# Estimating The Direct Effect of Economic Growth on Income Inequality in Sub-Saharan Africa: The Moderating Role of Natural Resource Governance.

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## Abstract

We examine the effect of natural resource governance on the direct impact of economic growth on income inequality in Sub-Saharan African countries. We use data from a panel of 40 of these countries, in which natural resource revenues represent at least 5% of GDP over the period 2001–2020. Dynamic panel data models are estimated using the System Generalized Method of Moments technique. Estimation yields two important results. First, economic growth is found to be increasing income inequality in these panel countries, whatever the income inequality measure is considered. Second, natural resource governance improvement, captured by the Extractive Industries Transparency Initiative (EITI)_Engagement and by the EITI_Compliance, is found to be directly reducing income inequality and to be reducing the income inequality increasing effect of economic growth in these countries. We conclude the paper by recommending that SSA-rich natural resource-rich countries, in search of justice, peace, and development, should engage and conform to EITI requirements.

**Keywords:** Natural resource governance; income inequality; economic growth; Sub-Saharan Africa

**JEL Classification Codes:** H23, I39, O13, O15, P35, P48

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## 1. Introduction

Africa is the second-highest income inequality region in the world after Latin America (Ravallion and Chen, 2012). In 2021, according to the World Inequality Database, the share of the top 10% of the population accounted for approximately 54% of the total national revenue, more than six times the share of the bottom 50% of the population in Africa; in terms of wealth inequality, the 10% richest Africans concentrated nearly 71% of the total wealth, representing more than the share of the bottom 90% of the population (Saoudi and Sarbib, 2023). It is also found that out of the 20 most unequal countries in the world, nine are African, mainly resource-rich African countries such as South Africa, Mozambique, Zimbabwe, Angola, the DR Congo, and Botswana, underscoring the complex interplay between resource wealth and income inequality (Saoudi and Sarbib, 2023).

Indeed, on average, countries that are rich in natural resources have poorer economic and socio-political performance than those that are poor in natural resources. This paradox has been attributed to a 'curse of natural resources''[1] (Auty, 1993; Sachs and Warner, 1995, 2001). This raised researchers' interest in analyzing the relationship between natural resources and economic growth growth[2]. According to Dauvin and Guerreiro (2017), these researchs yield tree types of results: for some researchers (Avom and Carmignini, 2010; Gerelmaa and Kotani, 2016; Tiba and Frikha, 2020; Sharma and Pal, 2021), this relationship is negative; for others (Brunnschweiler and Bulte, 2008; Arin and Braunfels, 2018), this negative effect of natural resources on growth is not inevitable; for a third category, this relationship depends on the quality of the institutions (Mehlum, Moeme, and Torvik, 2006; Epo and Faha, 2020), on political ideology (Andersen and Aslaksen, 2008), and on the country's ability to control negative behaviors induced by natural resource wealth (Papyrakis and Gerlagh, 2003). Many research works have then examined the effect of natural resources on growth, but very few have looked at the effect of natural resource rents on income inequality, with mitigated results (Tadadjeu *et al*., 2021; Njangang *et al*., 2022). According to Bhorat *et al*. (2017)[3], political elites can capture this rent in the absence of transparency, and this can increase income inequality, with growth holding constant. This means that, considering two countries with the same level of economic development, the same rate of economic growth, and the same level of natural resource rents, income inequality will be more important in countries with weak governance. The implication is that generally, when governance is weak, as it is in the majority of sub-Saharan African countries, economic growth tends to increase income inequality.

Sub-Saharan Africa is characterized by abundant natural resources and very high levels of income inequality. In SSA, we have 10 of the 19 most unequal countries in the world; 17 countries with 40% of the SSA population experienced a decrease in inequality in the 2000s; but Central and Southern Africa countries, which are characterized by large oil and mining

[1] Several natural resource rich countries (Nigeria, Sudan, and Venezuela, rich in oil; Congo, Sierra Leone, rich in diamonds, etc.) have experienced this 'curse', while natural resource poor countries (Japan, Taiwan, Singapore, Hong Kong, etc.) performed better (Badeeb, Lean, and Clark, 2017).

[2] In recent decades, the literature on the curse of natural resources has been extended to some development indicators such as public capital (Bhattacharyya and Collier, 2014), tax revenues (Mawejje, 2019), happiness (Mignamissi and Kuete, 2021), health (De Soysa and Gizelis, 2013; Wigley, 2017), access to drinking water (Tadadjeu et al., 2020), education (Cockx and Francken, 2016), financial development (Bhattacharyya and Hodler, 2014), environment (Kinda and Thiombiano, 2021), and women's political empowerment (Awoa, Ondoa, and Tabi, 2022).

[3] He notes that the increasing natural resource rent, in percentage of GDP, of many African countries in recent years has created a boom in the construction of various infrastructures, which has created many jobs, but temporary and low-skilled jobs; this is likely to increase income inequality, although analysis of the correlation between Gini coefficients and dependence on natural resources in most African countries is inconclusive.

sectors, experienced an increase in inequality since 2003 (Ayodele *et al*., 2017). Bhorat *et al.* (2017) found that in SSA, resource sectors are isolated from the rest of the economy, highly capitalistic sectors that create fewer jobs and generate important revenues that are massively exported through illicit channels, resulting in important income inequalities. These paradoxes suggest that the rise of income inequality in SSA countries can be attributed, to a certain extent, to their natural resource endowment and particularly to the quality of governance of their natural resources.

This article examines the relationship between economic growth and income inequality by examining the role of the governance of natural resource rents in Sub-Saharan African (SSA) countries. In view of the brief literature review and the brief description of the realities of the realities of the SSA countries presented above, which will be presented in detail in the next section, this study aims at testing two research hypotheses. H1: *Economic growth increases income inequality in SSA countries*. H2: *Improving the quality of natural resource governance moderates the inequality-increasing effect of economic growth in SSA countries*. To test these hypotheses, we use a two-step system Generalized Method of Moments (GMM), which takes into consideration the endogenous variable problem as well as non-observed and time-invariant country-fixed effects. To test the quality of our results, we carry out four sensitivity tests.

