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Spillover effects of natural resources on state fragility in Africa

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Abstract

This paper aims to analyze the spillover effects of natural resources on African state fragility. To this end, a dynamic spatial Durbin model was estimated, identifying endogenous and contextual effects. The analysis results showed that the fragility of African states is spatially dependent and that this fragility is a self-reinforcing phenomenon over time. However, for a given country, the fragility of neighboring countries contributes to the attenuation of fragility in that country through the diffusion of propagation signals. Spillover effects from economic growth and Internet use reduce fragility. A robustness analysis distinguishing between different categories of natural resources (gas, oil, coal and minerals) reveals that significant spatial spillover effects mainly stem from gas rents, while oil and mining rents do not exhibit statistically robust spillover effects. This means that the spatial impact of natural resources on state fragility is not uniform and depends on the specific nature of extractive rents. These results suggest participatory management of natural resources to reduce rent-seeking and predatory behaviors. Given the complementarity of African countries in reducing fragility, they need to coordinate their policies to combat insecurity and share experiences in natural resource management.

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1. Introduction

The relationship between natural resources and economic growth is one of the great paradoxes of development economics. Although the availability of natural resources has often been a primary source of wealth for nations, it is not a sufficient condition for development. The natural resource curse theory shows that the long-term effects of natural resources can be negative. This controversy, which stems from the pioneering work of Auty (2000) and Sachs and Warner (1997), has continued to fuel debate on the effects of natural resources on the occurrence of conflict. Indeed, countries rich in natural resources are more likely to experience internal conflict than countries with fewer resources (Collier & Hoeffler, 2005). In particular, there is an inverted U-shaped relationship between resources and conflict, and the risk of civil war is higher when resource dependency is around 35%. For Collier (2004), the plundering of natural resources is the primary cause of conflict in Africa, helping to finance and perpetuate it. From this perspective, Ross (2004) shows that the abundance of natural resources is positively correlated with the risk of civil war, using measurements of oil and diamond deposits. Natural resources have thus played a major role in the financing of armed rebel groups and the persistence of civil wars in Africa (Collier & Hoeffler, 2005).

According to conflict recurrence data from the Peace Institute of Oslo, the total number of conflict episodes identified between 1989 and 2018 is 347 worldwide. Since 1989, the total number of conflicts in Africa has risen from 34 conflicts in 1989 to 104 in 2022, mainly due to an increase in non-state conflicts (Obermeier, 2023). Almost all states in situations of extreme fragility have abundant natural resources that can serve as a basis for macroeconomic development (African Development Bank Group, 2016). However, these states cannot often effectively transform these resources into economic growth. Moreover, heavy dependence on natural resources is often closely linked to conflict and state fragility. With this in mind, Rustad and Binningsbø (2012) identified 167 natural resource-related conflicts in 101 countries worldwide between 1946 and 2006. This is the case for diamonds, which financed the conflict in Sierra Leone, and the control of oil deposits, which is a major source of tension between South Sudan and Sudan.

A country's fragility is closely linked to the state's capacity to manage conflict, develop and implement public policies, and deliver essential services, as well as its ability to maintain systemic coherence, cohesion, and quality of life, respond effectively to challenges and crises, and support progressive development. In a highly interconnected world, the pressures exerted on a fragile state can have serious repercussions not only for that state and its population but also for its neighbors. Indeed, the fragility of one country acts as a destabilizing factor for the entire region, creating a climate of uncertainty and lawless zones for armed groups in neighboring countries. What's more, of the 27 chronically fragile states over the past decade, two-thirds are African (Hoeffler, 2019). Africa is rich in natural resources, accounting for 30% of the world's oil, gas, and mineral reserves. More than half the exports of many countries in sub-Saharan Africa come from natural resources — even 90% in the case of the most oil-dependent countries (IMF, 2012). In this respect, Men (2022) argues that if the resource curse exists, it is rather the over-reliance on the resource industry that underpins it. In this context, it is imperative to study the spatial impact of natural resources on the spread of fragility in Africa. This article examines the spillover effects of natural resources on the fragility of African states. The aim is to analyze the temporal and spatial heterogeneity between natural resources and state fragility. The empirical literature shows that some works argue that hydrocarbon revenues can also increase political instability and social conflict, while others claim that they enhance political stability.

