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Does natural resource curse in finance exist in Africa? Evidence from spatial techniques

Mira Nurmakhanova [a], Mohamed Elheddad [b,*], Abdelrahman J.K. Alfar [c], Alloysius Egbulonu [d], Mohammad Zoynul Abedin [b]

[a] Department of Accounting and Finance, KIMEP University, Almaty, 050010, Kazakhstan
[b] Teesside University International Business School, Middlesbrough, UK
[c] Global Business School for Health, Univeristy College London, UK
[d] School of Business and Creative Industries, University of West of Scotland, UK

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ABSTRACT

This paper aims to examine the relationship between financial development and natural resources. By using panel data of 20 selected African countries from 1995 to 2020, we investigate whether all types of financial development have the same relationship with natural resources. In doing so, a recently developed novel estimation technique, spatial econometric, is employed for the first time to estimate the FD-NR relationship and account for the possible spillover effect of financial development in one country on the neighbouring countries. The novelty of this methodology is to consider structural breaks and the heterogeneity issues that are common in panel data. The main findings of this paper are that there is a robust negative effect of natural resource rents on both stock market capitalization ratio and available private credit. Furthermore, the empirical evidence suggests new insights for policymakers to use appropriate and sophisticated policies to boost the development of the financial sector in African countries over the long term. More policy implications are further discussed in this study.

1. Introduction

Based on the traditional natural resource scarcity theory, having limited natural resources provides limited economic growth and vice versa. Therefore, it is expected that discoveries of natural resources such as oil, gas, and minerals lead to higher economic growth (Eboh et al., 2006), and one would surely anticipate that natural resource discovery in developing economies, would similarly contribute positively to economic development. Auty (1993) however noted that resource-rich economies perform economically poorer than resource-poor economies.

Since the empirical work by Sachs and Warner (2001), a flood of papers emerged to validate the so-called "natural resource curse". This term generally refers to the negative relationship between economic growth and natural resource dependence in developing resource-rich economies. It is also observed that those countries suffer from some economic, political and social problems such as high levels of poverty, low level of education, economic growth volatility, political instability and low institutional quality.

In the same line with previous issues, resource-rich economies, in specific developing countries, tend to have a slower pace of financial development than resource-poor economies. The role of financial development on economic growth is small and weak in these countries (Samargandi et al., 2014). In particular, financial development covey lower impacts on economic development in oil-exporting economies than in oil-importing countries (Nili and Rastad, 2007). This negative impact is not only due to oil dependence but also because of the low quality of financial institutions. This phenomenon was coined as "*natural resource curse in finance*" (Beck, 2011; Beck and Steven Poelhekke, 2017).

Besides, in natural resource abundant countries, own-state financial institutions, in particular, banks dominate financial activities, and the financial stock market has a small contribution to the local economy (Naceur et al., 2014). What makes matter worse is that the financial stock market in these countries is a follower rather than a leader. In other words, the distribution of financial stock markets has been observed to follow the structure of production, which is mostly oil-oriented (rent-seeking behaviour) rather than contributing to productive sectors (Lin et al., 2009).

* Corresponding author.
E-mail address: m.elheddad@tees.ac.uk (M. Elheddad).

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It is well documented that financial development indicators are low in natural resource-based countries. According to World Bank statistics, OECD countries (natural resource-poor economies) outpace sub-Saharan Africa and MENA regions, which are described as resource-abundant economies. According to Dwumfour and Ntow-Gyamfi (2018), 32% of African countries depend on resource rents varying from a low of 12.5% (Zambia) to 52.6% (Angola) share of GDP. Domestic credit to private banks as a share of GDP averaged about 132% in OECD from (1980–2017), whereas sub-Saharan Africa and MENA averaged about 50% and 38% respectively (World Economic Indicators, World Bank) due to poor governance and mismanagement of financial and human resources (Yuxiang and Chen, 2011). This gap between these regions may raise a question regarding the impacts of natural resources on financial development.

The finance-natural resource nexus has been widely investigated, but the empirical findings are far from conclusive. Specifically, Dwumfour and Ntow-Gyamfi (2018) find that in Africa, the impact of natural resource rents (Rents) on financial development is ambiguous and largely depends on the Financial Development indicators employed. Similar asymmetric behaviour of natural resource rent on financial development was reported by Chaudhry et al. (2021) for Saudi Arabia.

Some studies argue that the presence of natural resources stimulates financial development (Ali and Ramakrishnan, 2022; Shahbaz et al., 2018). The reason behind this positive relationship is that natural resource capital affects the financial sector through deposits and funding side. Higher natural resource revenues generate higher deposit funding for the local baking system. Natural resources might also increase the demand for the loan, hence increasing deepening of the financial system (Beck and Poelhekke, 2017).

To give a deep understanding of the FD-NR association, Fig. 1 illustrates the potential hypothesis. It plots the financial development measured by domestic credit to private sector/GDP versus the share of natural resource rents in GDP. It preliminarily shows that there is expected a negative relationship between these two variables.

