0.014	0.020**	0.017**
	(0.007)	(0.007)	(0.005)	(0.005)
Education	0.032*	0.029*	0.017	0.015
	(0.014)	(0.014)	(0.013)	(0.012)
Democracy	0.433**	0.396**	0.282	0.255
	(0.120)	(0.135)	(0.171)	(0.189)
Government Expenditure	0.098**	0.090**	0.065*	0.059*
	(0.037)	(0.035)	(0.030)	(0.029)
Constant	-4.331**	-3.941**	-3.089*	-2.781
	(1.421)	(1.458)	(1.331)	(1.432)
Observations	36	36	36	36
R-squared	0.326	0.308	0.286	0.271
Number of groups	6	6	6	6

*** significance at 1% level; ** at 5% level; * at 10% level. Standard deviations in brackets.

Source: Authors.

5.2. Effects of mining resources on executive and violent instability

To deepen the results, the index of political instability is replaced by the index of executive instability on the one hand and violent instability on the other. The results are the same as before. These results contain clarifications that should be highlighted.

5.2.1. Effects of mining resources on executive instability

The results indicate that mining resources significantly increase the risk of executive instability. These results can be explained by the sensitivity of the executive to instability and by the frequency of coups, impeachments, contested elections, and constitutional amendments. These results on the effects of mining resources on executive instability can be explained by the public choice theory of the New Public Economy, which identifies the behavior of politicians, voters, and governance (Buchanan and Tullock, 1962). According to this explanation, political power is coveted by interest groups and political parties that influence the government's economic policies. These influences on the government may increase when a country exports a large number of mineral resources. Indeed, executive instability can persist when political parties or lobby groups exert pressure on governments and voters. Through their rational behavior, these political entrepreneurs seek to be elected

or reelected to political office and to achieve individual satisfaction. Conflicts of interest can therefore explain political conflicts.

Another explanation for these results is the environment of mining sites. In this environment, informal markets, corruption, and drug trafficking can develop, enabled by the rational calculations of some groups of people. These situations lead to the failure of government policies and tend to significantly increase the risk of political instability. The results also show that controlling corruption in the mining sector can reduce the risk of executive instability. These results confirm those found previously. These results can be explained by the fact that controlling corruption in the mining sector can prevent the ruling party from monopolizing mining resources for private purposes to the detriment of the majority of the population. Thus, controlling the mining sector can reduce coups and other pressures on governments.

The results of the estimates for executive instability are similar to the estimates for the overall index of political instability. Consequently, executive instability and the overall index of political instability behave in the same way. This similarity can be justified by the weight of executive instability, which is the first principal component in the construction of the political instability index.

Table 4. *Estimation of executive instability using the Driscoll and Kraay technique*

VARIABLES	Executive Instability	Executive Instability	Executive Instability	Executive Instability
Mining Resources	2.540*	8.675**	4.601	12.513
	(1.156)	(2.790)	(5.604)	(7.150)
Mining Resources*CCorrup		-0.186**		-0.196**
		(0.071)		(0.070)
Mining Resources*Education			-0.077	-0.131
			(0.189)	(0.211)
Durability of the regime	0.083*	0.081*	0.080	0.076
	(0.033)	(0.035)	(0.040)	(0.042)
Education	-0.016***	-0.013*	-0.013	-0.007
	(0.003)	(0.005)	(0.007)	(0.009)
Corruption control	0.012	0.015**	0.012	0.015*
	(0.006)	(0.006)	(0.006)	(0.006)
Inflation	0.003	0.002	0.005	0.005
	(0.013)	(0.014)	(0.014)	(0.016)
Government Expenditure	-0.031	-0.023	-0.023	-0.009
	(0.035)	(0.042)	(0.054)	(0.064)
Democracy	0.513**	0.535**	0.530***	0.565***
	(0.155)	(0.148)	(0.120)	(0.106)
Constant	-1.960*	-2.284**	-2.193**	-2.698**
	(0.810)	(0.792)	(0.679)	(0.858)
Observations	36	36	36	36
R-squared	0.456	0.464	0.456	0.466
Number of groups	6	6	6	6

*** significance at 1% level; ** at 5% level; * at 10% level. Standard deviations in brackets.
Source: Authors.

5.2.2. Effects of mining resources on violent instability

The variable mining resources has a positive and significant coefficient at the 5% threshold. The results show that mining resources significantly increase the risk of violent instability.

These results, highlighting the impact of mining resources, can also be explained by the new public economy. This new economy emphasizes the selfish behavior of groups of individuals dedicated to individual gain (Buchanan and Tullock, 1962). For this reason, the export of minerals, both from industrial and artisanal mines, explains the emergence of conflict. In this sense, the development of mining areas can lead to clashes between groups of individuals. These confrontations are explained by the pursuit of profits from mining resources. In this way, clashes are intensified by competition or rivalry for mining resources. These rivalries tend to increase the risk of conflict. Finally, mining resources can lead to frustrations among local populations, who often suffer from dispossession and unequal distribution of mining resources. These situations can lead to violent instability that takes the form of civil wars, terrorist attacks, indigenous uprisings, and anti-government demonstrations.