The remainder of the paper includes a review of the theoretical and empirical foundations of this expected effect of natural resource governance (2), the presentation of the methodology of empirical evaluation (3), the presentation and discussion of results (4), and the conclusion (5).

## 2. Literature review

Economists have studied inequality using two approaches: the functional distribution approach and the personal (or size) distribution approach. The functional approach examines factors of production (labor, capital, land, and other resources) and provides a theory for the determination of their returns (wages, profits, rent, and other forms of payment). This approach has founded the pioneers' economic theories of Adam Smith, David Ricardo, François Quesnay, and Karl Marx. Still in this approach, marginalist economists of the 1900s argued that inequality is the outcome of market forces when the earning of economic agents is commensurate with their marginal productivity (Shimeles and Nabassaga, 2017). The personal (or size) income distribution approach is more recent; it maps a given population with income earned or assets owned. It is a statistical summary that provides information on how equitable a society or a country is at a given point in time. This approach is adopted in the early development theories of Lewis (1954) and Kaldor (1956), who analyze the impact of inequality on economic growth, arguing that inequality is good for growth because the rich tend to have a higher marginal rate of saving, resulting in a higher savings rate at the country level. But, based on the new growth theory, Galor and Zeira (1993) found, on the contrary, that inequality is bad for growth, after Kuznets (1955), who found that growth increases inequality in the first stages of development and reduces it later. Our research is carried out within the framework of this personal distribution approach and seeks reflection on what drives income inequality.

The relationship between natural resources and economic growth has been largely studied, and the risk of a curse has been unanimously highlighted[4]. The relationship between growth and

[4] The literature indicates that natural resources can be a curse to economic growth in three circumstances: when it comes to one-time natural resources and not diffuse natural resources (Isham et al., 2005), when weak institutions allow politicians to exploit natural resources for their personal advantage (Brunnsweiler and Bulte, 2008; Diamond and Mosbacher, 2013), and when the country's economy is less diversified with a weak manufacturing sector

income inequality has also been largely studied, but there is yet no consensus. We can point out four important moments in the development of this literature. First, Kuznets (1955) postulated an inverted U-curve relationship between economic growth and income inequality. But from empirical tests, no consensus emerges (Bourguignon, 2004). Indeed, some researchers found a negative relationship between income growth and income inequality (Pearson and Tabellini, 1994; Alesina and Rodrik, 1994; Alesina and Perotti, 1996); some found a non-linear relationship between income growth and income inequality, meaning that growth negatively affects poor countries but positively affects rich countries (Barro, 2000); while some others found no significant relationship between income growth and income inequality (Bruno, Ravallion, and Squire, 1996; Fishlow, 1995; Ravallion, 1995; Deininger and Squire, 1997).

Given these controversial empirical results, a second question is: what other factors affect income inequality and, by so doing, affect the impact of economic growth on income inequality? Answering this question, some researchers found a relationship between government expenditure and income inequality (Calderon and Servèn, 2004; Chatterjee and Turnovsky, 2012; Blejer and Guerrero, 1998; Maestri and Roventini, 2012; Sarel, 1997). The role of globalization and trade has also been found (Dollar and Kraay, 2004; Milanovic, 2005; Barro, 2000; Bourguignon and Morisson, 1990; Marrewijk, 2007). The role of inflation and unemployment has been discussed (Maestri and Noventini, 2012; Stiglitz, 2011; Kumhof and Ranciere, 2010; Jantti and Jenkins, 2010; Sarel, 1997). In addition to these macroeconomic factors, the role of some demographic factors such as education, employment structure, and population growth has been found to be significant (Breen and Garcio-Penalosa, 2005; Gunatilaka and Chotikapanich, 2005; Barro, 2000; Li, Squire, and Zou, 1998; De Gregorio and Lee, 2002; Anderson and Nielsen, 1995). The role of foreign aid has been analyzed (Herzer and Nunnenkamps, 2012; Bjornskov, 2010). The role of some political factors has also been studied. So the role of democratization has been found (Rodrik, 1999; Milanovic, 2004; Dreher and Gaston, 2008); the role of governance has also been found (Ciung-ju Huang and Yuan-Hong Ho, 2018; Saima and Rashida, 2006; Fateme, Mohammad, and Shahram, 2023). Our study pursues an investigation into the role of governance, especially the role of natural resource governance, considering the tendency toward high income inequality in resource-rich countries, as already mentioned.

The debate on the impact of growth on income inequality regained interest in 2014 when Piketty (2013, 2014) noted an increase in income inequality that he attributes to a slowdown in growth and an increase in the capital/income ratio. Piketty has been criticized by Jackson and Victor (2016), who believe that rising inequality is not inevitable, even when growth is low, if good governance protects wages from the interests of capital. This importance of governance as a monitor of the relation between growth and income inequality had already been highlighted by Lundberg and Squire (2003) and Bourguignon (2004), who argued that growth and reducing income inequality can be achieved together with a good policy mix, as well as by Gyimah-Brempong (2002), who, on a panel of African countries, found that increased corruption increases income inequality when growth is kept constant.

In this paper, we pursue investigations on the role of governance, particularly natural resource governance, in monitoring the impact of economic growth on income inequality in sub-Saharan Africa. Indeed, natural resource wealth tends to increase corruption and deteriorate governance, and this widens the gap between the rich elites and the rest of the population. Elites always want to exploit natural resources in order to capture the rents and establish their political power (Van

(Auty, 2007; Collier and Goderis, 2008; Frankel, 2010; Van der Ploeg and Poelhekke, 2009; Papyrakis and Gerlagh, 2004).

der Ploeg, 2011; Diamond and Mosbacher, 2013; Basedau, 2005). This is particularly true in the case of mineral resources (Goderis and Malone, 2011). Ross (2007) makes a distinction between vertical inequality (between rich and poor) and horizontal inequality (between regions)[5]. As far as the impact of natural resources on inequality is concerned, Ross, Lujala, and Rustad (2012) argued that the geographical location of natural resources is a determinant of their impact on income inequality: if the natural resource is located in a poor region, it could help reduce income inequality between that region and other regions of the country; if it is located in an already rich region, the natural resource could aggravate income inequality. Similarly, Fum and Hodler (2010) argue that resource rents can increase income inequality in already unequal societies and reduce it in more homogeneous societies.