Recent studies, however, have observed a negative relationship between natural resources and financial development indicators (Khan et al., 2020; Nathaniel, 2021; Beck, 2011; Beck and Poelhekke, 2017; Bhattacharyya and Hodler, 2014). This negative relationship comes through three main channels. First, natural resources shift the wealth out of local domestic financial institutions into foreign firms. Second, through traversing resource capital to non-financial sectors. Third, natural resources rent might lead to more extraction "resource sector" crowding out of the non-resource sector. Thus, causing lower demand for external finance (Beck and Poelhekke, 2017).

The diverse results which are based on conventional econometric analysis of time-series or cross-sectional data, complicate the process of formulating government policies for an individual country. Specific temporal effects are not taken into account in cross-sectional studies, whereas all spatial effects are not taken into account in traditional time-series research. According to Ancelin et al. (2008), When the structure of the dependency is connected to place and distance, spatial dependence or spatial heterogeneity may produce spatial effects. The spatial econometric methods, on the other hand, enable the investigation of regional financial development dependent on the neighbouring countries. Since trade revenues greatly depend on distance costs (e.g., Nitsch, 2000), it might be the case that international interactions are subject to bundling with neighbouring countries. As developing countries reduce the distance from more-developed economies, their potential economic and financial growth develops. Additionally, compared to developed countries, less-developed ones are more inclined to create a high trade concentration. Thus, there is the question of whether spatial techniques contribute to assessing the impact of globalization on financial development.

The purpose of this study is to re-examine the relationship between financial development indicators and natural resource abundance using panel data analysis covering the period 1995–2017 for 20 African countries. Applying spatial panel data techniques is essential to avoid the problem of cross-countries (heterogeneity). Panel data also controls for the expected endogeneity issue. This study applies various financial development indicators to see whether different types of financial development have the same relationship with natural resources.

This paper contributes to the existing literature by empirically examining the FD-NR association. Analysing this relationship is an important issue for many reasons. First, this importance is related to the natural resource curse hypothesis. Studying the FD-NR relationship provides a deep understanding of the natural resource curse. Since FD plays a significant role in the long-run economic growth, any effects of natural resource endowment on the financial sector might impact the variation of economic growth (Yuxiang and Chen, 2011). Second, spatial econometric techniques are employed to estimate the FD-NR relationship to account for the possible spillover effect of financial development in one country on the neighbouring countries. Further, this study is related to the literature on financial development determinants, thus helping policymakers to arrange an appropriate and sophisticated policy to boost the development of the country's financial sector.

The main findings of this paper are that there is a robust negative effect of natural resources rents in a specific country on both stock market capitalization ratio and available private credit of the same

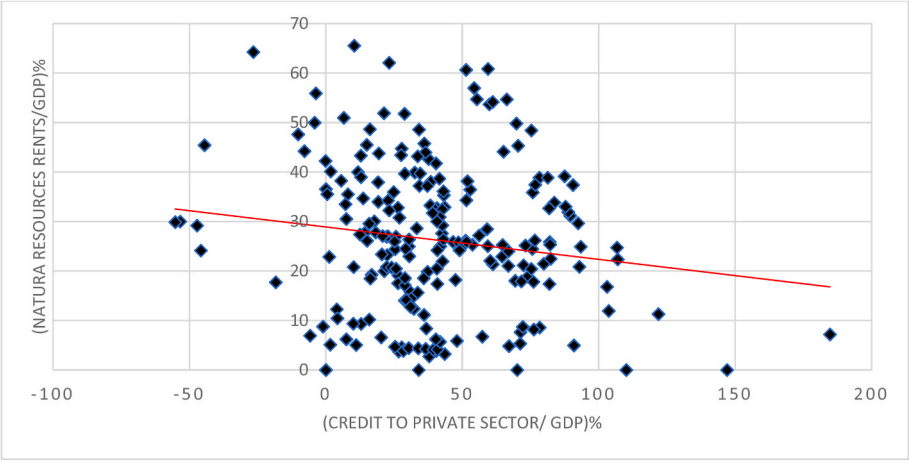

Fig. 1. Financial development-Natural Resources relationship.
Source: Author's work based on Data from World Bank

country. However, the impact of natural resources rent is positive on the financial development of a neighbouring country.

This paper is structured as follows. Section 2 reviews the related studies and Section 3 discusses the data. section 4 presents the methodology followed by the empirical results in section 5. Finally, section 6 provides the main conclusions and some policy implications.

