Economics Bulletin

Volume 44, Issue 3

The effects of natural resource rents on income inequality in Sub-Saharan Africa: Is the informal economy a curse or a blessing?

Relwende Sawadogo
Université Joseph KI-ZERBO

Youmanli Ouoba
Université Thomas SANKARA

Abstract

The informal sector plays an important role in resource-rich countries in Sub-Saharan Africa. However, previous works have not considered this sector as a link between natural resources and income inequality. Our study intends to fill this gap by applying a finite mixture model to 30 sub-Saharan African countries over the 2005–2020 period. The data outlined two regimes from countries associated with two important results. First, we found that natural resource rents are positively related to income inequality in the first regime, while in the second regime, natural resource rents are negatively associated with income inequality. Second, countries with significant informal economies are less likely to be in a regime where natural resource rents negatively affect income inequality.

This is a resubmission to replace the first submission whose number is EB-23-00437115296_temp because we made a mistake by sending the wrong version of the manuscript. We are sorry and apologize for the inconvenience this may cause.
Citation: Relwende Sawadogo and Youmanli Ouoba, (2024) "The effects of natural resource rents on income inequality in Sub-Saharan Africa: Is the informal economy a curse or a blessing?", *Economics Bulletin*, Volume 44, Issue 3, pages 832-846
Contact: Relwende Sawadogo - relwende.sawadogo@ujkz.bf, Youmanli Ouoba - youmanli.ouoba@uts.bf.
Submitted: September 14, 2023.   **Published:** September 30, 2024.

1. Introduction

Using natural resource rents for poverty reduction and growth has long been a debated subject in the theoretical and empirical literature. This literature distinguishes between diffuse resources (forest rent, wheat, maize) and point resources (oil, natural gas, and mineral rents). However, the latter has attracted more attention in debates on natural resource exploitation (Ebeke & Etoundi, 2017).

From a theoretical view, there are two opposing schools of thought on the effect of natural resources on reducing income inequalities. On the one hand, deficient sustainability theory stipulates that reinvesting rents in other forms of capital (human and manufactured) is an effective, growth-enabling way to reduce inequality (Hartwick, 1977; Solow, 1974). In this view, Gamu et al.(2015) identified several ways whereby natural resource exploitation through extractive industries reduce poverty. These include fiscal transfers, direct as well as indirect jobs, upstream and downstream linkages, investment of extractive industries in public goods, and corporate social responsibility initiatives. Consequently, reinvesting rents collected by the state or direct operators of these resources is likely to contribute to reducing inequalities.

On the other hand, resource curse theory argues that natural resource exploitation is a source of inequality for several reasons, including exchange rate appreciation (Goderis & Malone, 2011), price volatility (Alvarado et al., 2021; Berisha et al., 2021), poor institutional quality (Acheampong et al., 2023; Björklund & Jäntti, 2020; C. Hartwell et al., 2022), unsustainable policies (Farzanegan & Habibpour, 2017; Robinson et al., 2006) and ethnic and religious polarization and fragmentation (Björklund & Jäntti, 2020; Sebri & Dachraoui, 2021). These factors are mostly inherent to the context of developing countries, notably Africa, which is characterized by low-quality institutions, raw product exports, conflicts, etc., that carry the seeds of the curse.

The informal sector plays a role in this relationship between natural resources and inequality. Indeed, when the informal economy accounts for a large share of production, tax revenues are low (Ishak & Farzanegan, 2020). Consequently, public spending on social policies aimed at reducing inequality have a low financial capacity (Alvarado et al., 2021). Furthermore, informal economic activities can limit workers' labour rights, generating losses in the real wages of people who work in those informal activities compared with people in formal activities, thus reinforcing income inequality.

Empirical work reinforces the theoretical controversy since several authors have found that inequality derives from natural resource dependence (Akpa, 2023; Björklund & Jäntti, 2020; Hartwell et al., 2019), while others have shown that inequality decreases in resource-rich countries (Kim & Lin, 2018; Policardo & Carrera, 2018). For African countries, the literature indicates that these countries are more likely to be victims of the resource curse (Owusu et al., 2014; Tadadjeu et al., 2023). Therefore, empirical studies have shown that natural resource exploitation heightens inequalities in Africa (Acheampong et al., 2023; Akpa, 2023). Indeed, Akpa (2023) utilizes a GMM method and shows that natural resource rents solely increase income inequality in Sub-Saharan Africa. Similarly, a study conducted on 43 sub-Saharan African countries using instrumental variable techniques and the Driscoll–Kraay estimator Acheampong et al. (2023) showed that natural resources and democracy increase income inequality in West, Central, and Southern Africa, while this effect is neutral in Eastern Africa. In contrast, Avom et al. (2022) used a panel quantile regression (QR) approach for 42 sub-Saharan Africans (SSAs) and found that natural resource rents reduce income inequality in all subregions except Southern Africa.

This debate remains topical, given that the COVID-19 pandemic drove approximately 100 million more people into extreme poverty and increased inequality in 2020 (World Bank, 2021), while for almost all types of natural capital, the global stock of nature-provided resources and services declined (World Bank, 2023). These stylized facts underpin the whole debate on the connection between natural resources and inequality, particularly in Africa, where populations depend on these natural resources to improve their well-being. The exploitation of natural resources in sub-Saharan Africa is characterized by a high degree of informality. Indeed, many people are involved in artisanal resource exploitation, which is essentially informal. This shows the need for new evidence on the specific case of sub-Saharan African countries.