The present research makes two major contributions to the existing literature. Firstly, works that have examined the effects of natural resources on state fragility have not taken spatial dependence into account (Collier, 2004; Collier & Hoeffler, 2005; Ross, 2006). However, in the

current African context, there is a polarization of conflicts and a tendency for these instabilities to spread to neighboring countries. The article therefore explores the spatial effects of natural resources, which have so far been little documented. Secondly, the spatial model used allows us to take into account both the spillover effects of natural resources and exogenous variables such as the level of development and access to the Internet.
The rest of the article is organized as follows: the first section presents a brief overview of the literature; the second section deals with the methodology; and the third section presents the results and discussion. Finally, the fourth section concludes.

2. Literature review

This literature review examines the spillover effects of natural resources on state fragility, focusing on existing empirical studies. It also discusses the debates and controversies surrounding this topic, including the methodological limitations of existing empirical studies. State fragility refers to a state's vulnerability to political instability, violence, and other forms of internal conflict. Natural resources, such as oil, gas, minerals, and agricultural products, are often considered factors that can influence state fragility.
Recently, Li et al. (2023) studied the spatial spillover effects of the resource curse based on a spatial statistical model in China. They show the existence of a spatial agglomeration of the resource curse. The formation of a resource curse club with Shanxi, Shaanxi, Ningxia, Qinghai, and Inner Mongolia at its core. In addition, the spatial spillover effect of the resource curse is very significant, and the resource curse of local provinces will be affected by the resource curse of neighboring provinces. Also, in the case of China, Wang et al. (2019) tested the resource curse hypothesis using provincial panel data for the period 2005–2018 through the spatial partial difference regression method. The empirical results show that the total spatial spillover effect of natural resources on economic growth is significantly negative. Using a Durbin spatial model and panel data from 30 Chinese provinces between 2004 and 2020, Men (2022) shows that the resource curse exists and is strongly related to resource dependence. Indeed, increased dependence on resource industries in one region can improve the economic situation of neighboring regions, and the spatial spillover effect has obvious nearby characteristics.
Geographical factors also play a key role in determining how a civil war is fought (Buhaug & Gates, 2002). Using ordinary least squares (OLS) and three-stage least squares (3SLS) estimation techniques over the period 1946–2000, they show that, in addition to geographical factors such as the total area of the country, the extent of conflict is strongly influenced by factors such as proximity to a border with a neighboring country, the incidence of natural resources in the conflict zone, and the duration of the conflict. From this perspective, through a maximum likelihood analysis of some 138 countries throughout the post-Cold War period, De Soysa (2002) shows that the abundance of mineral wealth makes countries highly unstable, while the scarcity of renewable resources has little to do with civil conflict. What's more, very slight political liberalization leads to conflict, but larger increases considerably reduce the danger, confirming that conflict is driven by opportunistic behavior rather than grievance.
Using a meta-analysis of 14 cross-national econometric studies as well as numerous qualitative studies that highlight the relationship between natural resources and civil war, Ross (2004) suggests that, collectively, natural resources imply four underlying regularities: firstly, oil increases the likelihood of conflict, particularly separatist conflict; secondly, lootable commodities such as gems and drugs do not increase the likelihood of conflict but tend to prolong existing conflicts; thirdly, there is no apparent link between legal agricultural commodities and civil war; and finally, the association between primary commodities and the onset of civil war is not strong.
More recent empirical evidence has substantially nuanced these pessimistic conclusions. Using a meta-analysis based on more than 900 estimates from 41 empirical studies, Vesco et al. (2020) demonstrate that natural resource abundance does not mechanically increase the risk of conflict

or state fragility. Once institutional variables are taken into account, the destabilizing effects of resource rents are significantly reduced and may even be reversed, particularly in contexts where the state possesses a minimum capacity for governance and redistribution. Complementing this argument, Welsch (2008) shows that, unlike mineral resources, agricultural resource abundance can reduce the likelihood of conflict by increasing labor productivity and income opportunities, thereby contributing to social and political stability.

From a methodological standpoint, it should be noted that existing work is characterized by two major limitations. Firstly, the work that has analyzed the spatial effects of natural resources has focused solely on economic growth (Men, 2022; Wang et al., 2019). Secondly, the work that has examined the effects of natural resources on state fragility has not taken spatial dependence into account (Collier, 2004; Collier & Hoeffler, 2005; Ross, 2006). However, in the current African context, there is a polarization of conflicts and a tendency for these instabilities to spread to neighboring countries.

3. Methodology

According to Anselin & Bera (1998), spatial autocorrelation refers to the fact that geographically close units tend to have similar values. Spatial autocorrelation can be taken into account in econometric models through several mechanisms, namely through lagged spatial variables, endogenous or exogenous variables, or through spatial autocorrelation of error terms (Le Gallo, 2002). When no a priori spatial specification is available, different tests can be combined to choose the best model specification. To do this, we combine Moran's test, the Lagrange multiplier test and information criteria.