2. Literature review

The finance-natural resource nexus has been widely investigated, but the empirical findings are far from conclusive. Specifically, Dwumfour and Ntow-Gyamfi (2018) investigated the nexus between financial development, natural resources and institutional quality for African countries during 2000–2012 and concluded that the effect of natural resource rents on financial development is vague and largely depends on the financial development indicator employed. Similar asymmetric behaviour of natural resource rent on financial development was reported by Chaudhry et al. (2021) for Saudi Arabia. Yuxiang and Chen (2011) examined how natural resources impacted China's financial performance and came to the conclusion that they had a negative impact. Similar to this, Bhattacharyya and Hodler (2014) used a fixed effect technique to assess the influence of natural resources on financial development for a panel of 130 countries from 1970 to 2015 and observed that natural resources had a sizable and detrimental impact on financial growth. Guan et al. (2020) investigated the effects of economic growth, natural resources, globalisation, and human capital on China's financial development from 1971 to 2017. They discovered that natural resources had a detrimental effect on economic development and identified a unidirectional causal relationship between natural resources and financial development. The effect of natural resources on the financial growth of seven developing countries was studied by Sun et al. (2020), and their conclusions suggested that natural resources had a negative impact on economic growth. Khan et al. (2020) utilized the ARDL model to examine how natural resources affect financial development while also accounting for other factors including human capital, technical innovation, and trade openness.

According to their empirical research, natural resources have a sizable yet detrimental impact on financial development. The nexus between China's natural resources, GDP, investment, and trade openness was studied by Jiang et al. (2021), encompassing the years 1981–2018, the study argued that the development of the financial sector is negatively impacted by natural resources. Nevertheless, Doytch et al., 2015 conclude that mining FDI has a detrimental effect on services FDI in upper-middle-income and high-income nations. yet these findings do not reveal whether mining FDI affects financial services FDI differently from non-financial services FDI.

For a panel of 10 countries, Hadj and Ghodbane (2021) looked into the connections between financial development, economic variables, institutional factors, and human capital, the study suggested that natural resources have a significant but harmful impact on economic growth.

According to certain research, the availability of natural resources encourages financial development (Ali and Ramakrishnan, 2022; Shahbaz et al., 2018). The notion that natural resource capital has an impact on the financial sector through deposits and the funding side supports this claim. The local banking system receives more money from deposits as a result of increasing natural resource income. The need for loans might potentially expand as a result of natural resources, thereby deepening the financial system (Beck and Poelhekke, 2017).

Shahbaz et al. (2018) explored the association among natural resources, education, capitalization, economic growth, and financial development in the United States from 1960 to 2016, the findings are consistent with other comparable research. They verified that the growth of the financial sector is significantly yet favourably impacted by natural resources. Additionally, their research shows that natural resources and financial development are causally related in both directions. Zaidi et al. (2019) explored the effects of human capital, globalisation, and natural resources on financial development for OECD nations from 1990 to 2016. According to this study, natural resources have a positive influence on economic growth. Their empirical research suggests that there is a unidirectional causal link between natural resources and economic growth. Yıldırım et al. (2020) analysed the effect of natural resources on financial development using data from 16 developing nations between 1994 and 2017. Their empirical evidence demonstrates that natural resources have a substantial and positive effect on financial development. Similarly, Doytch & Eren (2012) find that the natural resource endowments have a positive impact on FDI in agriculture and manufacturing sectors, yet the impact is insignificant in the service sector.

Atil et al. (2020) studied the effect of natural resources, oil prices, globalisation, and economic growth on Pakistan's financial development between 1972 and 2017. Their empirical findings indicate that natural resources have a considerable and favourable effect on financial development. Asif et al. (2020) analysed the effect of natural resources on the financial development of Pakistan during 1975–2017. Their findings indicate that natural resources have a beneficial effect on financial development in the short term, but a negative effect on financial development in the long term. Hussain et al. (2021) investigated the connection between natural resources and financial development for 23 resource-rich, high-income countries. This study discovered that natural resources affect positively financial development.

The current study in different from the pervious studies into two folds. First, this importance is related to the natural resource curse hypothesis. Studying the FD-NR relationship provides a deep understanding of the natural resource curse. Since FD plays a significant role in the long-run economic growth, any effects of natural resource endowment on the financial sector might impact the variation of economic growth (Yuxiang and Chen, 2011). Second, spatial econometric techniques are employed to estimate the FD-NR relationship to account for the possible spillover effect of financial development in one country on the neighbouring countries. Further, this study is related to the literature on financial development determinants, thus helping policymakers to arrange an appropriate and sophisticated policy to boost the development of the country's financial sector.

3. Data

The model to investigate the relationship between financial development and natural resource assumes that the level of financial development depends on rents from natural resources (natural rents) along with other control variables. To do so, a panel data of 20 African developing countries for the period 1995–2020. The list of the countries is reported in Table .1. One of the key characteristics of these economies

Table 1
List of sample countries.

1. Benin	11. Madagascar
2. Botswana	12. Malawi
3. Burkina Faso	13. Mali
4. Cameroon	14. Mozambique
5. Central African Republic	15. Niger
6. Congo, Rep.	16. Rwanda
7. Djibouti	17. South Africa
8. Egypt, Arab Rep.	18. Tanzania
9. Gabon	19. Togo
10. Kenya	20. Uganda

is the abundance of natural resources. However, these economies are poor in terms of financial development.