## 3. Methodology of research

### 3.1. Variables, data, data source and data description

#### *3.1.1. Variables and their expected impact*

**Dependent variable: income inequality**

It is measured using the GINI index, which permits easy interpretation. The use of this index is recommended by the European Union and Eurostat (Langel, 2012). It varies from 0 to 1, increasing with the importance of income inequality.

***Independent variables***

**Economic growth:** It is captured by the real GDP per capita (GDP/cap). Real GDP measures the level of wealth in a country; relative to the population, it measures the average wealth per capita (Krugman and Wells, 2009). Income inequality depends on the level of wealth created in the country, although the relationship is not always linear (Kuznets, 1955). Following Kuznets reversed U curve and considering that SSA countries are on average in the first part of the curve because they are in the early stages of their economic development, the awaited estimated coefficient is negative, as stipulated in Hypothesis H1.

**The Governance Indicator (GOV):** We calculate a composite governance index as an arithmetic average of the six (06) indicators of Kaufmann, Kraay, and Mastruzzi (2005) in six dimensions (freedom of speech and responsibility, political stability and absence of violence, government effectiveness, quality of regulation, rule of law, and control of corruption), based on data from the World Bank's 2021 Worldwide Governance Indicators (WGI).

**The Natural Resource Governance Indicator (NRGOV):** This is the main explanatory variable of interest. In order to capture natural resource governance, we don't follow the NRGI (2017)[6], but we consider both the commitment and the compliance of countries with the requirements of the Extractive Industries Transparency Initiative (EITI). So our natural resource

[5] To combat vertical inequality, Ross (2007) argues that governments may choose to redistribute natural resource revenues directly, but such a policy is almost impossible in developing countries where governance is known to be of poor quality. To combat horizontal inequality, decentralization (the distribution of natural resource rents between central and decentralized governments) is an appropriate solution, but in reality, this solution often clashes with reality, this solution often clashes with the importance of the responsibilities of central governments (massive investments, macroeconomic management, etc.) in an increasingly volatile and uncertain world, resulting in half-decentralization in developing countries.

[6] Indeed, since 2017, the Natural Resource Governance Institute (NRGI) has published a Resource Governance Index that measures the quality of extractive sector governance in resource-producing countries around the world. It is a robust, evidence-based tool that allows stakeholders, such as governments, civil society actors, private companies, and citizens, to understand how their countries perform in terms of resource governance. It measures the quality of governance in the oil, gas, and mining sectors. Unfortunately, the data in this index does not cover every SSA country or the whole period of our study.

governance is represented by two qualitative variables: 'Engagement to EITI', which takes the value 1 when the country is committed and 0 if not; and 'Conformity with IETI Requirements', which takes the value 1 if the country is compliant and 0 if not.

**The interaction between GDP/capita and governance:** This interaction is captured by GDP/cap*Gov. It is expected to reduce income inequality. **The investment rate (INVEST)** is a control variable, measured by the gross fixed capital formation (GFCF) as a percentage of GDP. Investment generates an increase in GDP and external effects that benefit the lower classes. It is then supposed to contribute to reducing income inequality, and so the expected coefficient is negative.

**The inflation rate (INFL):** This control variable is measured by the consumer price index (in%). Inflation negatively affects fixed incomes by reducing their purchasing power. Since the holders of this type of income are generally the most disadvantaged, inflation is expected to increase income inequality.

**Taxes:** We measure this third control variable by the overall tax rate, as a percentage of commercial profits. Recent research has found that there are taxes that increase income inequality (regressive taxation) and others that reduce it (progressive taxation). But originally, the tax was aimed at redistribution, so we expect a negative effect on income inequality.

### 3.1.2. Data, their sources and statistical characteristics

This study is based on data from a non-motorized panel of 40 sub-Saharan African countries over a period from 2001 to 2020. 37 of these countries depend on natural resources (Following Van der Ploeg (2011) and Yanikkaya and Turan (2018), we consider as dependent on natural resources the country whose average rent is greater than or equal to 5% of GDP during the study period.), 16 of which are EITI compliant between 2003 and 2019. Data on the Gini Index are from the *World Income Inequality Database* of the World Institute for Development Economics Research (WIDER 2021), data on GDP per capita and control variables are from the *World Development Indicators (2021)* and those on governance are extracted from the *World Bank's Worldwide Governance Indicators (WGI)*, 2021. All our variables are quantitative. Their descriptive statistics and the correlation coefficients between them are presented in Tables 1 and 2 below.

**Table 1: Descriptive statistics of variables**

| Variables | Obs | Mean | Stand. Dev | Min | Max |
|---|---|---|---|---|---|
| Gini Index (%) | 840 | 43.91433 | 7.306922 | 29.62738 | 64.84758 |
| GDP per capita | 840 | 1.576606 | 5.170302 | -36.55693 | 56.78894 |
| Coruption | 840 | -.6493 | .6255271 | -1.627693 | 1.244929 |
| Gov. Effectiveness | 820 | -.7464941 | .5925197 | -1.887359 | 1.160924 |
| Voice and Resp | 840 | -.5790036 | .7202318 | -1.999271 | .9825176 |
| Political Stability | 820 | -.5673774 | .8833206 | -2.699193 | 1.223638 |
| Quality of regulation | 820 | -.625189 | .5692533 | -1.843162 | 1.196947 |
| Rule of law | 820 | -.6722959 | .6137424 | -1.850253 | 1.023956 |
| Composite Gov Index | 840 | -.6715793 | .6090895 | -1.982477 | 1.043524 |
| Investment | 840 | 22.21667 | 9.477317 | 1.0968193 | 81.02102 |
| Inflation | 840 | 12.92749 | 95.79032 | -21.16523 | 2630.123 |
| Taxes | 840 | 24.86361 | 13.34659 | 3.9680383 | 89.39852 |