3.1. Global autocorrelation detection tests

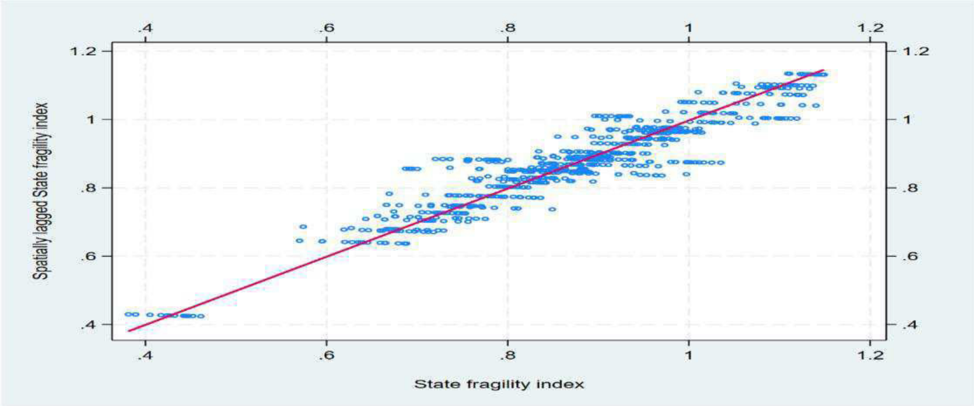
Moran's I statistic and the diagram of Moran (1948) were used to detect global autocorrelation. Moran's statistic I (1948) is defined as follows:

$$I = \frac{n \times \sum_{i}^{n} \sum_{j}^{n} W_{ij} \left(x_i - \bar{x}\right)\left(x_j - \bar{x}\right)}{\sum_{i}^{n} \sum_{j}^{n} W_{ij} \sum_{i}^{n} \left(x_i - \bar{x}\right)^2}$$

where n is the number of spatial units indexed by i and j ; X represents the variable of interest; $\bar{x}$ is the mean of x ; W_{ij} is an $n \times n$ weight matrix describing the relationships between a variable and its neighboring variables.

Moran's diagram (Figure 1) shows that state fragility is positively and spatially correlated for all countries in the sample. Moran's I index is equal to 0.88 and significant at the 1% level. This means that, in terms of geographical distribution, highly fragile countries are generally distributed around very fragile countries, and vice versa. In other words, countries with similar levels of fragility tend to cluster together geographically. Consequently, the fragility of African states is spatially dependent. Ignoring spatial autocorrelation and using the OLS estimator leads to biased results.

Figure 1: Moran's diagram of state fragility index



Source: Constructed by the author from State Fragility Index data from The Fund for Peace.

The above results provide information on the presence of spatial autocorrelation but not on its nature. The question arises as to the appropriate spatial model. These results imply the need to consider regional dynamics and mutual influences between states when addressing state fragility.

3.2. Spatial model specification tests

To help select the appropriate spatial model, Anselin et al. (2008) propose Lagrange Multiplier (LM) tests to detect the presence of spatial autocorrelation in panel models. Starting from the fact that Moran's I test supports the presence of spatial autocorrelation related to an autoregressive variable or error autocorrelation, Gallo (2002) shows that the choice between these two forms of spatial dependence should be made by comparing the significance levels of the Lagrange Multiplier tests $\left(LM_{ERR} \text{ and } LM_{LAG}\right)$ and their robust versions $\left(RLM_{ERR} \text{ and } RLM_{LAG}\right)$. In the empirical literature, the choice of the appropriate model is based on the following decision rule (Anselin and Rey, 1991; Florax and Folmer, 1992; Anselin and Florax, 1995):

- If LM_{LAG} is more significant than LM_{ERR} and RLM_{LAG} is significant but not RLM_{ERR}, we include a lagged endogenous variable;
- If LM_{ERR} is more significant than LM_{LAG} and RLM_{ERR} is significant but not RLM_{LAG}, then we choose the model with error autocorrelation.

Table 1 presents the results of the Lagrange Multiplier tests and their robust versions. All the Lagrange Multiplier statistics for the dependent variable and the error terms are statistically significant at the 1% level. However, the statistic for the error terms is lower than that for the dependent variable. Furthermore, the robust version of the Lagrange Multiplier of the error terms is insignificant, making it inappropriate to introduce the interactions of the error terms into the analysis. Consequently, the hypothesis of the omission of an autocorrelation of the endogenous variable is rejected. These various Lagrange Multiplier tests confirm the presence of autocorrelation in the spatially lagged dependent variable.