To describe the financial development of the country several proxies are utilized. Following Boyd and Runkle (1993), Čihák and Hesse (2010) and Čihák et al. (2012), we use the Bank *Z* score. The bank *Z* score is one of the variables that measures the financial stability and financial development. It captures the probability of default of a country's banking system. The popularity of the *z*-score stems from the fact that it has a clear (negative) relationship to the probability of a financial institution's insolvency, that is, the probability that the value of its assets becomes lower than the value of its debt. A higher *z*-score therefore implies a lower probability of insolvency.

Z-score compares the buffer of a country's banking system (capitalization and returns) with the volatility of those returns. It is estimated as (ROA+(equity/assets))/sd(ROA); sd(ROA) is the standard deviation of ROA, calculated for country-years with no less than 5 bank-level observations. ROA, equity, and assets are country-level aggregate figures. The bank-by-bank unconsolidated data comes from Bankscope and Orbis. The result is not reported if a country-year has less than 3 bank-level observations. This variable is obtained from Global Financial Development Database.

$$Z - Score = \frac{ROA + (equity + assets)}{\sigma(ROA)} \quad (1)$$

Furthermore, we use the Domestic credit to private sector as a percentage of GDP. It refers to financial resources provided to the private sector. This ratio suggests that a country is financially underdeveloped if there is little credit available for the private sector relative to the size of its economy.

Table 2.a
Definitions of variables and sources.

Variable	Key definition	Source
Bank *Z*-score	Bank *Z*-score	Global Financial Development Database
Domestic credit provided by financial sector	Domestic credit provided by financial sector (% of GDP)	The World Development Indicators (WDI)
Total Natural Resources Rents	Total natural resources rents (% of GDP)	The World Development Indicators (WDI)
Trade	Trade (% of GDP)	The World Development Indicators (WDI)
GDP per capita	Logarithm of GDP per capita (constant 2010 US$)	The World Development Indicators (WDI)
Population	Logarithm of total population	The World Development Indicators (WDI)
Inflation	Inflation based on Consumer price index (2010 = 100)	The World Development Indicators (WDI)

The main independent variable of our interest is natural resources abundance. This variable is measured by the natural resource rents. They are calculated as the difference between the price of a commodity and the average cost of producing it. This is done by estimating the price of units of specific commodities and subtracting estimates of average unit costs of extraction or harvesting costs.

For a number of reasons, this study employs this indicator of natural resource revenues. First off, it provides a decent representation of resource earnings that might possibly be seized by political leaders by assessing resource rents. Second, it covers a sizable number of nations. As a result, we can reduce the chance of sample selection bias. Additionally, it offers a somewhat long-time dimension. Third, some recent research has employed it (e.g., Bhattacharyya and Hodler, 2014; Collier et al., 2009; Ross, 2006). Fourth, because resource rents are mostly dependent on the stock of natural resources and exogenous global pricing, it may be possible to get around some endogeneity-related difficulties.

The level of financial development is affected by several macroeconomic factors such as: inflation, trade (as a share of GDP), population, and GDP per capita. The effect of natural resources on the financial development is estimated using the spatial econometric technique. According to Elhorst (2017). Controlling for time-specific and spatial effects is the main advantage of using spatial panel models. Being unaware of these spatial and temporal factors raises the likelihood of getting non-reliable findings. Therefore, verifying the presence of spatial interaction effects is thus the primary goal of the spatial econometric approach.

The estimated model is formulated as follows.

$$FD_{i,t} = \beta_0 + \beta_1 NR_{i,t} + \beta_2 X_{i,t} + \varepsilon_{i,t} \quad (2)$$

Where is *FD* referring to the financial development measures by two different proxies, *NR* is the proxy of natural resource abundance and *X* is a victor of control variables. Table 3 provides the descriptive statistics of the variables used in our model.

Table 3
Descriptive statistics.

Variable	Mean	Std. Dev.	Min	Max
Bank *Z*-score	10.371	6.772	2.644	93.742
Domestic credit provided by financial sector	35.639	44.553	−79.092	192.660
Total Natural Resources Rents	8.428	6.338	0.375	35.272
Trade	63.837	20.513	23.981	122.949
GDP per capita	1843.452	1952.302	318.964	7583.590
Population	16.650	0.863	14.328	18.335
Inflation	4.364	0.380	2.709	5.326

Table 2.b
Correlations matrix.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Bank Z score	1.000						
(2) Domestic credit provided by financial sector	0.024	1.000					
(3) Total Natural Resources Rents	0.183*	−0.155*	1.000				
(4) Trade	0.135*	0.010	0.101	1.000			
(5) Ln (GDP per capita)	−0.006	0.120*	0.033	0.368*	1.000		
(6) Ln (population)	−0.009	0.150*	0.151*	−0.365*	0.014	1.000	
(7) Inflation	0.014	0.098	0.173*	0.085	0.112	0.060	1.000

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

4. Methodology

According to Elhorst (2017), three are different types of spatial interaction effects such as Endogenous interaction effect, Exogenous interaction effect and Interaction among the error terms.