Table 5. *Estimation of violent instability using the Driscoll and Kraay technique*

VARIABLES	Violent Instability	Violent Instability	Violent Instability	Violent Instability
Mining Resources	2.323**	6.799	2.256	27.502
	(0.662)	(7.030)	(5.507)	(18.648)
Mining Resources*Education		-0.159		-0.873
		(0.230)		(0.450)
Mining Resources*CCorrup			0.002	-0.138
			(0.167)	(0.207)
Durability of the regime	-0.110***	-0.115***	-0.110***	-0.164***
	(0.014)	(0.012)	(0.013)	(0.011)
Education	0.050**	0.055***	0.050**	0.106***
	(0.014)	(0.008)	(0.013)	(0.011)
Corruption control	-0.004	-0.005	-0.004	0.013**
	(0.006)	(0.005)	(0.008)	(0.005)
Inflation	0.011	0.014	0.011	0.036
	(0.040)	(0.038)	(0.042)	(0.028)
Democracy	-0.052	0.003	-0.053	-0.097
	(0.159)	(0.140)	(0.146)	(0.127)
Government Expenditure				0.298***
				(0.027)
Constant	-0.325	-0.565	-0.322	-6.038***
	(0.911)	(0.719)	(0.792)	(0.772)
Observations	36	36	36	36
R-squared	0.436	0.439	0.436	0.580
Number of groups	6	6	6	6

*** significance at 1% level; ** at 5% level; * at 10% level. Standard deviations in brackets.
Source: Authors.

5.2.3. Checking the robustness of findings using a new interest variable

Findings reported in Table 6 were obtained using the Driscoll and Kraay estimation method. The new variable of interest used concerns global mining resources. These results suggest that mining resources significantly affect the risk of political instability. These results confirm those previously obtained using the first estimation method.

Table 6 also shows the coefficient of the interaction variable between mining resources and corruption control on political instability. This coefficient is not significant. On the other hand, the coefficient of the interaction term between mining resources and education is

significant and negative at the 1% threshold. This result confirms once again that the management of mining resources through education can significantly reduce the risk of political instability in WAEMU countries.

The previous method highlights the role of corruption control in mitigating the impact of mining resources on the risk of political instability. However, the robustness method emphasizes the role of human capital formation as a channel that mitigates the impact of mining resources on the risk of political instability. Thus, human capital and corruption control are channels through which mining resources successfully mitigate the risk of political instability.

Table 6. *Estimation of political instability using the Driscoll and Kraay technique*

VARIABLES	Political Instability	Political Instability	Political Instability	Political Instability
Mining Resources	1.223*	13.461***	7.954	21.458***
	(0.534)	(2.887)	(4.459)	(5.248)
Mining Resources*Education		-0.443**		-0.465**
		(0.118)		(0.142)
Mining Resources*CCorrup			-0.202	-0.221*
			(0.133)	(0.091)
Education	0.015	0.028*	0.018	0.031*
	(0.012)	(0.013)	(0.013)	(0.014)
Corruption control	0.017**	0.015*	0.020***	0.019**
	(0.005)	(0.007)	(0.005)	(0.007)
Inflation	0.014	0.020	0.013	0.018
	(0.016)	(0.013)	(0.015)	(0.012)
Democracy	0.253	0.369**	0.277	0.401**
	(0.189)	(0.135)	(0.170)	(0.120)
Government Expenditure	0.059*	0.087*	0.065*	0.095**
	(0.028)	(0.034)	(0.030)	(0.037)
Constant	-2.775	-3.831**	-3.099*	-4.239**
	(1.414)	(1.427)	(1.336)	(1.427)
Observations	36	36	36	36
R-squared	0.271	0.305	0.287	0.324
Number of groups	6	6	6	6

*** significance at 1% level; ** at 5% level; * at 10% level. Standard deviations in brackets.
Source: Authors.

6. Conclusion

The export of mineral resources is a financial windfall for the countries of the WAEMU. The objective of this study is to analyze the impact of mineral resource exports on political instability in the WAEMU. To achieve this objective, the analyses are carried out for a set of 6 countries in the WAEMU, covering the period 2002 - 2019. The results obtained are based on the standard error estimation technique of Driscoll and Kraay. The index of political instability, which constitutes the explained variable, is obtained using the PCA method. Findings support that increasing exports of mineral resources increases the risk of political instability. However, the findings indicate that corruption control and human capital formation can play an essential role in mitigating political instability.

In terms of economic policy implications, WAEMU countries are urged to increase corruption control in order to reduce the impact of the mining sector on the risk of political instability. This control of corruption can be applied to the recovery and redistribution of profits from mining resources. Moreover, the increase in political instability can also be explained by artisanal mining activities, which tend to attract more interest groups and unrest in the mining sector. Thus, reducing and controlling artisanal mining could help reduce the risk of political instability. The control of artisanal mining aims to monitor the mining sector against clandestine extraditions of minerals to unknown destinations. Given that the export of mineral resources entails risks of political instability, WAEMU governments can also take measures to encourage the production of luxury goods from these mineral resources, instead of exporting the raw ore.

In the context of WAEMU countries, where there is unrest surrounding elections and constitutional order, it is necessary to control the mining sector from the extraction of minerals right through to their export. Governments are invited to implement new export policies aimed at mitigating the risks of political instability. In addition, to reduce political instability, governments can strengthen mine security and combat interest groups by implementing regulations. In this way, strengthening regulatory frameworks in the mining sector can contribute to a less unstable political environment.

In addition, transparency, traceability, and accountability in the management of mining resources need to be strengthened in order to control corruption and prevent the illicit financing of pressure groups and their clandestine activities. This regulatory measure will also prevent the risk of political instability. In addition, strengthening human capital can mitigate the effect of mining resources on the risk of political instability. The transfer of mining resources to the education sector can also help shape human capital and calm the demands of pressure groups. The development of human capital is therefore a channel through which countries exporting mining resources can mitigate the risk of political instability.

Furthermore, the results indicate that mining resources tend to influence violent instability more than executive instability. The results therefore suggest that policymakers should consider this specificity of types of political instability. The specificity of these instabilities may enable policymakers to find appropriate measures to ensure that mining resources do not lead to violence. Violent instability, like executive instability, can be reduced when mining resource exports are channeled through corruption control and human capital training.

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