Table 1: Local autocorrelation tests

Tests	Statistics
LM_{ρ}	40.740***
LM_{λ}	33.229***
RLM_{ρ}	7.547***
RLM_{λ}	0.036
Breusch-Pagan-Godfrey Z	21.637***
Baltagi Z Test	26.410***
Wooldridge F Test	6.286**

*** p<0.01, ** p<0.05, * p<0.1

Source: Author

The Breusch-Pagan-Godfrey, Baltagi, and Wooldridge tests (Table 1) confirm the existence of serial autocorrelation at the 1% threshold. Thus, the spatial model must take serial autocorrelation into account by including the lagged dependent variable in the model. However, several models allow for the integration of endogenous interactions and the dependent variable shifted by one period. This is why we use information criteria to select the appropriate model.

3.3. Choosing the right model

The Akaike information criterion (AIC) and the Schwarz information criterion (BIC) are used to select the appropriate model. In this case, the appropriate model is the one that minimizes both the AIC and BIC criteria. The criteria are defined as follows: $AIC = 2\hat{L} + 2K$ and $BIC = -2\hat{L} + (3K-1)\log n$, where $\hat{L}$ is the log-likelihood estimator, n is the number of observations and the factors $2K$ and $3K-1$ correspond to the number of parameters to be estimated. Table 2 summarizes the values of the AIC and BIC criteria.

Table 2: Akaike information criterion and Bayesian information criterion

Model	AIC	BIC
OLS	5735	5762.721
SAR	4233.173	4274.753
SEM	3904.584	3936.924
SDM	2788.769	2838.831
SAC	3804.948	3841.908

Source: Author

A comparison of these information criteria for different specifications shows that the AIC and BIC values are minimized at the level of the Durbin spatial model (SDM). This reinforces the idea of the presence of spatial autocorrelation in both the dependent and exogenous variables. For this reason, we prefer the dynamic spatial Durbin model, which incorporates exogenous and endogenous interactions and lags the dependent variable by one period.

3.4. Dynamic Spatial Durbin Model

It should be noted that, with the establishment of the African Continental Free Trade Area, links between regional economic integration zones and countries have become increasingly developed. The impact of the natural resource curse should no longer be limited to a specific area but can also extend to neighboring areas (Li et al., 2023). The same applies to the fragility of states, which are currently either under terrorist threats or significant political pressure. However, at this stage, empirical work has focused mainly on verifying the transmission mechanisms and influencing factors of the resource curse, ignoring its spatial effect.

To analyze the spillover effects of natural resources on the fragility of African states, the dynamic spatial Durbin model to be estimated was formulated as follows:

$$fragility_{it} = \beta_0 + \tau\, fragility_{it-1} + \rho W fragility_{it-1} + \beta_1^1 res\_nat_{it} + \beta_1^2 hci_{it} + \beta_1^3 polity_{it} + \beta_1^4 gdp\_growth_{it} + \beta_1^5 net\_use_{it} + W\theta_1 gdp\_growth_{it} + W\theta_2 net\_use_{it} + \varepsilon_{it} \quad (1)$$

Where $fragility_{it}$ is the fragility level of state i at period t, $Wfragility_{it-1}$ reflects endogenous interactions shifted in space and time, W is the spatial weighting matrix describing the spatial arrangement of the units in the sample, ρ is the spatial autocorrelation coefficient to be estimated, which will indicate the strength and sign of the spatial relationship in $fragility_{it}$ captured by W and $W\theta$ refers to exogenous interaction effects linked to economic growth and Internet use, res_nat_{it} refers to rents derived from natural resources, gdp_growth_{it} is the economic growth rate and net_use_{it} refers to Internet access. Parameter τ is the response parameter of the time-shifted dependent variable $(fragility_{it-1})$, β_1 is the vector of coefficients of exogenous explanatory variables and ε_{it} is the error term. Regarding control variables, hci_{it} is the human capital index and $polity_{it}$ indicates the quality of political institutions.

3.5. Data and weight matrix

The sample covers 50 African countries over the period 2007–2021. The choice of countries and periods is based exclusively on the availability of data on fragility. The data come from several sources. State fragility comes from the Fund for Peace. Fragility data highlights not only the normal pressures faced by all states but also all cases where these pressures exceed a state's ability to manage them. Data on natural resource rents are provided by the International Centre for Tax and Development. Data on political institutions comes from Polity IV of the Center for Systemic Peace. The human capital index is taken from the Penn World Table database. Data on economic growth rates and internet access come from World Development Indicators.
Table 3 presents descriptive statistics for the main variables studied in the analysis of the spillover effects of natural resources on state fragility in Africa.