The first effect demonstrates the relationship between values of dependent variable of two different units. The second effect demonstrates the relationship between values of the dependent and independent variables of two different units. Finally, the last effect captures similarity in units' behaviour due to analogous unobserved conditions. The linear regression that includes all interaction effects has the following form:

$$u_t = \lambda W u_t + \varepsilon_t \tag{3}$$

where the scalar parameters ρ and λ and the K × 1 vector of parameters θ are measures of the strength of spatial dependence between the units. However, empirical research uses models with one or two spatial interaction effects. Depending on what types of spatial interaction terms are included into the model, there are several practical implementations of regression (1): (1) SAR contains the endogenous interaction effect, (2) SEM contains the interaction effect among the error terms, (3) SAC contains both endogenous and error interaction terms, and (4) SDM contains both endogenous and exogenous spatial interaction effects. Additionally, there are two fixed effects dynamic variants of the SAR and SDM. Thus, the first issue while conducting the empirical research is the choice of the appropriate model.

The model selection process follows the approach provided in LeSage and Pace (2009) and Elhorst (2010). Based on the approach, SDM should be a starting model, which will be compared with other alternatives.

The SDM can be derived from Eq. (3) by imposing a restriction on Manski's model by letting $\lambda = 0$. Therefore, the SDM equation should be as follow:

$$Y_t = \rho W Y_t + X_t\beta + W X_t\theta + \mu + \xi_t i_N + u_t, \tag{4}$$

The Spatial Durbin Model enables inferring the impact of the financial development of a specific country on its neighbouring countries, at the same time, it assesses the impact of the exogenous explanatory variables of both the country and its neighbours on the outcome variable.

The SAR model is a special case for the SDM model and is obtained by introducing a restriction to the model by making $\theta = 0$ and $\rho \neq 0$. Therefore, the model would be as follows,

$$Y_t = \rho W Y_t + X_t\beta + \mu + \xi_t i_N + u_t, \tag{5}$$

by imposing different restrictions on Manski's model (Eq. (3)) by making $\theta = 0$ and $\rho = 0$, the effect of overlooked variables can be attained, which is characterised by the error term on the error term for neighbouring countries. According to these restrictions, the Spatial Error Model (SEM) can be obtained. The following equations represent the SEM model.

$$Y_t = + X_t\beta + + \mu + \xi_t i_N + u_t, u_t = \lambda W u_t + \varepsilon_t \tag{6}$$

If we assume that the model is such that $\theta = 0$, we conclude the Kelejian-Prucha or the heteroskedastic model which is also known as the Spatial Autoregressive Confused (SAC).

$$Y_t = \rho W Y_t + X_t\beta + \mu + \xi_t i_N + u_t, u_t = \lambda W u_t + \varepsilon_t \tag{7}$$

For the appropriateness of the SAC model, Akaike's information criterion and Bayesian information criterion are employed. As for the inclusion of spatial and time specific effects which should be treated as fixed or random effects in spatial regression models, likelihood ratio (LR) tests and the Hausman test are employed (Belotti et al., 2017). For estimation purposes of the final model specification the Maximum-Likelihood estimator was employed.

5. Empirical results and discussions

To test the natural resources-financial development curse, we measure the financial development by two key proxies; one related to the banks' stability which is *Z* score. And the second one is Domestic credit provided by the financial sector. These two variables make our results robust.

First, the spatial Durbin model (SDM) is estimated to determine which spatial econometric regression recommends the best fit (Elhorst, 2010; LeSage and Pace, 2009). Second, likelihood ratio (LR) tests are performed for the further choice between SDM, SAR or SEM model. For appropriateness of SAC model, the Akaike's information criterion and Bayesian information criterion are employed.

5.1. Bank Z score

Our analysis starts with the bank *Z* score. This proxy is one of the variables that represents the financial stability in a country. It captures the probability of default of a country's banking system. It has a clear (negative) association to the probability of a financial institution's bankruptcy, that is, the probability that the value of its assets becomes lower than the value of its debt. A higher *z*-score therefore implies a lower probability of insolvency.

Table 4 demonstrates test results of model selection for Bank *Z*-score, and the dynamic SDM model with spatial fixed-effects is chosen for the Bank *Z*-Score. Then the dynamic SDM model is estimated with the results provided in Table 5.

As shown in Table 5, estimates of Bank *Z*-Score are significant for all model specifications. Concentrating on value of the spatially lagged term Rho in Table 4, positive estimated value of this term implies that financial development in neighbouring countries have a positive effect on local development of financial system.