Source : Computed by the authors

**Table 2: Inter-variables corelation matrix**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Gini index | 1.0000 | | | | | | | | | | | | |
| (2) GDP per capita | -0.0277 | 1.0000 | | | | | | | | | | | |
| (3) Coruption Con. | 0.3744 | 0.1002 | 1.0000 | | | | | | | | | | |
| (4) Voice and Resp | 0.2294 | 0.0536 | 0.7265 | 1.0000 | | | | | | | | | |
| (5) Gov. Eff. | 0.2895 | 0.1104 | 0.8420 | 0.7220 | 1.0000 | | | | | | | | |
| (6) Political Stab | 0.3810 | 0.0519 | 0.6746 | 0.6275 | 0.6519 | 1.0000 | | | | | | | |
| (7) Quality regl. | 0.2869 | 0.0538 | 0.8141 | 0.7534 | 0.7110 | 0.6311 | 1.0000 | | | | | | |
| (8) Rule of law | 0.2544 | 0.0765 | 0.8858 | 0.7944 | 0.8090 | 0.7472 | 0.8785 | 1.0000 | | | | | |
| (9) Compo index | 0.3416 | 0.0806 | 0.8701 | 0.7857 | 0.8271 | 0.8635 | 0.8097 | 0.556 | 1.0000 | | | | |
| (10) Investment | -0.0651 | -0.0200 | 0.1121 | 0.0079 | 0.1149 | 0.1336 | 0.0103 | 0.1419 | 0.1169 | 1.0000 | | | |
| (11) Inflation | -0.0122 | -0.0828 | -0.0767 | -0.0887 | -0.0747 | -0.1087 | -0.0924 | -0.0924 | -0.1112 | 0.0009 | 1.0000 | | |
| (12) CO2 Emission | 0.4419 | 0.0129 | 0.1630 | 0.1236 | 0.3027 | 0.3271 | 0.2298 | 0.2450 | 0.3098 | 0.0976 | -0.0199 | 1.0000 | |
| (13) Taxes | 0.1743 | 0.0628 | 0.1008 | 0.1932 | 0.2320 | 0.0960 | 0.2251 | 0.1495 | 0.1836 | -0.1130 | -0.0178 | 0.2503 | 1.0000 |

Source: Computed by the authors

### 3.2. Econometric model specification

Considering the well-known bilateral relation between growth and income inequality (Lundberg and Squire, 2003), we specify our econometric model following Forbes (2000), Deininger and Squire (1998) and Odusanya (2023). All the variables will not be introduced at the same time. So we first specify the baseline econometric model (1) as follow:

$$GINI_{it} = \alpha_0 + (1+\beta_1)GINI_{it-1} + \beta_2(GDP/cap)_t + \beta_3 INVEST_{it} + \beta_4 INFLA_{it} + \beta_5 TAXES_{it} + \sum_{it}$$

Let $\Sigma_{i,t} = \eta_i + \lambda_t + \upsilon_{i,t}$ a composite element with unobserved components as a country specific component $\eta_i$, a time specific component $\lambda_t$and a residual one $\upsilon_{i,t}$, *i* and *t* for countries and periods respectively. Equation (1) can be written in the corresponding dynamic panel model (2):

$$GINI_{it} - GINI_{it-1} = \alpha_0 + \beta_1 GINI_{it-1} + \beta_2(GDP/cap)_{it} + \beta_3 INVEST_{it} + \beta_4 INFL_{it} + \beta_5 TAXES_{it} + \sum_{it}$$

In more simplified version we have:

$$GINI_{it} - GINI_{it-1} = \beta_1 GINI_{it-1} + \beta_2(GDP/cap)_{it} + \overline{\beta_3} X_{it} + \eta_t + \lambda_t + \nu_{iy}$$

So

$$GINI_{it} = \alpha_0 + \beta_1 GINI_{it-1} + \beta_2(GDP/cap)_{it} + \overline{\beta_3} X_{it} + \sum_{it} \qquad (1) \text{ (baseline equation).}$$

In which $X_{it}$ is the vector of the three control variables (investment, inflation and taxes).
When we introduce governance (GOV), we have equation (2):

$$GINI_{it} = \alpha_0 + \beta_1 GINI_{it-1} + \beta_2(GDP/cap)_{it} + \overline{\beta}_3 X_{it} + \overline{\beta_4}((GDP/cap)(GOV))_{it} + \overline{\beta_5} GOV_{it}$$

Where ((GDP/cap)(GOV) is the vector of interaction between the dimensions of governance and GDP per capita.

Introducing natural resource governance (NRGOV), we'll have equation (3) that follows:

$$GINI_{it} = \alpha_0 + \beta_1 GINI_{it-1} + \beta_2(GDP/cap)_{it} + \overline{\beta}_3 X_{it} + \overline{\beta_4}((GDP/cap)(NRGOV))_{it} + \overline{\beta_5} NRGOV_{it}$$

In which NRGOV is the vector of the two dimensions of our natural resource governance, EITI_Engagement and EITI_Conformity.

### 3.3. Estimation method and dynamic panel tests

In order to avoid simultaneity, endogeneity, correlation, and autocorrelation bias, we estimate the models using the two-step Generalized Method of Moments (GMM) technique of Arellano and Bond (1991) in a dynamic panel because of its better precision and higher consistency over the one-step system GMM (Roodman, 2009). There are two variants[7]: (a) the first difference

[7] The first variant consists first of taking for each period the first difference of the equation to be estimated in order to eliminate the individual country effects, then instrumenting the explanatory variables of the equation of the model in the first difference by their values in the delayed level of a period or more. The second combines the equations in the first difference with those in the level at which the variables are instrumented by their first differences.

GMM estimator and (b) the system GMM estimator (Blundel and Bond 1998). In this work, we use the second variant. The usual diagnostic tests (Wald chi2 to ensure that the system GMM is appropriate; Sargan/Hansen (1982) over-identification test to ensure that the instruments used are valid[8], and first-order autocorrelation tests (AR (1)) and second-order (AR (2)) of Arrelano-Bond) are carried out simultaneously.