Table 3: Descriptive statistics

	N	Mean	SD	Min	Max
Fragility index	750	87.602	13.86	38.1	114.9
Natural resources rents	750	5.901	11.128	0.020	72.35
GDP growth (annual %)	750	3.777	6.96	-50.339	86.827
Human Capital Index	750	1.881	0.455	1.136	2.939
Polity IV	750	1.445	5.315	-9	10
Internet users (% of population)	750	16.182	17.307	0.105	88.13

Source : Author

The state fragility index shows considerable variability, with a high average of 87.60, indicating marked heterogeneity in fragility levels among African countries. Natural resource rents account for an average of 5.9% of GDP, varying widely between 0.020 and 72.35 depending on the year, reflecting highly uneven dependence on extractive resources. GDP growth averages 3.77% with significant volatility, reflecting heterogeneous macroeconomic responses to shocks related to natural resource rents and external shocks. The human capital index remains relatively low (1.88) with limited disparities. The Polity IV indicator, which measures political governance, averages 1.45. It also shows great diversity, with regimes ranging from highly authoritarian to more democratic. Finally, the low average rate of Internet users (16.18%) with a high standard deviation of 17.3% illustrates unequal access to technology, which can affect resource management and state resilience. These results highlight the complexity of the relationship between natural resources and fragility in an African context marked by economic and political disparities.
To capture spatial interactions, we use the binary adjacency matrix. This interaction matrix describes the interdependencies between countries and the intensity of their interactions. The elements w_{ij} of the matrix W reflect the strength of the spatial link between two localized observations i and j. The elements w_{ij} take on a positive non-zero value whenever the two countries are assumed to interact, and this value is assumed to increase with the intensity of the interactions based on geographical contiguity. In the context of a binary matrix, neighboring countries are assumed to interact, while those that are not neighbors have no interaction. $W = (w_{ij})$ is the adjacency matrix defined so that for any country i and all its neighbors j, the weights w_{ij} of this matrix can be written as:

$$w_{ij} = \begin{cases} 1 & for \quad j \in J \\ 0 & for \quad j \notin J \end{cases}; \quad w_{ii} = 0 \quad \forall i$$

The nature of the weights in the W matrix means that for neighboring countries, the interaction weight is 1, and 0 for non-neighboring countries. For the same country, interaction is zero. In other words, diagonal terms are zero and non-diagonal terms are higher the greater the effect of observation j on observation i.

To test the robustness of the results, we also resorted to the k-nearest neighbor matrix, which allows us to broaden the analysis beyond immediate contiguity by considering the k nearest neighbors of each country, regardless of their geographical contiguity. Unlike the binary matrix, where interaction is strictly defined by immediate geographical proximity, the k-nearest neighbor matrix allows for the inclusion of countries that may not be contiguous but are sufficiently close based on a distance criterion or other relevant factors. This enriches our model by providing a broader view of potential interactions and better capturing complex regional dynamics, where relationships between countries can be influenced by both geographical and non-geographical factors.

4. Results and discussions

4.1. Basic results

Table 4 presents the results of econometric estimates of the effects of natural resource spillover on state fragility in Africa. The Dynamic Spatial Durbin Model (DSDM) is estimated under a log-log specification for strictly positive continuous variables. Consequently, the associated coefficients can be interpreted directly as elasticities. More specifically, variables such as state fragility, natural resource rents, the share of the population with access to the internet, and human capital are expressed in natural logarithms. However, variables constructed as indices, such as the Polity IV index and the economic growth rate, which can take zero or negative values, were transformed by adding the minimum value plus one to each variable before taking the logarithm. This distinction ensures a consistent interpretation of the estimated parameters and avoids inappropriate logarithmic transformation of indicators that include zero or negative values.

Table 4: Results of natural resource spillover effects on state fragility

VARIABLES	Coefficients	WX	Direct effect	Indirect effect	Total effect
L.state fragility	0.903***				
	(42.42)				
L.Wstate fragility	-0.417***				
	(-5.35)				
Natural resource rents	-0.032***		-0.031***	-0.029**	-0.061***
	(-3.10)		(-3.13)	(-2.41)	(-2.88)
Human capital index	0.482		0.495	0.464	0.959
	(1.43)		(1.49)	(1.40)	(1.48)
Polity IV	0.014		0.016	0.015	0.031
	(0.52)		(0.58)	(0.56)	(0.58)
GDP growth rates	0.038***	-0.095***	0.034***	-0.149**	-0.115*
	(3.38)	(-2.81)	(3.12)	(-2.32)	(-1.74)
Internet access	-0.014*	-0.027**	-0.015**	-0.063***	-0.078***
	(-1.89)	(-2.07)	(-2.03)	(-2.94)	(-3.57)
rho	0.485***				
	(7.71)				
sigma2_e	3.205***				
	(19.93)				
Observations	700				
R-squared	0.977				
R2a	0.996				
Number of id	50				

z-statistics in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Source: Author