This study aims to provide new evidence on the effect of natural resources on income inequality in sub-Saharan Africa, taking into account the role of the informal sector. Despite the numerous existing empirical works on this issue, methodological problems remain, and curse transmission channels are still unexplored. Studies on Africa have focused mainly on institutional problems, explaining the paradox of poverty in abundance (Adams et al., 2019; Arezki & Gylfason, 2013; Epo & Nochi Faha, 2020; Frynas & Buur, 2020). Our study not only addresses a different issue but also makes two contributions. First, unlike previous works that used standard models, we use a finite mixture model to account for heterogeneity problems. For example, Avom et al. (2022) found that coal rents increase inequality, while income inequality is reduced by forestry and oil rents. However, arbitrary and ad hoc grouping of countries without considering their differential endowments of resource types can affect the results. The finite mixture model helps a country's endogenous membership in a given group be explained by several factors (Di Vaio & Enflo, 2011). Second, all previous works on the effect of natural resources on inequality do not consider the role of the informal economy. Indeed, the informal sector plays an important role in poverty reduction in developing countries (Soharwardi et al., 2021), while empirical work shows that natural resource rents increase the size of this informal economy (Blanton & Peksen, 2021; Ebeke & Etoundi, 2017; Kpognon, 2022). Considering the informal sector in the relationship between natural resources and income inequalities seems to be an important contribution to the literature.

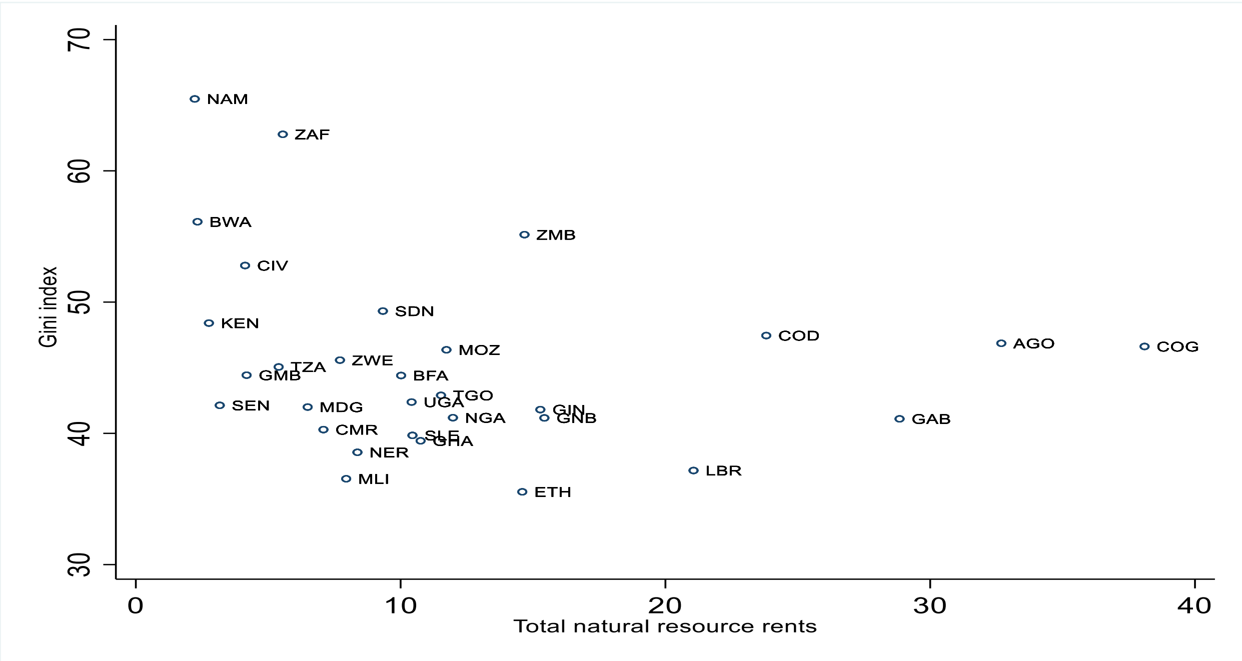
The rest of the article is divided into 4 sections. The second presents the data description. The third describes the finite mixture model. The fourth presents results and discussion. The last one concludes with policy implications.

2. Data description

Our sample covers 30 sub-Saharan countries over the period 2005–2020. We divided the total period into the average of three nonoverlapping periods to reduce the impact of short-term shocks (2005–2007, 2008–2010, 2011–2013, 2014–2016, and 2017–2020). Country selection is based on data availability. The data come from many sources. The dependent variable, income inequality, is taken from the Solt's (2020) Standardized World Income Inequality Database (SWIID), Version 9.5, June 2023. The Gini index is the main indicator of income inequality. A value close to zero represents an equitable distribution of income among individuals, whereas a value close to 100 represents an extremely unequal income distribution. The natural resource rent as a percentage of GDP is used as a natural resource indicator for measuring the explicative variable. This variable is from the World Bank's World Development Indicators. For control variables, we include manufacturing value added to the GDP, agriculture, forestry, and fishing value added to the GDP, the ratio of arable land to land area, general government final consumption expenditure to the GDP, the ratio of urban population to total population, foreign direct investment, net inflows to the GDP and trade openness to the

GDP. All these control variables are taken from the World Bank's World Development Indicators. Table A-1 presents the descriptive statistics and data sources. The list of countries is presented in Table A-2 in the appendix. Figure 1 shows that the heterogeneous distribution of countries into several groups connecting natural resource rents and income inequality is likely to vary from one group to another. This does not allow for an a priori relationship between natural resource rents and income inequality for all countries in the sample.