## 4. Presentation, interpretation and discussion of the results

We first estimate the direct impact of economic growth on income inequality (equation 1), and secondly, we appreciate the impact of governance (equation 2) and of natural resource governance specifically (equation 3).

### 4.1. The direct impact of growth on income inequality

#### 4.1.1. The baseline model estimation results

According to the results of the simultaneous diagnostic tests, our models are well specified[9]. Table 3 presents the results of their two-step GMM estimation[10] with Windmeijer's (2005) finite sample correction of the direct effect of growth on income inequality. In column (1), the bivariate relationship is tested without control variables, and then in columns (2) to (4), control variables (investment, inflation, and taxes) are introduced successively.

[8] Through the use of the "collapse" command, the Stata 14 software guarantees a small number of instruments used that does not exceed the number of countries in order to avoid the problem of the proliferation of instruments (Roodman, 2009).

[9] Hansen's test does not reject the validity of the instruments; we reject the null hypothesis of the absence of serial correlation of first-order residues and accept the hypothesis of the absence of second-order serial correlation. Our system GMM estimates generated a maximum of 32 instruments, lower than the number of countries (40), so our results are valid according to the empirical rule of Roodman (2009).

[10] In this estimate, all explanatory variables are treated as potentially endogenous. The delayed values of the explanatory variables are taken as instruments for the differential equation, while the primary differences of the explanatory variables are taken as instruments for the level equation.

**Table 3: Estimating the direct effect of economic growth on income inequality**

| | Dependent variable : Income inequality (GINI index) | | | |
|---|---|---|---|---|
| VARIABLES | (1) | (2) | (3) | (4) |
| $GINI_{t-1}$ | 0.948*** | 0.448*** | 0.990*** | 0.087 *** |
| | (0.011) | (0.006) | (0.005) | (0.017) |
| GDP/cap | 0.012*** | 0.100*** | 0.008*** | 0.085*** |
| | (0.004) | (0.017) | (0.002) | (0.005) |
| Invest | | -0.226*** | -0.021*** | -0.039*** |
| | | (0.012) | (0.003) | (0.009) |
| Inflation | | | -0.010*** | -0.027*** |
| | | | (0.001) | (0.004) |
| Taxes | | | | 0.010** |
| | | | | (0.004) |
| Constant | 1.240*** | 15.28*** | 1.946*** | 1.000*** |
| | (0.368) | (0.250) | (0.256) | (0.435) |
| Nombre of observations | 800 | 800 | 800 | 800 |
| Nombre of countries | 40 | 40 | 40 | 40 |
| Nombre of instruments | 24 | 32 | 32 | 29 |
| Test AR(1) (P-value) | 1.38e-05 | 9.60e-11 | 0.001 | 0.038 |
| Test AR(2) (P-value) | 4.42e-05 | 1.00e-10 | 0.000 | 0.311 |
| Hansen Test (P-value) | 0.112 | 0.108 | 0.612 | 0.936 |

Notes : *, **, *** if significant at 10 %, 5 % and 1 % respectively; Standard deviations are in brackets.

According to these results, growth increases income inequality in our panel countries, regardless of the model specification. Our H1 research hypothesis is validated. Indeed, in column (2), we estimate the model by introducing investment as a control variable, and the coefficient associated with GDP per capita remains positive and significant, meaning that economic growth increases income inequality. The coefficient associated with the investment is negative and significant, as expected. When we introduce a second control variable, inflation (column (3)), result always confirms the inequality-increasing effect of economic growth. The introduction of a third control variable (taxes) does not change the inequality effect of economic growth (column (4)).

This result, consistent with the Kuznets curve, also falls in line with that of Odusanya (2023), who, using the GMM system on a panel of 31 SSA countries' data for the period 1995–2015, found the presence of an inverted-U relationship between economic growth and income inequality. Using OLS on Tunisian data from the period 1984–2011, Wahiba and Weriemmi (2014) also found that growth increases income inequality. Not very different is Niyimbanira (2017), who found, using pool OLS and fixed effects data from 18 local municipalities in the South-African province of Mpumalanga, that growth does not reduce income inequality. Our result also falls in line with that of Akadiri and Akadiri (2018), who, using panel fixed effects models on 20 African countries, found a positive long-term relationship between economic growth and income inequality. On their side, Batuo, Kararach, and Malki (2022), on a panel of 52 African countries, found that the Kuznets inverted-U relationship became unstable after controlling for the multiple steady states, while Mhaka and Sahdev (2023), using the Fixed Effects panel regression model on Middle and South African countries data from 2000–2019,

found a U-shaped relationship between economic growth and income inequality. Considering the absence of absolute unanimity in African countries, we carried out sensibility tests to verify the solidity of our results.

### 4.1.2. Robustness tests

We performed three sensitivity tests (by estimating the model with alternative measures of income inequality, by introducing additional control variables, and by reconsidering the natural resource dependency threshold) to ensure the robustness of our results.

#### 4.1.2.1. Robustness tests with alternative measures of income inequality

We consider two alternative measures of income inequality: the Theil index and the Palma index. Theil's entropy-based index measures the gap between an egalitarian distribution and the observed distribution of income. The more dispersed the income, the higher it is. The Palma index is the sum of income earned by individuals or households in the top 10% divided by the sum of income earned by the bottom 40% of the population. Table 4 below shows the results of these estimations.