The spatial autocorrelation coefficient is positive and reaches 0.485 at the 1% level, meaning that the fragility of one state increases by 0.485% when the fragility of neighboring countries increases by 1%. Consequently, the DSDM estimate confirms an important spatial diffusion effect of state fragility in Africa. Indeed, the fragility of a state depends on both its own characteristics and the level of fragility of neighboring countries. The positive sign of the spatial parameter (rho) suggests a propagation effect of state fragility.

The third column of Table 4 represents the contextual effects of the exogenous variables of level of development and Internet access on state fragility. Contextual effects represent the average effects of neighboring countries on the country under consideration. The contextual effects of the level of development and Internet access have a negative influence on the level of state fragility in Africa. Thus, when the average economic growth rate of a country i's neighbors increases by 1%, the fragility level of country *i* decreases by 0.10%. In the case of Internet access, when neighboring countries improve their average levels of Internet use, the level of fragility in country *i* decreases by 0.03%. These contextual effects illustrate that reducing the fragility of a country *i* in Africa benefits its neighbors.

Spillover effects through GDP growth and Internet access show that economic growth and Internet access reduce fragility in Africa through their positive externalities to neighboring countries. This can be explained by different interconnection policies between different African countries and macroeconomic convergence in certain regional economic integration zones.

The second column of Table 4 represents the average effects of the different variables on state fragility. Indeed, an increase in fragility lagged one period by 1%, leading to an increase in the fragility level of the following year by 0.90%. Thus, fragility is a self-perpetuating process in which previous fragilities reinforce the fragility level of subsequent years. On the other hand, spatially shifted fragility significantly reduces the fragility level of states. For example, a 1% increase in average fragility levels in neighboring countries in previous years translates into a 0.42% reduction in fragility in country *i*. These results reveal a strong temporal and spatial persistence of fragility in Africa, suggesting a cumulative process where past vulnerabilities tend to recur and spread over time and space. The spatial effect observed may reflect regional interdependencies. From this perspective, an increase in fragility in neighboring countries is likely to increase risk perception, encourage national preventive measures, stimulate regional cooperation, or attract increased international support. It may also lead to a reallocation of economic flows to relatively more stable countries. However, these channels remain hypothetical and cannot be directly identified within the estimated model. This is the case for relatively stable countries, which are racing to arm themselves against possible crises. While regional instability generates risks of contagion (refugees, movement of armed groups, cross-border crime), it also prompts preventive responses from neighboring countries (Buhaug & Gleditsch, 2008). In line with realist security theory, states facing external threats strengthen their military and institutional capacities in order to maximize their security (Glaser, 2000). In Africa, this dynamic can be observed following the civil wars in Liberia and Sierra Leone, which led neighboring countries such as Côte d'Ivoire and Guinea to increase their defense spending to counter the spread of conflict (OECD/SWAC, 2020). The Economic Community of West African States Ceasefire Monitoring Group (ECOMOG), the G5 Sahel, and the Alliance of Sahel States (AES) are initiatives aimed at preventing and stabilizing the region. Similarly, crises in eastern DRC and the spread of insecurity in the Sahel have led to a tightening of security measures in neighboring countries such as Rwanda and Uganda (Autesserre, 2010; Raleigh & Dowd, 2013). Recent empirical work confirms that regional fragility can encourage the adoption of preventive policies aimed at containing the spread of instability (Feindouno & Wagner, 2020). Thus, the estimated effect may reflect an institutional and security response mechanism rather than a simple contagion process.

In addition, resource rents have significant negative average effects on state fragility at the 1% threshold. Thus, a 1% increase in natural resource rents leads to a 0.03% decrease in state fragility. This result casts doubt on the idea that natural resources fuel conflict. On the contrary, natural resource rents make it possible to reduce dissension and contain popular pressure through broad redistribution policies. Natural resource rents can also be used to finance the acquisition of equipment to deal with fragility, especially security-related fragility. Although the dominant strand of the literature associates natural resource rents with increased state fragility through the “resource curse” hypothesis (De Soysa, 2002; Ross, 2004b), more recent contributions suggest that this relationship is highly conditional. In particular, Vesco et al. (2020) show that natural resource abundance does not systematically lead to a higher risk of conflict once institutional and contextual factors are taken into account. From this perspective, the result obtained in this study can be interpreted as evidence of a conditional “resource blessing” mechanism, whereby natural resource rents, when mobilized in a context of minimum state capacity, contribute to the financing of core state functions and redistribution policies, thereby reducing potential sources of state fragility.