Figure 1: Natural resources vs income inequality



Source : Authors' calculations

3. Econometric Specifications

The finite mixture regression method has recently been applied in the empirical economic literature to identify the existence of multiple regimes or trajectories of dependent variables. This is a semiparametric method suitable for correcting possible unobserved heterogeneity that may exist in the data without any a priori grouping of countries based on observed characteristics (Flachaire et al., 2014; Frühwirth-Schnatter, 2006; Konte, 2016). This helps with flexibility and better data adjustment. Therefore, let us consider our income inequality dependent variable, the key explanatory variable (Gini index), and X, the set of control variables defined above (see Data description). Under these conditions, the finite mixture model is defined as follows:

$$f\left(\mathrm{Gini}_{i,t} \middle| \mathrm{NR}_{i,t}, \mathrm{X}_{i,t}; \Phi\right) = \sum_{c=1}^{C} \pi_c \, f_c\left(\mathrm{Gini}_{i,t} \middle| \mathrm{NR}_{i,t}, \mathrm{X}_{i,t}; \gamma_c, \tau_c\right) \quad (1)$$

where C is the number of groups or inequality unknown regimes, and its optimal value is selected using the Bayesian information criterion (BIC). The parameter π_c is the proportion of the countries that belong to the specific inequality regime c; $f_c(\mathrm{Gini}_{i,t}|\mathrm{NR}_{i,t}, \mathrm{X}_{i,t}; \gamma_c, \tau_c)$ is the conditional density of the inequality income in the latent regime c. The parameters in the latent inequality regime $c$care γ_c and τ_c. Both γ_c and $\tau_c$are unknown and are estimated. We suppose that $f_c(.)$is a Gaussian distribution.

For our case, if data are generated by a model with a single inequality regime, which implies that $C = 1$, then Equation (1) is reduced to group1: $\mathrm{Gini}_{i,t} = \gamma_0 + \gamma_1 \mathrm{NR}_{i,t} + \gamma_2 \mathrm{X}_{i,t} + \varepsilon_{i,t}$, $\varepsilon_{i,t} \sim N(0, \sigma^2)$. for $C = 2$. In contrast, if we suppose that the data are better generated by two different inequality regimes, assuming that $C = 2$, we will have the following two regressions:

$$\text{Group 1: } \mathrm{Gini}_{i,t} = \gamma_{01} + \gamma_{11} \mathrm{NR}_{i,t} + \gamma_{21} \mathrm{X}_{i,t} + \varepsilon_{1i,t}, \qquad \varepsilon_1 \sim N(0, \sigma_1^2),$$

$$\text{Group 2: } \mathrm{Gini}_{i,t} = \gamma_{02} + \gamma_{12} \mathrm{NR}_{i,t} + \gamma_{22} \mathrm{X}_{i,t} + \varepsilon_{2i,t}, \qquad \varepsilon_2 \sim N(0, \sigma_2^2)$$

In this second scenario, the error terms ε_1 and ε_2 are assumed to be independent. The coefficients on natural resource rents may differ between the two regimes because the countries where income inequality occurs may have different regimes. This implies that countries are heterogeneous and behave differently in their income inequality process. Hence, ignoring the existence of multiple income inequality regimes may lead to incorrect findings on the effect of natural resource rents on income inequality.

As recommended by Hawkins et al., (2001), in the case of a mixture of linear regressions, the BIC is used for selecting the optimal number of groups. Thus, a lower BIC value indicates a better fit. We also rely on previous studies to determine the maximum number of inequality regimes to be estimated. Once the number of regimes C is selected and the model parameters are estimated, we can compute the posterior probability of each country being assigned to a given latent inequality regime c, using the Bayes rule such that:

$$\hat{\pi}_{ic} = \frac{\hat{\pi}_c f_c(Gini|NR, X; \hat{\gamma}_c, \hat{\tau}_c)}{\sum_c^C \hat{\pi}_c f_c(Gini|NR, X; \hat{\gamma}_c, \hat{\tau}_c)}$$

The estimated probabilities will be used to sort countries into the different inequality regimes found in our sample. The rule is that a given country i belongs to the inequality regime c rather than j if its estimated probability $\hat{\pi}_{ic}$is higher than its probability $\hat{\pi}_{ij}$where $c \neq j$.

4. Results and Discussion

We first focus on selecting the number of groups by using the BIC. Table 1 below shows the BIC values for each group. Usually, the lower the BIC value is, the better the econometric specification. Table 1 shows that the BIC values are high for C=1, which is the case for one group for all countries in the sample. Thus, this result suggests that traditional econometric models are not appropriate for this study. The BIC value is lowest when the number of groups is 2. Given that the trend of the change in the BIC decreases (from C=1 to C=2) and then increases (to C=3) and that the value is minimized at C=2, we select a mixture model with two groups.

Table 1: Regimes number selection

	C=1	**C=2**	C=3	C=4	C=5
BIC	2167.907	**751.509**	770.7174	788.1256	778.1861

Source : Authors' calculations

Table 2 presents the results of the generalized least squares (GLS) and generalized least squares–finite mixture models (GLS–FMM) regressions. In the standard regression, the coefficient associated with natural resource rents is negative and statistically significant. Thus, an increase in natural resource rents by 1 percent of GDP is associated with a decline in income inequality by 0.216 percent. However, this traditional estimator does not allow for the analysis of potential differential effects across countries ; hence, there is a need to use the finite mixture model, which offers this possibility. Furthermore, to account for autocorrelation and endogeneity problems (Cerra & Saxena, 2008), we used the standard error estimator Discroll-Kraay, and the results confirm those found with the GLS. Thus, we see that the coefficients of our variables are substantially identical to those of GLS.

For GLS–FMM, the results show that the model is best described with two groups. We observe that 62% of the countries are more likely to be classified in the first inequality group than in the second inequality group (38%). Thus, we find that the results differ between the two groups of sub-Saharan countries. When we focus on our interest parameter, the natural resource rent has a positive and statistically significant 10 percent effect on income inequality in the first group, while in the second, the natural resource rent effect is negative and statistically significant at the 1 percent level. In the first group, a rise in natural resource rents by 1 percent of GDP will increase income inequality by 0.088 percent, while a decrease in income inequality by 0.302 percent will occur in the second group. This finding is consistent with previous studies showing that natural resource reliance is the cause of inequality (Akpa, 2023; Hartwell et al., 2019; Jäntti et al., 2018) on the one hand and the decline in inequality in resource-rich countries on the other hand (Kim & Lin, 2018; Policardo & Carrera, 2018).