The feedback loop among spatially linked units is a fascinating aspect of spatial econometric models. The spatial lagged dependent variable and the spatially lagged independent variables both contribute to a portion of the feedback effects. In this study, these spatial feedback effects are imitated by the spatially lagged independent variables, W. Total Natural Resources Rents, W. Trade, W. GDP per capita, W. Population, W. Personal Remittances Received, and W. Inflation, besides, the spatially lagged dependent variable W. Bank Z-score and.

This feedback loop, as indicated by Belotti et al. (2017), explains why the direct impacts of the explanatory variables differ from their parameter estimates in Table 2. As a result, direct, indirect, and total marginal impacts differ from one another. Marginal impacts are estimated and shown in Table 6, both short-run (panel A) and long-run (panel B) effects which reflect the dynamic nature of the model are computed.

Concentrating on the results in Table 6, total natural resources have both direct and indirect effect on bank *Z*-score in the short- and long-run. The direct effect means, the impact on a region's outcome variable resulting from a change in an explanatory variable for that region. However, the indirect effect shows the influence on the dependent variable in a region rendered by a change in some other region(s) (Golgher and Voss, 2016).

One percent increase in total natural resources is followed by

Table 4
Test for model selection for Bank *Z* Score.

Model	Chi^2	*P*-value	AIC
SAR vs dynamic SAR	203.16	0.00	.
SDM vs dynamic SDM	192.83	0.00	.
Dynamic SDM vs Dynamic SAR	4.74	0.58	.
SDM vs SEM	21.1	0.002	.
SAC	.	.	1794.78
Dynamic SDM	.	.	1245.3

Table 5
Estimation results of dynamic SDM model for Bank Z-Score.

Variables	(1)	(2)	(3)
L. Bank *Z*-score	0.358***	0.515***	0.328***
	(0.05)	(0.0888)	(0.0447)
L.W Bank *Z*-score	−0.0182	−0.00225	−0.0353
	(0.0212)	(0.0398)	(0.0238)
Total Natural Resources Rents	−0.0713**	0.0429	−0.0345
	(0.0347)	(0.0334)	(0.0448)
Trade	−0.00265	0.0253	−0.00723
	(0.00644)	(0.0205)	(0.00932)
GDP per capita	0.000531	−8.28e-05	0.00165
	(0.000885)	(0.000198)	(0.00147)
Population	3.910	0.323	9.016
	(5.194)	(0.440)	(9.068)
Personal Remittances Received	−0.0142	0.0980	−0.0383
	(0.193)	(0.119)	(0.153)
Inflation	0.850	0.666	1.215
	(0.856)	(0.896)	(0.915)
W.Total Natural Resources Rents	0.0782*	0.110	0.122**
	(0.0404)	(0.0725)	(0.0510)
W.Trade	−0.00260	−0.0268	−0.0197
	(0.0176)	(0.0287)	(0.0243)
W.GDP per capita	−0.000160	0.000300	0.000485
	(0.000798)	(0.000361)	(0.000990)
W.Population	−8.839	0.113	−12.37*
	(5.965)	(0.284)	(6.692)
W.Personal Remittances Received	−0.0575	−0.117	−0.144
	(0.161)	(0.218)	(0.121)
W.Inflation	1.211*	−0.665	2.416*
	(0.704)	(1.001)	(1.327)
Rho	0.0657**	0.0931	0.00435
	(0.0278)	(0.0761)	(0.0498)
Variance	4.192**	6.052**	3.894**
	(2.108)	(2.462)	(1.880)
Country FE	YES		YES
Year FE		YES	YES

Robust standard errors in parentheses ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

proportional deterioration (0.068 percent) in bank *Z*-score in the short run. Furthermore, the direct long-run effect of percent increase in total natural resources is almost twice stronger, 0.107 percent. Nevertheless, because indirect feedback effects, the total effect of total natural resources on bank *Z*-score is insignificant. As for controls, only inflation has a long-run effect on bank *Z*-score. Higher level of inflation improves bank *Z*-score in the long run. One percent increase in inflation rate results in 2.03 and 3.2 percent improvement of bank *Z*-score in the short-run and the long-run respectively.

In the next section we investigate the short- and the long-run effect of total natural resources on domestic credit provided by financial sector.

5.2. Domestic credit provided by financial sector

The model selection process for domestic credit provided by the financial sector is like the one for bank *Z*-score. Table 7 offers the results of tests for model selection for domestic credit provided by the financial sector.

The dynamic SDM model with spatial fixed effects is selected for the domestic credit provided by the banking sector based on these tests for the model appropriateness. The outcomes of the dynamic SDM model estimate are shown in Table 8.

Given the dynamic nature of the chosen model, both short-run and long-run effects are computed. Table 9 provides calculated marginal effects for domestic credit provided by financial sector.