**Table 4: Results of robustness test with two alternative measures of income inequality**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | SYS-GMM | | | |
| VARIABLES | **Palma Index** | | **Theil Index** | |
| $PALMA_{t-1}$ | 0.997*** | 0.883*** | | |
| | (0.022) | (0.002) | | |
| $THEIL_{t-1}$ | | | 0.807*** | 0.879*** |
| | | | (0.024) | (0.018) |
| GDP/cap | -0.069*** | 0.017*** | -0.218*** | -0.135*** |
| | (0.009) | (0.004) | (0.047) | (0.029) |
| INVEST | -0.006 | 0.009*** | 0.022** | 0.296*** |
| | (0.006) | (0.002) | (0.003) | (0.018) |
| Inflation | -0.007 | -0.000 | 0.011 | -0.102*** |
| | (0.009) | (0.003) | (0.014) | (0.009) |
| Taxes | 0.005 | -0.012*** | -0.055*** | -0.172** |
| | (0.028) | (0.003) | (0.025) | (0.063) |
| Constant | 1.875** | 1.799*** | -1.708 | 13.97*** |
| | (0.809) | (0.109) | (1.094) | (1.88) |
| Observations | 700 | 700 | 700 | 700 |
| Nombre of groups | 35 | 35 | 35 | 35 |
| Instruments | 32 | 35 | 31 | 32 |
| AR (1) p-value | 0.000 | 0.000 | 0.000 | 0.001 |
| AR (2) p-value | 0.193 | 0.119 | 0.244 | 0.114 |
| Hansen p-value | 0.601 | 0.727 | 0.331 | 0.162 |

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

According to these results, economic growth increases both the Palma and the Theil indexes. So economic growth increases income inequality, whatever measure of income inequality we consider. Our results are then robust.

#### 4.1.2.2. Robustness test with additional control variables

What happens if we introduce some other control variables into the model? Will economic growth still be considered an increase in income inequality? We answer this question by estimating enlarged models in which we have included progressively four additional control

variables: namely financial development (measured by domestic credit to the private sector, in% of GDP), population growth rate, inward foreign direct investment (FDI, in% of GDP), and trade openness (measured by the sum of exports and imports of goods and services as a percentage of GDP). Column (1) is the model with one additional control variable (financial development); column (2) is the model with two additional control variables (financial development and population growth); column (3) is the one with three additional control variables (financial development, population growth, and FDI); and column (4) is the one with all four additional control variables. The results of the estimation of the four enlarged models are presented in Table 5 below. They indicate that whatever the model, economic growth will be considered as income inequality increasing. So our results are robust.

**Table 5: Results of robustness tests with additional control variables**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | SYS-GMM | | | |
| VARIABLES | GINI INDEX | | | |
| $GINI_{t-1}$ | 0.709*** | 0.790*** | 0.354** | 0.529*** |
| | (0.095) | (0.059) | (0.055) | (0.079) |
| GDP/cap | 0.019** | 0.0542** | 0.002*** | 0.056* |
| | (0.004) | (0.00771) | (0.002) | (0.026) |
| Inflation | 2.331*** | 1.019*** | 1.422*** | 1.252*** |
| | (0.448) | (0.465) | (0.422) | (0.288) |
| Taxes | 0.609*** | 0.875** | 0.080 | 0.352** |
| | (0.401) | (0.205) | (0.071) | (0.205) |
| Financial development | 0.946** | 0.071 | 0.088 | 0.080 |
| | (0.034) | (0.087) | (0.068) | (0.0702) |
| Population growth | | -3.884*** | -10.17*** | -5.098*** |
| | | (0.687) | (0.630) | (0.786) |
| FDI inflow | | | 0.279** | -0.005 |
| | | | (0.084) | (0.052) |
| Trade openess | | | | 0.280 |
| | | | | (0.548) |
| Constant | 15.72*** | 14.68*** | 57.06*** | 17.30*** |
| | (3.132) | (3.534) | (4.720) | (4.721) |
| Observations | 700 | 700 | 700 | 700 |
| Nombre of groups | 35 | 35 | 35 | 35 |
| Instruments | 32 | 32 | 35 | 32 |
| AR (1) p-value | 0.000 | 0.000 | 0.001 | 0.000 |
| AR (2) p-value | 0.559 | 0.328 | 0.708 | 0.400 |
| Hansen p-value | 0.487 | 0.277 | 0.125 | 0.242 |

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

**4.1.2.3. Robustness test with a higher level of dependence on natural resources**

So far, we have considered a panel of African countries in which natural resource revenues represent at least 5% of their GDP. Will the results be different in a panel of more natural resource-dependent countries? To answer this question, let's now consider countries in which natural resource revenues represent at least 15% of GDP and re-estimate the model. The results of this re-estimation of the model for these reduced panel countries are summarized in Table 6.

**Table 6: Results of robustness test with increased level of dependence on natural resources**

| | (1) | (2) |
|---|---|---|
| | SYS-GMM | |
| VARIABLES | GINI index | |
| $GINI_{t-1}$ | 0.264*** | 0.580*** |
| | (0.063) | (0.030) |
| GDP/cap | 0.532*** | 0.0307*** |
| | (0.098) | (0.001) |
| Invest | -0.098** | 0.002*** |
| | (0.076) | (0.000) |
| Inflation | -0.035 | 0.004*** |
| | (0.036) | (0.001) |
| Taxes | 0.377*** | -0.000 |
| | (0.083) | (0.001) |
| Constant | 39.71*** | 0.096 |
| | (2.774) | (0.028) |
| Observations | 460 | 460 |
| Nombre of groupes | 23 | 23 |
| Instruments | 21 | 19 |
| AR (1) p-value | 0.000 | 0.000 |
| AR (2) p-value | 0.613 | 0.330 |
| Hansen p-value | 0.597 | 0.958 |

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

These results still confirm the income inequality-increasing effect of economic growth. So our results are consistent, and our research hypothesis H1 is accepted: economic growth increases income inequality in SSA countries.

**4.2. Estimating the moderating effect of natural resource governance**

We first estimate the impact of general governance dimensions on the relationship between growth and income inequality (equation 2). Secondly, we evaluate the specific impact of natural resource governance (equation 3).