Table 2: Estimation results of the mixture model

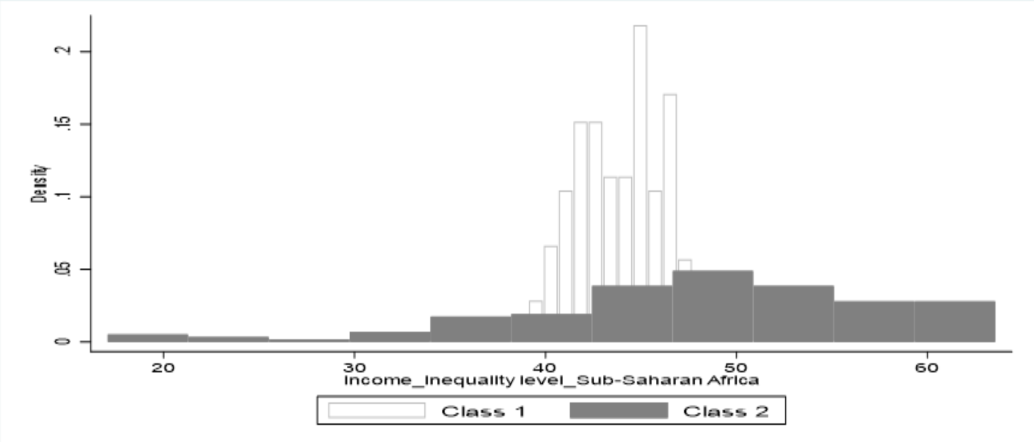
VARIABLES	GLS	Driscoll -Kraay	GLS-FMM Group1	GLS-FMM Group 2
Total natural resources rents (% of GDP)	**-0.216*** **	**-0.216*** **	**0.088***	**-0.302*** **
	(-3.32)	**(-5.43)**	**(1.87)**	**(-2.63)**
Agriculture VA (% of GDP)	-0.336***	-0.336***	-0.147***	-0.711***
	(-6.09)	(-19.24)	(-4.78)	(-11.51)
Manufacturing VA (% of GDP)	-0.279**	-0.278***	-0.306***	0.625
	(-2.13)	(-5.16)	(-2.74)	(1.08)
Arable land (% of land area)	-0.062	0.006***	-0.051	0.018
	(-1.40)	(-9.00)	(-1.27)	(0.05)
Urban population (% of total population)	-0.024	-0.023*	-0.101***	-0.143
	(-0.66)	(-2.36)	(-2.73)	(-0.77)
FDI net inflows (% of GDP)	0.007	0.006	0.028	0.007
	(0.06)	(0.10)	(0.50)	(0.02)
General government final consumption expenditure (% of GDP)	0.158	0.157	0.183**	-0.163
	(1.17)	(2.59)	(2.10)	(-0.78)
Trade (% of GDP)	0.020	0.019	-0.063***	0.057
	(0.53)	(0.79)	(-2.67)	(0.62)
Constant	56.317***	56.316	55.355***	64.635***
	(12.67)	(42.49)	(19.28)	(7.80)
Observations	122	122	75	46
Number of id	29	29	29	
Posterior probability			0.62	0.38
Likelihood ratio	-367.5953		-325.31226	

Source: Author's calculations. Notes: z-statistics in parentheses*** p<0.01, ** p<0.05, * p<0.1

We are now interested in the composition of the two groups of countries. Table A-3 in the appendix presents country rankings for the two inequality groups, including the estimated posterior probability membership. Countries are ranked in the group where they have the highest estimated probability. As the results indicate, some countries moved from one group to another, while other countries remained in the same group throughout the study period. Thus, countries rich in natural resources such as Angola, Gabon, Ghana, Nigeria, Senegal, Sera Leone, Togo, Tanzania, and Zimbabwe remained in Group 1 throughout the study period of 2005–2020, while countries such as Botswana, Mali, Namibia, Niger, South Africa and Zambia remained in Group 2 during the same period. In contrast, some countries, including Cameroon, the Republic of the Congo, Madagascar, and Mozambique, have experienced movements between the two groups. For example, Cameroon moved from Group 1 in 2005–2016 to Group 2 in 2017–2020. These results indicate that there is a large heterogeneity of countries within the inequality groups, which indicates that our ranking does not fit with those obtained in the ad hoc *ex-ante* ranking.

Figure 2 presents a visualization of the predicted distributions of income inequality levels for the two groups in the sample, showing that the groups differ in terms of income inequality. Group 2 countries lie at the left and right ends of the distribution with a strong concentration on the right, suggesting that they are more heterogeneous and likely to have high income inequality. Conversely, Group 1 countries in the center have the highest bars, reflecting a relatively homogeneous level of relatively low income inequality.

Figure 2: Distribution of predicted income inequality for each group



Source: Author's calculations

We next extend our model by including concomitant variables to analyse country ranking determinants in the various income inequality groups. Thus, after identifying the two groups, we analysed the role of the shadow or informal economy in the connection between natural resource rents and income inequality. Previous work, such as that of Alvarado et al. (2021), has shown that inequalities are at the origin of the underground economy because unequal income distribution within society leads to the search for informal or clandestine activities. Therefore, in countries with low levels of inequality and high levels of informal economic activity, natural resource abundance should result in lower inequality. For all regressions where we use concomitant variables, we use Group 2 as our benchmark given that the relationship between natural resource rents and income inequality is negative. This will help us compare the countries in Group 2 with those in Group 1, where natural resource rents are positively associated with income inequality. We use concomitant variables such as the informal output as a percentage of official GDP, informal employment as a percentage of total employment estimated by Elgin et al.(2021), and the participation rate of the shadow economy in real output at constant prices (shadow economy) of Medina & Schneider (2020). The choice of these variables is motivated by the fact that the underground economy represents a major challenge for modern economies. On average, in poor countries, more than a quarter of total production is hidden from the authorities. Likewise, the informal artisanal exploitation of mining resources employing hundreds of thousands of diggers escapes the authorities. Thus, high participation in the underground economy in total production generates low tax revenues. Therefore, we hypothesize that countries where the informal economy is significant are less likely to be in the group where natural resource dependence reduces inequalities.