5.3. Discussion

The financial development includes the development of financial institutions, financial markets and financial instruments. Financial development can be reached through the non-stop enhancement of financial efficiency conveyed by the expansion of the financial transaction scale. Yet, countries with an abundance of natural resources witness less financial development. This is known as the resources curse, which arise from the spending on infrastructure and investment centralization.

Nevertheless, the natural resources are a blessing for neighbourhood countries, the natural resources in country "*i*" have a positive impact on the financial development of the country's "*i*" neighbours. Two reasons can justify the concluded result. First, as long the resources are cursing the financial development locally, capital will move outside the country of the rich resources "capital flight". Most of resource-based economies experience the largest capital flight (Epstein, 2005). And more likely to its neighbours which in return strengthens their financial system.

Second, labours tend to move from a resource-poor country to a rich country, this movement initially takes place to a neighbouring country. In return, labours transfer money to their home countries "remittance".

Table 7
Test for model selection for domestic credit provided by financial sector.

Model	Chi^2	P-value	AIC
SAR vs dynamic SAR	950.47	0.00	.
SDM vs dynamic SDM	460.24	0.00	.
Dynamic SDM vs Dynamic SAR	26.49	0.0002	.
SDM vs SEM	152.02	0.00	.
SAC	.	.	2323.15
Dynamic SDM	.	.	1779.01

Table 6
The direct, indirect, and total marginal impacts for the Bank Z-Score in the short- and long-terms.

Panel A: Short-Run	Direct		Indirect		Total	
	Coeff.	St. Error	Coeff.	St. Error	Coeff.	St. Error
Total Natural Resources Rents	−0.0685**	−0.0332	0.0688*	−0.0368	0.00027	−0.0524
Trade	−0.00299	−0.0064	−0.0029	−0.0157	−0.0059	−0.0171
GDP per capita	0.000572	−0.0009	−0.0001	−0.0007	0.00047	−0.0011
Population	3.775	−5.259	−8.121	−5.297	−4.346	−3.122
Personal Remittances Received	−0.0161	−0.188	−0.0506	−0.149	−0.0666	−0.194
Inflation	0.863	−0.844	1.171**	−0.566	2.034**	−0.824
Panel B: Long-Run	**Direct**		**Indirect**		**Total**	
	Coeff.	St. Error	Coeff.	St. Error	Coeff.	St. Error
Total Natural Resources Rents	−0.107**	−0.0517	0.107*	−0.0581	4.51E-05	−0.0823
Trade	−0.0047	−0.0101	−0.0045	−0.0247	−0.00917	−0.0269
GDP per capita	0.00089	−0.0014	−0.0002	−0.0011	0.000731	−0.0018
Population	5.837	−8.164	−12.67	−8.257	−6.832	−4.898
Personal Remittances Received	−0.0246	−0.293	−0.077	−0.233	−0.102	−0.306
Inflation	1.351	−1.315	1.845**	−0.887	3.196**	−1.301

Table 8
Estimation results of dynamic SDM model for domestic credit provided by financial sector.

Variables	(1)	(2)	(3)
L.Domestic credit provided by financial sector	0.816***	0.778***	0.858***
	(0.0621)	(0.0170)	(0.0533)
L.W Domestic credit provided by financial sector	−0.0243	0.399***	0.0475
	(0.0374)	(0.0131)	(0.0492)
Total Natural Resources Rents	−0.440	−0.268***	−0.511**
	(0.268)	(0.0537)	(0.209)
Trade	−0.0151	0.362***	0.0108
	(0.0439)	(0.0285)	(0.0414)
GDP per capita	−0.00114	0.00207***	−0.0110***
	(0.00158)	(0.000322)	(0.00351)
Population	10.67	17.54***	−68.43**
	(17.50)	(1.023)	(28.42)
Personal Remittances Received	−0.280	−0.644***	−0.150
	(0.324)	(0.169)	(0.309)
Inflation	−4.185	64.01***	−5.682***
	(2.591)	(1.325)	(1.948)
W.Total Natural Resources Rents	0.0100	0.370***	−0.110
	(0.155)	(0.0963)	(0.186)
W.Trade	0.0428	−0.208***	0.0357
	(0.0297)	(0.0304)	(0.0300)
W.GDP per capita	−0.00287	−0.00589***	−0.00214
	(0.00225)	(0.000379)	(0.00206)
W.Population	21.18	−15.54***	36.28*
	(21.28)	(0.457)	(21.87)
W.Personal Remittances Received	−0.845*	−1.693***	−0.585
	(0.447)	(0.190)	(0.425)
W.Inflation	3.537	65.15***	−7.426*
	(2.782)	(1.550)	(4.500)
Rho	0.0100	0.0111	0.0104
	(0.0299)	(0)	(0.0358)
Variance	26.81***	119.7***	24.48***
	(9.093)	(11.12)	(8.809)
Country FE	YES		YES
Year FE		YES	YES

Robust standard errors in parentheses ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

In the short run, more transfers enforce the financial system to develop its infrastructure and motivate households to open new banking accounts. In the long run, the financial markets and the innovation in financial instruments can be more developed in neighbouring countries.