**4.2.1. The effect of the general governance**

Table 7 below presents the results of estimating the effect of different dimensions of general governance on the relationship between growth and income inequality. The upper first part of the table presents the coefficients for the five main variables so far ($GINI_{t-1}$, GDP per capita growth, investment, inflation, and taxes). In the second part of the table, the six dimensions of governance and their interaction with economic growth are successively included. So, in column (1), the first dimension (corruption) is included in the model; in column (2), the second dimension (political stability) is introduced; in column (3), the third dimension (voice and

responsibility) is introduced; column (4) introduces the fourth dimension (government effectiveness); column (5) introduces the fifth dimension (quality of the regulation); column (6) introduces the sixth dimension (rule of law); and column (7) considers the composite index of general governance.

**Table 7: Estimating the direct effect of different dimensions of governance on the relation between growth and income inequality**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | SYS-GMM | | | | | | |
| VARIABLES | GINI INDEX | | | | | | |
| $GINI_{t-1}$ | 0.285*** | 0.859*** | 0.601*** | 0.808*** | 0.779*** | 0.744*** | 0.799*** |
| | (0.0787) | (0.0218) | (0.0544) | (0.0364) | (0.0238) | (0.0428) | (0.0286) |
| GDP per capita growth | 0.239** | 0.0181*** | 0.0459* | 0.0812* | 0.0732** | 0.0578** | 0.109* |
| | (0.115) | (0.00459) | (0.0237) | (0.0420) | (0.0304) | (0.0240) | (0.0539) |
| Investment | -0.126*** | -0.0216*** | -0.0601*** | -0.00944 | -0.0169*** | -0.0422*** | -0.0155*** |
| | (0.0452) | (0.00447) | (0.00571) | (0.00655) | (0.00471) | (0.00372) | (0.00540) |
| Inflation | -0.0188 | 0.00215*** | 0.00783*** | 0.00571** | 0.00699*** | 0.00279* | 0.0101*** |
| | (0.0215) | (0.000604) | (0.00206) | (0.00269) | (0.00149) | (0.00140) | (0.00266) |
| Taxes | 0.337** | 0.0284*** | 0.0379*** | 0.00707* | 0.0108*** | 0.0222*** | 0.0106* |
| | (0.134) | (0.00930) | (0.00763) | (0.00385) | (0.00187) | (0.00295) | (0.00625) |
| Coruption | -8.328*** | | | | | | |
| | (2.211) | | | | | | |
| GDP per capita growth*Coruption | -0.289** | | | | | | |
| | (0.126) | | | | | | |
| Political stability | | -0.299*** | | | | | |
| | | (0.0477) | | | | | |
| GDP per capita growth*Political stability | | -0.00812** | | | | | |
| | | (0.00321) | | | | | |
| Voice and responsibility | | | -0.604*** | | | | |
| | | | (0.158) | | | | |
| GDP per capita growth *Voice and responsibility | | | -0.143*** | | | | |
| | | | (0.0330) | | | | |
| Government effectiveness | | | | -0.782*** | | | |
| | | | | (0.230) | | | |
| GDP per capita growth *Gov. effectiveness | | | | -0.187*** | | | |
| | | | | (0.0399) | | | |
| Quality of regulation | | | | | -0.635*** | | |
| | | | | | (0.151) | | |
| GDP per capita growth *Quality of regulation | | | | | 0.177*** | | |
| | | | | | (0.0307) | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Rule of law | | | | | | -1.001*** | |
| | | | | | | (0.181) | |
| GDP per capita growth *Rule of law | | | | | | -0.158*** | |
| | | | | | | (0.0239) | |
| Composite governance index | | | | | | | -0.949*** |
| | | | | | | | (0.263) |
| GDP per capita growth *Compo gov. index | | | | | | | -0.240*** |
| | | | | | | | (0.0659) |
| Constant | 29.71*** | 4.794*** | 15.08*** | 6.733*** | 7.987*** | 9.108*** | 7.069*** |
| | (3.778) | (0.815) | (2.284) | (1.533) | (1.071) | (1.737) | (1.255) |
| Nombre of observations | 800 | 780 | 800 | 780 | 780 | 780 | 800 |
| Nombre of countries | 40 | 39 | 40 | 39 | 39 | 39 | 40 |
| Instruments | 27 | 38 | 31 | 31 | 37 | 37 | 31 |
| AR (1) p-value | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| AR (2) p-value | 0.221 | 0.125 | 0.329 | 0.238 | 0.219 | 0.105 | 0.821 |
| Hansen p-value | 0.466 | 0.328 | 0.420 | 0.143 | 0.325 | 0.413 | 0.269 |

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Source: Computed by the authors

According to these results, all six dimensions of governance, as well as the composite index of governance and their respective interactions with growth, significantly reduce income inequality. Corruption and its interaction with growth[11], political stability and its interaction with growth[12], voice and responsibility and their interaction with growth, government effectiveness and its interaction with growth, the rule of law and its interaction with growth, and the composite index of governance and its interaction with growth significantly and directly reduce income inequality. This result is consistent with that of Gyimah-Brempong (2002), who found that corruption increases income inequality in Africa. It also falls in line with the one of Chung-Ju and Yuan-Hong (2018), who, on a panel of ten Asian countries during the period 1996–2015, found that governance directly reduces income inequality. Governance also indirectly reduces income inequality by reducing the inequality-increasing effect of economic growth. This result is consistent with that of Behnezhad, Razmi, and Sadaki (2021), who, on a panel of middle- and high-income countries during the period 2004–2017, found that good governance increases the capacity of growth to reduce income inequality. These authors found a threshold effect, meaning that beyond a certain level of good governance, the inequality-reducing power of economic growth significantly increases. Taking into consideration the role of these dimensions of governance in reducing inequality, they increase the initial inequality impact of economic growth, meaning that good governance helps moderate the inequality impact of economic growth in these countries. The role of one only dimension of governance, the fifth one, the quality of regulation (column 5) is confusing: it significantly reduces inequality, but its interaction with economic growth increases inequality. This demonstrates the important role of good governance in mitigating inequality and increasing the impact of economic growth in SSA countries. What about the specific governance of the sector of natural resources in natural resource-rich African countries?