Table 4 presents the results when using informal economy variables as concomitant variables. We find that countries with an important informal economy are less likely to be in Group 2. Indeed, the results show that the marginal effects associated with informal output, informal employment, and the shadow economy are negatively associated with the probability of being in Group 2, where natural resource rent dependence decreases income inequality. Informal or shadow economy issues can be explained by these results due to asymmetries in the provision of public services and fiscal pressure, leading to resource allocation inefficiency and economic inequalities among populations. Thus, our results are consistent with those of Alm & Embaye (2013) and Alvarado et al. (2021), who show that the underground economy constitutes another channel of income inequality. Furthermore, Fawaz & Frey (2020) showed that low-income countries with a large informal sector generally experience less inequality if they do not have abundant natural resources.

Table 4: The role of the informal economy in the relationship between natural resources rents and income inequality

Variables	**Marginal effect of variables**		
Informal output (% of official GDP)	-0.023667*** (-4.72)		
Informal employment (% of total employment)		-0.01445*** (-4.96)	
Shadow economy (% of GDP)			-0 .026710*** (-4.68)
Observations	120	33	120
Likelihood ratio	-307.32157	-64.396078	-308.49939

Source: Author’s calculations. Notes: z-statistics in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

4. Conclusion and policy implications

In this paper, we explored the differential effects of natural resource rents on income inequality regimes in 30 sub-Saharan countries. We estimated a finite mixture model with the generalized least squares estimator. Thus, we took into account the possible unobserved heterogeneity that may exist in the data and considered the possibility of the existence of multiple income inequality regimes or paths. The assumption that all countries follow a single, unique income inequality regime was set aside in favour of the view that multiple inequality regimes exist in which the marginal effects of the explanatory variables, including natural resource rents, may differ.

Our results have provided evidence that for the period 2005–2020, the data are better fitted with a model that contains two different income inequality regimes. Thus, we found that natural resource rents are positively associated with income inequality in the first group, while in the second group, natural resource rents are negatively associated with income inequality. Moreover, we focused on the importance of the informal or shadow economy in explaining group membership. The results show that countries with important informal or shadow economies are less likely to fall into the group where natural resource rents negatively affect income inequality. The results suggest that for sub-Saharan African countries to fully benefit from their natural resources, political authorities should work to legalize clandestine or unregulated economic activities. This will improve tax resource mobilization for financing income redistribution policies and ultimately reduce the size of the informal sector.

References

Acheampong, A. O., Dzator, J., Abunyewah, M., Erdiaw-Kwasie, M. O., & Opoku, E. E. O. (2023). Sub-Saharan Africa's Tragedy: Resource Curse, Democracy and Income Inequality. In *Social Indicators Research* (Vol. 168, Issue 1). Springer Netherlands. https://doi.org/10.1007/s11205-023-03137-2

Adams, D., Ullah, S., Akhtar, P., Adams, K., & Saidi, S. (2019). The role of country-level institutional factors in escaping the natural resource curse: Insights from Ghana. *Resources Policy*, *61*(January 2018), 433–440. https://doi.org/10.1016/j.resourpol.2018.03.005

Akpa, A. F. (2023). Effect of natural resources rents on income inequality in sub-Saharan Africa: exploring the direct and indirect transmission mechanisms. *International Journal of Development Issues*, *22*(2), 167–181. https://doi.org/10.1108/IJDI-11-2022-0244

Alesina, A., & Glaeser, E. (2004). Fighting Poverty in the US and Europe: A World of Difference. *Oxford University Press, Oxford.*, 1–262. https://doi.org/10.1093/0199267669.001.0001

Alexeev, M., & Conrad, R. (2009). The elusive curse of oil. *The Review of Economics and Statistics*, *91*(3), 586–598.

Alichi, A., & Arezki, R. (2012). An alternative explanation for the resource curse: The income effect channely. *Applied Economics*, *44*(22), 2881–2894. https://doi.org/10.1080/00036846.2011.568400

Alm, J., & Embaye, A. (2013). Using Dynamic Panel Methods to Estimate Shadow Economies Around the World , 1984 – 2006. *Public Finance Review*, *41*(5), 510–543. https://doi.org/10.1177/1091142113482353

Alvarado, R., Tillaguango, B., López-Sánchez, M., Ponce, P., & Işık, C. (2021). Heterogeneous impact of natural resources on income inequality: The role of the shadow economy and human capital index. *Economic Analysis and Policy*, *69*, 690–704. https://doi.org/10.1016/j.eap.2021.01.015

Arezki, R., & Gylfason, T. (2013). Resource rents, democracy, corruption and conflict: Evidence from Sub-Saharan Africa. *Journal of African Economies*, *22*(4), 552–569. https://doi.org/10.1093/jae/ejs036

Avom, D., Ovono, N. N., & Nkoa, E. O. (2022). Revisiting the effects of natural resources on income inequality in Sub-Saharan Africa. *International Journal of Development Issues*, *21*(3), 389–412. https://doi.org/10.1108/IJDI-11-2022-0244

Berisha, E., Chisadza, C., Clance, M., & Gupta, R. (2021). Income inequality and oil resources: Panel evidence from the United States. *Energy Policy*, *159*(September), 112603. https://doi.org/10.1016/j.enpol.2021.112603

Bertinelli, L., & Bourgain, A. (2023). Mining revenues and quality of public goods in sub-Saharan Africa. *Journal of International Development*, 0–16.