Our findings are in line with the financial development-natural resources curse which supported by several studies reported in Table 10. However, the current study takes in account the impact of neighbourhood countries.

6. Conclusions

The main aim of this study is to re-examine the relationship between financial development indicators and natural resource abundance using panel data analysis covering the period 1995–2020 for 20 African countries. Applying spatial panel data techniques is essential to avoid the problem of cross-countries (heterogeneity). Thus, the study answers the question of whether spatial techniques contribute to assessing the impact of globalization on financial development.

The main findings of this paper are that there is a robust negative effect of natural resources rents in a specific country on both stock market capitalization ratio and available private credit of the same country. However, the impact of natural resources rent is positive on the financial development of a neighbouring country. The financial system is principally accountable for reflecting natural resources on economic growth. Therefore, revenues from the natural resources should be efficiently used to improve the financial development in Africa. These findings contribute to the existing literature and practical implications by emphasizing on the spatial impact's "spillovers" among the oil-rich African economies.

Our results have several implications. For governments "policy makers, Firstly, designing the diversification policy. resource rents should be directed from traditional (non-renewable) to modern sectors such as service sector, in particular, financial sector. Instead of inefficiently distributing resource rents to non-productive sectors, this will allow for the growth and development of the productive sectors. As a result, it is crucial for the nations to maximise productive investments. To demonstrate this, policymakers should encourage private investments in the financial sector. Also, the Multinational Corporations (MNCs) should diversify their investments between resource-sector and service sector (financial systems). The strengthening of financial sector orientation and contribution to financial development will result from this enhancement. Second, the rent should be kept in the neighbourhood banking system. As a result, loans to the private sector rose along with an increase in bank deposits. Finally, it needs to accurately determine how resource availability affects institutional growth. The institutional

Table 10
Comparisons of related studies.

FD-NR negative relationship	FD-NR positive relationship
Yuxiang and Chen (2011)	Ali and Ramakrishnan (2022)
Hodler (2014)	Shahbaz et al. (2018)
Guan et al. (2020)	Zaidi et al. (2019)
Sun et al. (2020)	
Jiang et al. (2021)	

Table 9
Short-run and long-run direct, indirect and total marginal effects for domestic credit provided by financial sector.

Panel A: Short-Run	Direct		Indirect		Total	
	Coeff.	St. Error	Coeff.	St. Error	Coeff.	St. Error
Total Natural Resources Rents	−0.435*	−0.251	0.00939	−0.137	−0.426	−0.266
Trade	−0.0163	−0.0439	0.0389	−0.027	0.0226	−0.0478
GDP per capita	−0.0012	−0.0015	−0.0025	−0.002	−0.00366*	−0.0021
Population	10.25	−16.79	19.12	−17.7	29.37*	−15.12
Personal Remittances Received	−0.271	−0.321	−0.745*	−0.389	−1.016	−0.656
Inflation	−4.168	−2.581	3.049	−2.322	−1.119	−3.328
Panel B: Long-Run	**Direct**		**Indirect**		**Total**	
	Coeff.	St. Error	Coeff.	St. Error	Coeff.	St. Error
Total Natural Resources Rents	−2.417*	−1.402	0.259	−0.907	−2.158	−1.351
Trade	−0.102	−0.254	0.226	−0.154	0.124	−0.255
GDP per capita	−0.006	−0.0082	−0.0126	−0.011	−0.0186*	−0.0108
Population	49.79	−94.48	94.26	−95.08	144.1**	−70.42
Personal Remittances Received	−1.266	−1.707	−3.762**	−1.898	−5.027	−3.253
Inflation	−23.35	−14.4	18.13	−12.15	−5.213	−17.02

reforms are one of the key factors affecting the financial sector.

For the environment, our results could have some implications to develop the sustainable finance. For instance, to make the financial development more useful and beneficial for the economy, the policy-makers could utilise the natural resources revenues to promote the green bonds and invest in the green cities such as in Saudi Arabia.

We believe that further research is needed. One of the key limitations of study is focusing in in African economies. One could investigate this relationship in OPEC and None-OPEC economies. Another point is related to the role of institutions. Further investigation is needed to see the role of institutions and the political instability. Also, one could use different proxies for financial development such as foreign direct investments (FDI). In particular, the sectorial level of FDI and natural resource relationship.

Author contribution

Mira Nurmakhanova: Conceptualization, project admin, software, methodology.

Mohamed Elheddad: Conceptualization, Data curation, project admin, resources, investigation.

Abdelrahman J. K. Alfar: software, methodology, visualization, Writing up.

Alloysius Egbulonu: writing the original draft.

Mohammad Zoynul Abedin: supervision, software, validation.

Data availability

Data will be made available on request.

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