As far as the control variables are concerned, an improvement in the economic growth rate leads to an increase in state fragility. This result can be explained when growth is achieved in a context of high inequality and growing impoverishment. In this case, economic growth resulting in improved living conditions for a few individuals will be a source of tension, making the state more fragile. On the other hand, an increase in the proportion of the population using the Internet reduces the fragility of the state, as Internet access is generally perceived in Africa as an improvement in people's living conditions.

The last three columns of Table 4 show the direct, indirect, and total effects, respectively. Natural resource rents contribute to reducing state fragility both directly and indirectly. An increase in natural resource rents in country i reduces the fragility of that country by 0.03%, but also that of all neighboring countries by the same amount. The total effect of an increase in natural resource rents on reducing fragility in Africa is estimated at 0.06%. This indicates that when a country stabilizes through the exploitation of natural resource rents, all neighboring countries benefit indirectly. Economic growth and Internet access have significant positive and negative direct effects, respectively, at the 1% threshold. Thus, a 1% increase in economic growth and internet access directly increases fragility by 0.03% and decreases fragility by 0.02% in each country, respectively. On the other hand, the spillover effects of such an improvement translate into a decrease in fragility in neighboring countries. These results indicate that economic growth is not systematically stabilizing. As a result, growth that is not inclusive or is spatially concentrated or captured by certain individuals can exacerbate distributional conflicts and competition for rents in accordance with the voracity effect mechanism (Tornell & Lane, 1999). Conversely, economic growth in neighboring countries mitigates fragility in Africa by expanding regional demand, cross-border trade opportunities, and technology transfers. Indeed, trade integration and investment opportunities would increase the opportunity cost of violence and thereby reduce incentives for conflict (Gleditsch, 2007; Martin et al., 2008). Thus, more prosperous neighbors can reduce the room for maneuver of parties in conflict and promote more stable regional balances (Gleditsch, 2007). This is how regional clusters make growth spillovers potentially stabilizing for neighboring countries (Besley & Persson, 2009).Taking direct and indirect effects into account, an increase in growth and Internet access translates into a reduction in the fragility of African countries. Thus, the beneficial effect of increased GDP outweighs its harmful effects in terms of fragility.

The results show that human capital and institutions have no significant effect on fragility. The insignificance of human capital and Polity IV may seem surprising given the literature emphasizing the role of institutions and education in political stability. However, in economies dependent on natural resources, rents can exert a dominant influence in the short and medium term by strengthening the state's fiscal and security capacity, which can temporarily mitigate the direct impact of institutional fundamentals. The literature also shows that the effect of human capital and institutions on fragility is often conditional, non-linear, and dependent on the rentier context (Bhattacharyya & Hodler, 2014; Bodea & Elbadawi, 2008; Goldstone et al., 2010). Furthermore, human capital acts mainly in the long term and can influence fragility indirectly via income and productive structure (Collier & Hoeffler, 2005). Thus, the lack of significance observed seems to reflect a cyclical dominance of natural rents rather than a questioning of the structural role of institutions and human capital.

4.2. Robustness tests

We performed a sensitivity analysis to check the robustness of our results both according to natural resource type and using the k-neighbor matrix to capture spatial interactions. The results of these two tests are presented in Table 5. It emerges that only gas rents exhibit spillover effects in line with our baseline results. The other types of rents (oil, coal, and minerals) do not show significant spillover effects, although the spatial dependence of fragility is confirmed. This result can be explained by the fact that these rents are not easily appropriated and therefore require heavy cross-border investment. Natural gas exploitation is characterized by high capital intensity, dependence on integrated regional infrastructure (pipelines, terminals, and cross-border networks), and long-term contracts that encourage cooperation. These specific characteristics favor mechanisms of energy interdependence that can strengthen state capacity and spread stabilizing effects beyond national borders, particularly through the establishment of contractual commitments and joint investments (Cashin et al., 2017; Lei & Michaels, 2014; Van Der Ploeg & Poelhekke, 2017). Conversely, mining extraction often remains spatially concentrated, organized in the form of enclaves that are poorly integrated into regional economies and more exposed to localized rent capture and distributional conflicts, which limits the generation of positive cross-border externalities (Arezki et al., 2020; Berman et al., 2017; Cust & Poelhekke, 2015). These structural differences between resources explain why, in our robustness tests, only gas rents have significant spatial spillover effects on state fragility, unlike oil or mining rents, whose spillover effects appear to be more limited and less conducive to regional stabilization dynamics.