Björklund, A., & Jäntti, M. (2020). Research in Social Strati fi cation and Mobility Intergenerational mobility , intergenerational e ff ects , sibling correlations , and equality of opportunity : A comparison of four approaches. *Research in Social Stratification and Mobility*, *70*(December), 100455. https://doi.org/10.1016/j.rssm.2019.100455

Blanton, R. G., & Peksen, D. (2021). Natural resource wealth and the informal economy. *International Political Science Review*, *44*(3), 418–433. https://doi.org/10.1177/0192512121991973

Brunnschweiler, C. N., & Bulte, E. H. (2008). The resource curse revisited and revised: A tale of paradoxes and red herrings. *Journal of Environmental Economics and Management*, *55*(3), 248–264. https://doi.org/10.1016/j.jeem.2007.08.004

Cerra, V., & Saxena, S. C. (2008). Growth Dynamics: The Myth of Economic Recovery. *The American Economic Review*, *98*(1), 439–457.

Deacon, R. T., & Rode, A. (2015). Rent seeking and the resource curse. *Companion to the Political Economy of Rent Seeking*, 227–247. https://doi.org/10.4337/9781782544944.00022

Di Vaio, G., & Enflo, K. (2011). Did globalization drive convergence? Identifying cross-country growth regimes in the long run. *European Economic Review*, *55*(6), 832–844. https://doi.org/10.1016/j.euroecorev.2010.11.004

Ebeke, C. H., & Etoundi, N. S. M. (2017). The Effects of Natural Resources on Urbanization, Concentration, and Living Standards in Africa. *World Development*, *96*, 408–417. https://doi.org/10.1016/j.worlddev.2017.03.026

Elgin, C., Kose, A. M., Ohnsorge, F., & Yu, S. (2021). *Understanding Informality* (CAMA Working Paper 76/2021; September 2021).

Epo, B. N., & Nochi Faha, D. R. (2020). Natural Resources, Institutional Quality, and Economic Growth: an African Tale. *European Journal of Development Research*, *32*(1), 99–128. https://doi.org/10.1057/s41287-019-00222-6

Farzanegan, R. M., & Habibpour, M. M. (2017). Resource rents distribution , income inequality and poverty in Iran. *Energy Economics*, *66*, 35–42. https://doi.org/10.1016/j.eneco.2017.05.029

Fawaz, F., & Frey, E. (2020). Kasetsart Journal of Social Sciences The impact of abundancy of resources and regime type on income inequality : The case of less-developed countries. *Kasetsart Journal of Social Sciences*, *41*, 1–7.

Flachaire, E., García-Peñalosa, C., & Konte, M. (2014). Political versus economic institutions in the growth process. *Journal of Comparative Economics*, *42*(1), 212–229. https://doi.org/10.1016/j.jce.2013.05.001

Frühwirth-Schnatter, S. (2006). Finite Mixture and Markov Switching Models. In Springer (Ed.), *Essentials of Monte Carlo Simulation* (Springer s). Springer. https://doi.org/10.1007/978-1-4614-6022-0

Frynas, J. G., & Buur, L. (2020). The presource curse in Africa: Economic and political effects of anticipating natural resource revenues. *Extractive Industries and Society*, *7*(4), 1257–1270. https://doi.org/10.1016/j.exis.2020.05.014

Fum, R. M., & Hodler, R. (2010). Natural resources and income inequality : The role of ethnic divisions. *Economics Letters*, *107*(3), 360–363. https://doi.org/10.1016/j.econlet.2010.03.008

Gamu, J., Le Billon, P., & Spiegel, S. (2015). Extractive industries and poverty: A review of recent findings and linkage mechanisms. *Extractive Industries and Society*, *2*(1), 162–

176. https://doi.org/10.1016/j.exis.2014.11.001

Goderis, B., & Malone, S. W. (2011). Natural Resource Booms and Inequality : Theory and Evidence. *The Scandinavian Journal of Economics*, *113*(2), 388–417. https://doi.org/10.1111/j.1467-9442.2011.01659.x

Gylfason, T. (2001). Natural resources, education, and economic development. *European Economic Review*, *45*(4–6), 847–859. https://doi.org/10.1016/S0014-2921(01)00127-1

Hartwell, C. A., Horvath, R., Horvathova, E., & Popova, O. (2019). Democratic Institutions , Natural Resources , and Income Inequality. *Comparative Economic Studies*, *61*(4), 531–550. https://doi.org/10.1057/s41294-019-00102-2

Hartwell, C., Horvath, R., Horvathova, E., & Popova, O. (2022). Natural resources and income inequality in developed countries: synthetic control method evidence. *Empirical Economics*, *62*(2), 297–338. https://doi.org/10.1007/s00181-021-02023-5

Hartwell, C., Horvath, R., Popova, O., & Horvathova, E. (2021). Natural resources and income inequality in developed countries : synthetic control method evidence. *Empirical Economics*, *20*. https://doi.org/10.1007/s00181-021-02023-5

Hartwick, J. M. (1977). Intergenerational equity and the investing of rents from exhaustible resources. *The American Economic Review*, *67*(05), 972–974. https://doi.org/10.4324/9781315240084-4

Hawkins, D. S., Allen, D. M., & Stromberg, A. J. (2001). Determining the number of components in mixtures of linear models. *Computational Statistics and Data Analysis*, *38*(1), 15–48. https://doi.org/10.1016/S0167-9473(01)00017-2

Ishak, P. W., & Farzanegan, M. R. (2020). The impact of declining oil rents on tax revenues: Does the shadow economy matter? *Energy Economics*, *92*, 104925. https://doi.org/10.1016/j.eneco.2020.104925

Jäntti, M., Pirttilä, J., & Rönkkö, R. (2018). The Determinants of Redistribution Around The World. *Review of Income and Wealth*, *0*(0), 59–73. https://doi.org/10.1111/roiw.12406

Kim, D.-H., & Lin, S.-C. (2018). Oil Abundance and Income Inequality. *Environmental and Resource Economics*, *71*, 825–848. https://doi.org/10.1007/s10640-017-0185-9

Kim, D. H., Chen, T. C., & Lin, S. C. (2020). Does oil drive income inequality? New panel evidence. *Structural Change and Economic Dynamics*, *55*, 137–152. https://doi.org/10.1016/j.strueco.2020.08.002

Konte, M. (2016). The effects of remittances on support for democracy in Africa: Are remittances a curse or a blessing? *Journal of Comparative Economics*, *44*(4), 1002–1022. https://doi.org/10.1016/j.jce.2016.02.004

Kpognon, K. D. (2022). Effect of Natural Resources on the Size of Informal Economy in sub-Saharan Africa: An Empirical Investigation. *Structural Change and Economic Dynamics*, *63*(August), 1–14. https://doi.org/10.1016/j.strueco.2022.08.005

Lessmann, C., & Steinkraus, A. (2019). The geography of natural resources, ethnic inequality and civil conflicts. *European Journal of Political Economy*, *59*(January), 33–51. https://doi.org/10.1016/j.ejpoleco.2019.01.005

Manzano, O., & Rigobon, R. (2001). *Resource Curse or Debt Overhang?* (8390). http://www.nber.org/papers/w8390

Medina, L., & Schneider, F. (2020). Shedding Light on the Shadow Economy: A Global Database and the Interaction with the Official One. *World Economics Journal*, *21*(2). https://doi.org/10.2139/ssrn.3502028

Mehlum, H., Moene, K., & Torvik, R. (2006). Institutiona and the resource curse. *The Economic Journal*, *116*(508), 1–20.

Ondoa, A. H., & Andela, N. B. (2023). Are natural resources a blessing or a curse for scientific and technical research in Africa? *Resources Policy*, *85*(PA), 103759. https://doi.org/10.1016/j.resourpol.2023.103759

Owusu, F., Alessandro, C. D., & Hanson, K. T. (2014). Moving Africa beyond the Resource Curse: Defining the "Good-Fit" Approach Imperative in Natural Resource Management and Identifying the Capacity Needs. In P. Macmillan (Ed.), *Managing Africa's Natural Resources* (Palgrave M, pp. 206–225). Springer.

Policardo, L., & Carrera, E. J. S. (2018). Corruption causes inequality , or is it the other way around ? An empirical investigation for a panel of countries. *Economic Analysis and Policy*, *59*, 92–102. https://doi.org/10.1016/j.eap.2018.05.001

Robinson, J. A., Torvik, R., & Verdier, T. (2006). Political foundations of the resource curse. *Journal of Development Economics*, *79*, 447–468. https://doi.org/10.1016/j.jdeveco.2006.01.008

Ross, M. L. (2004). What do we know about natural resources and civil war? *Journal of Peace Research*, *41*(3), 337–356. https://doi.org/10.1177/0022343304043773

Sachs, J. D., & Warner, A. M. (1999). The big push, natural resource booms and growth. *Journal of Development Economics*, *59*(1), 43–76. https://doi.org/10.1016/S0304-3878(99)00005-X

Sachs, J. D., & Warner, A. M. (2001). Natural Resources and Economic Development The curse of natural resources. *European Economic Review*, *45*, 827}838 Natural.

Sebri, M., & Dachraoui, H. (2021). Natural resources and income inequality: A meta-analytic review. *Resources Policy*, *74*(September), 102315. https://doi.org/10.1016/j.resourpol.2021.102315

Soharwardi, M. A., Firdous, A., & Gill, A. R. (2021). Are environment, informal sector and poverty interrelated? *International Journal of Agricultural Extension*, *9*(2), 277–284. https://doi.org/10.33687/ijae.009.02.3579

Solow, R. M. (1974). The Economics R esources of Resources or the of Economics. *The American Economic Review*, *64*(2), 1–14.

Solt, F. (2020). Measuring Income Inequality Across Countries and Over Time: The Standardized World Income Inequality Database. *Social Science Quarterly*, *101*(3), 1183–1199. https://doi.org/10.1111/ssqu.12795

Spiegel, S. J. (2012). Governance Institutions, Resource Rights Regimes, and the Informal Mining Sector: Regulatory Complexities in Indonesia. *World Development*, *40*(1), 189–205. https://doi.org/10.1016/j.worlddev.2011.05.015

Su, F., Wei, G., & Tao, R. (2016). China and Natural Resource Curse in Developing Countries: Empirical Evidence from a Cross-country Study. *China and World Economy*, *24*(1), 18–40. https://doi.org/10.1111/cwe.12142

Tadadjeu, S., Njangang, H., Asongu, S., & Nounamo, Y. (2023). Natural resources and wealth inequality: a cross-country analysis. *Journal of Economic and Administrative Sciences*, *39*(03), 596–608.

The World Bank. (2023). *Nature's Frontiers. Achieving Sustainability, Efficiency, and Prosperity with Natural Capital*.

Van der Ploeg, F., & Poelhekke, S. (2010). The pungent smell of "red herrings": Subsoil assets, rents, volatility and the resource curse. *Journal of Environmental Economics and Management*, *60*(1), 44–55. https://doi.org/10.1016/j.jeem.2010.03.003

World Bank. (2021). *Green, Reslient and InclusiveDevelopment* (Issue October). https://openknowledge.worldbank.org/bitstream/handle/10986/36322/Green-Resilient-and-Inclusive-Development.pdf?sequence=5

Appendix

Table A-1. Descriptive statistics and data sources.