Table 5: Robustness test using an alternative measure of natural resource rents and spatial weighting matrix

	Gas rents					k-neighbor matrix				
Variables	Coefficients	WX	Direct effect	Indirect effect	Total effect	Coefficients	WX	Direct effect	Indirect effect	Total effect
L.state fragility	0.932***					0.816***				
	(44.38)					(38.94)				
L.Wstate fragility	-0.378***					-0.285**				
	(-4.83)					(-2.33)				
Gas rents	-0.410**		-0.442**	-0.453*	-0.895**	-0.021**		-0.020**	-0.024*	-0.044**
	(-1.97)		(-2.17)	(-1.83)	(-2.05)	(-2.36)		(-2.35)	(-1.75)	(-2.11)
Human capital index	0.419		0.432	0.438	0.870	1.091***		1.100***	1.318**	2.418***
	(1.23)		(1.29)	(1.22)	(1.27)	(3.49)		(3.56)	(2.12)	(2.85)
Polity IV	0.018		0.020	0.020	0.040	0.038		0.039	0.046	0.084
	(0.66)		(0.72)	(0.68)	(0.70)	(1.54)		(1.60)	(1.43)	(1.56)
GDP growth rates	0.032***	-0.119***	0.027**	-0.207***	-0.180***	0.043***	-0.176***	0.040***	-0.324***	-0.285***
	(2.88)	(-3.49)	(2.46)	(-3.07)	(-2.59)	(4.00)	(-3.21)	(3.76)	(-3.00)	(-2.58)
Internet access	-0.014*	-0.033**	-0.016**	-0.078***	-0.093***	0.005	-0.065***	0.003	-0.131***	-0.128***
	(-1.87)	(-2.48)	(-2.07)	(-3.39)	(-3.97)	(0.67)	(-3.71)	(0.46)	(-4.25)	(-4.09)
rho	0.505***					0.530***				
	(8.01)					(6.05)				
sigma2_e	3.265***					3.186***				
	(19.92)					(22.07)				
Observations	700					700				
R-squared	0.977					0.978				
R2a	0.996					0.996				
Number of id	50					50				

z-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Author

The results of changing the spatial weighting matrix confirm most of the findings previously highlighted. Thus, an increase in natural resource rents in one country leads to a reduction in fragility both in that country and in neighboring countries. Overall, the results in Table 4 confirm all the basic findings, notably the spatial dependence of state fragility and the direct and indirect effects of natural resource rents. Overall, our results are stable using an alternative measure of rents and a change in the spatial weighting matrix.

5. Conclusion

The objective of this paper is to analyze the spillover effects of natural resource rents on state fragility in Africa. Unlike previous studies, our study takes into account the spatial autocorrelation of natural resource rents between countries by estimating a dynamic spatial Durbin model on a sample of 50 African countries over the period 2007 - 2021. The empirical results show that there is significant spatial dependence and spatial heterogeneity in state fragility in Africa. We find that natural resource rents contribute to reducing state fragility both in resource-rich countries and in the region as a whole. However, robustness analysis distinguishing between different types of resources (gas, oil, and minerals) reveals significant heterogeneity in effects: only gas rents have statistically significant spatial spillover effects on the fragility of neighboring states, while oil and mining rents do not generate robust spatial externalities. This clarification is a major contribution of the article, showing that the stabilizing impact of natural resources depends on the sectoral nature of the rent and cannot be generalized uniformly across the entire extractive sector. What's more, country fragility is a self-reinforcing process in which previously observed fragilities are at the root of current state fragilities. On the other hand, for a given country, the previous fragility of neighboring countries is at the root of the decrease in fragility in that country, given the preventive measures taken.

In terms of economic policy implications, our results underline the important role that natural resource rents can play in reducing state fragility in Africa, both directly and indirectly. In particular, the results suggest that a differentiated approach to natural resource governance should be favored, with particular attention paid to gas revenues, whose regional externalities have been statistically established. As such, African countries should strengthen the regulatory framework for the exploitation of natural resources as alternative sources of revenue for countries to cope with fragility of all kinds. In this case, participatory and transparent governance of natural resource revenues should be promoted, involving civil society organizations and local populations to limit rent-seeking. Given the complementarity of African countries in reducing fragility, they need to coordinate their policies to combat insecurity and share experiences in natural resource management.

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