Variables	N	Mean	Std. Dev.	min	max	Source
Gini index	134	45.121	7.114	33.21	66.335	SWIID
Total natural resources rents (% of GDP)	149	11.942	9.660	.77	49.634	WDI
Agriculture VA (% of GDP)	149	22.219	13.643	1.831	65.15	WDI
Manufacturing VA (% of GDP)	144	9.803	4.178	1.731	19.256	WDI
Arable land (% of land area)	149	13.05	11.867	.351	48.722	WDI
Urban population (% of total population)	149	42.601	15.595	15.905	89.545	WDI
FDI net inflows (% of GDP)	149	4.913	8.225	-7.163	77.548	WDI
government final consumption expenditure (% of GDP)	138	13.646	5.493	5.928	32.403	WDI
Trade (% of GDP)	142	63.346	23.317	18.168	131.247	WDI
Shadow economy (% of GDP)	144	36.693	8.077	23	56.567	Medina & Schneider, (2020).
Informal output (% of official GDP)	144	41.637	7.925	27.044	62.637	Elgin et al. (2021)
Informal employment (% of total employment)	41	81.075	19.388	32.537	98.62	Elgin et al. (2021)

Table A-2: List of countries

Angola	Madagascar
Botswana	Mali
Burkina Faso	Mozambique
Cameroon	Namibia
Congo, Dem, Rep,	Niger
Congo, Rep,	Nigeria
Cote d'Ivoire	Senegal
Ethiopia	Sierra Leone
Gabon	South Africa
Gambia, The	Sudan
Ghana	Tanzania
Guinea	Togo
Guinea-Bissau	Uganda
Kenya	Zambia
Liberia	Zimbabwe

Table A-3: Classification obtained from the selected mixture model

Group 1			Group 2 (cont.)			Group 2		
Country	year	Prob	Country	year	Prob	Country	year	Prob
Angola	2008-2010	0.63	Madagascar	2008-2010	0.74	Botswana	2011-2013	1.00
Angola	2017-2020	0.71	Madagascar	2011-2013	0.54	Botswana	2005-2007	1.00
Angola	2011-2013	0.63	Mozambique	2014-2016	0.69	Botswana	2008-2010	1.00
Angola	2014-2016	0.81	Mozambique	2005-2007	0.66	Cote d'Ivoire	2005-2007	1.00
Angola	2005-2007	0.83	Mozambique	2011-2013	0.67	Cote d'Ivoire	2017-2020	1.00
Burkina Faso	2017-2020	0.95	Mozambique	2008-2010	0.58	Cameroon	2017-2020	1.00
Burkina Faso	2008-2010	0.89	Nigeria	2005-2007	0.65	Congo. Dem. Rep.	2011-2013	0.98
Burkina Faso	2011-2013	0.94	Nigeria	2014-2016	0.99	Congo. Rep.	2014-2016	0.97
Burkina Faso	2005-2007	0.93	Nigeria	2017-2020	0.96	Ethiopia	2011-2013	1.00
Burkina Faso	2014-2016	0.92	Nigeria	2008-2010	0.60	Gambia. The	2014-2016	1.00
Cameroon	2005-2007	1.00	Nigeria	2011-2013	0.79	Gambia. The	2005-2007	0.63
Cameroon	2011-2013	1.00	Sudan	2005-2007	1.00	Gambia. The	2017-2020	0.66
Cameroon	2014-2016	1.00	Sudan	2008-2010	1.00	Guinea-Bissau	2017-2020	0.63
Cameroon	2008-2010	1.00	Senegal	2011-2013	1.00	Kenya	2017-2020	0.58
Congo. Dem. Rep.	2005-2007	0.55	Senegal	2017-2020	1.00	Liberia	2005-2007	0.69
Congo. Rep.	2008-2010	0.64	Senegal	2005-2007	1.00	Madagascar	2014-2016	0.56
Congo. Rep.	2005-2007	0.60	Senegal	2008-2010	1.00	Mali	2017-2020	1.00
Congo. Rep.	2011-2013	0.70	Senegal	2014-2016	1.00	Mali	2005-2007	1.00
Gabon	2008-2010	1.00	Sierra Leone	2014-2016	1.00	Mali	2014-2016	0.95
Gabon	2017-2020	1.00	Sierra Leone	2008-2010	1.00	Mali	2008-2010	1.00
Gabon	2011-2013	1.00	Sierra Leone	2005-2007	1.00	Mozambique	2017-2020	1.00
Gabon	2005-2007	0.99	Sierra Leone	2017-2020	1.00	Namibia	2005-2007	1.00
Gabon	2014-2016	1.00	Sierra Leone	2011-2013	1.00	Namibia	2014-2016	1.00
Ghana	2005-2007	0.69	Togo	2008-2010	0.71	Namibia	2017-2020	1.00
Ghana	2008-2010	0.65	Togo	2005-2007	0.68	Niger	2008-2010	1.00
Ghana	2014-2016	1.00	Togo	2011-2013	0.95	Niger	2005-2007	1.00
Ghana	2017-2020	1.00	Togo	2014-2016	0.88	Niger	2011-2013	1.00
Ghana	2011-2013	0.87	Togo	2017-2020	1.00	Niger	2017-2020	1.00
Guinea	2011-2013	1.00	Tanzania	2008-2010	0.76	Niger	2014-2016	1.00
Guinea	2017-2020	1.00	Tanzania	2014-2016	0.68	Sudan	2017-2020	1.00
Guinea	2005-2007	1.00	Tanzania	2017-2020	0.69	South Africa	2008-2010	1.00
Guinea	2008-2010	1.00	Tanzania	2005-2007	0.84	South Africa	2011-2013	1.00
Guinea	2014-2016	1.00	Tanzania	2011-2013	0.60	South Africa	2005-2007	1.00
Gambia. The	2008-2010	0.94	Uganda	2008-2010	0.85	South Africa	2017-2020	1.00
Gambia. The	2011-2013	0.52	Uganda	2014-2016	1.00	Zambia	2011-2013	1.00
Guinea-Bissau	2014-2016	1.00	Uganda	2017-2020	1.00	Zambia	2005-2007	1.00
Guinea-Bissau	2008-2010	1.00	Uganda	2011-2013	1.00	Zambia	2014-2016	1.00
Guinea-Bissau	2011-2013	1.00	Zimbabwe	2005-2007	1.00	Zambia	2017-2020	1.00
Guinea-Bissau	2005-2007	1.00	Zimbabwe	2017-2020	1.00			
Kenya	2008-2010	0.99	Zimbabwe	2014-2016	1.00			
Kenya	2011-2013	0.99	Zimbabwe	2008-2010	1.00			
Kenya	2005-2007	0.73	Zimbabwe	2011-2013	1.00			