### 4.2.2. The specific effect of natural resource governance

In this subsection, we concentrate on analyzing the impact of sectorial governance, specifically that of the natural resource sector, which is assumed to have a more powerful mitigating power in natural resource-rich countries[13]. In order to capture natural resource governance, we consider both the engagement and the conformity of countries with the requirements of the Extractive Industries Transparency Initiative (EITI)[14]. The EITI is an anti-corruption

[11] This is in line with Li et al. (2000), who showed how corruption affects income distribution and growth.

[12] Political stability means the absence of political violence. Indeed, when there is political instability, the perpetrators of political violence, who are already not poor, regularly receive large transfers of public funds from the government, which is sometimes forced to negotiate with rebels. These transfers to rich rebels aggravate income inequality.

[13] Indeed, some authors have found that when growth is led by capital-intensive economic sectors and by highly qualified human capital sectors such as natural resource exploitation, mining, finance, insurance, and building, its inequality-increasing impact is more important in African countries (Saima and Haq, 2006; Wahiba and El-Weriemmi, 2014; Njangang *et al*., 2022). Odedokun and Jeffery (2001) also found that land resources have affected income inequality in African countries.

[14] Indeed, it is acknowledged that transparency through the EITI improves accountability to its citizens and civil society (Furstenberg and Moldalieva, 2022); a more responsible government will be more inclined to increase public spending on health and education (Kumah and Brazys, 2016), which may reduce income inequality. EITI reduces corruption in resource-rich countries (Villar, 2021); this will lead to better mobilization of revenues from the extractive industry to improve investment in sectors that promote growth and reduce inequality. Transparency is considered a pillar of good governance (Brunnschweiler et al., 2021), under the assumption that the publication of information will lead to a citizen reaction that will lead to an official government response (Joshi, 2013), according to the agency's theory (Prat, 2005; Humphreys, Sachs, and Stiglitz, 2007; Brunnschweiler, Edjekumbene, and Lujala, 2021; López and Fontaine, 2019; O'Donnell, 1998, 1994; Brunnschweiler, Edjekumbene, and Lujala, 2021). An informed public has the ability to compel the government (through advocacy or elections) to be more accountable for managing natural resource revenues (Epremian, Lujala, and Bruch, 2016).

mechanism that aims at promoting accountability and transparency in the management of natural resource revenues, particularly mineral resources (Rustad, Le, and Lugala, 2017). The EITI requires Member States governments to disclose information on the amounts received from extractive companies operating in their country and those companies to disclose how much they pay (Papyrakis, Rieger, and Gilberthorpe, 2017; Villar, 2021). By improving access to information, transparency can reduce corruption and improve social stability (Sovacool *et al.*, 2016; Klitgaard, 1998; Abbink, Irlenburch, and Renner, 2002; Kolstad and Wiig, 2009). Commitment and compliance with EITI are expected to mitigate the inequality effects of natural resources (Kasekende, Abuka, and Sarr, 2016). And, following Tadadjeu *et al*. (2021), we measure engagement and conformity with EITI using two dichotomous variables, taking the value 1 if yes and 0 if no.

Table 8 below presents the results of the estimation of the models. Column (1) presents the results of the estimation of the model comprising 'EITI_Engagement' and the interaction variable 'GDP*EITI_Engagement'. Column (2) presents the results of the estimation of the model with 'EITI_Conformity' and the interaction variable 'GDP*EITI_conformity'. In column (1), we found a negative and significant impact of EITI_Engagement and a negative and significant impact of GDP*EITI_Engagement on income inequality in SSA countries. This suggests that EITI engagement reduces income inequality in SSA countries. Furthermore, in this estimation, the coefficient related to GDP per capita growth is more important compared to that obtained in the baseline model estimation (table 2). This indicates that good governance of natural resources, captured by the engagement of countries with the EITI initiative, helps mitigate the increasing income inequality impact of economic growth in SSA countries. This suggests that for two countries with the same level of GDP per capita and the same level of natural wealth, income inequality is likely to be lower in the EITI-engaged country than in the non-engaged country. In column (2), we found similar results, which indicate that the conformity of SSA countries with EITI requirements also mitigates the inequality effect of growth[15].

[15] Indeed, through the reduction of corruption and the improvement of accountability, the EITI promotes the allocation of revenues from natural resources to essential social sectors (health and education), thus reducing social inequalities.

**Table 8: Estimating the mitigating effect of EITI_engagement and EITI_conformity on the relation between growth and income inequality in SSA countries**

| | (1) | (2) |
|---|---|---|
| | SYS-GMM | |
| VARIABLES | GINI index | |
| $GINI_{t-1}$ | 0.363*** | 0.970*** |
| | (0.052) | (0.000) |
| GDP per capita | 0.242** | 0.011* |
| | (0.068) | (0.001) |
| EITI_Engagement | -1.165* | |
| | (0.405) | |
| GDP per capita*EITI_Engagement | -0.490** | |
| | (0.121) | |
| EITI_Conformity | | -0.078*** |
| | | (0.011) |
| GDP per capita*EITI_Conformity | | -0.010** |
| | | (0.003) |
| Investment | -0.058** | 0.001*** |
| | (0.0265) | (0.000) |
| Inflation | -0.0335 | 0.002*** |
| | (0.024) | (0.000) |
| Taxes | 0.237*** | -0.000 |
| | (0.083) | (0.000) |
| Constant | 19.81*** | 0.016*** |
| | (2.684) | (0.018) |
| Observations | 700 | 700 |
| Nombre of groupes | 35 | 35 |
| Instruments | 29 | 26 |
| AR (1) p-value | 0.000 | 0.000 |
| AR (2) p-value | 0.513 | 0.230 |
| Hansen p-value | 0.398 | 0.758 |

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

This result is pertinent to the literature. Improving natural resource governance directly reduces income inequality; it also reduces it indirectly by reducing income inequality and increasing the effect of economic growth. This indirect effect means that improving governance is a way to promote pro-poor growth and inclusive growth in SSA countries. This is particularly true for natural resource governance in natural resource-rich SSA countries. Improving natural resource revenue governance is good for pro-poor growth and for inclusive growth in these countries; it is a way out of the natural resource curse and civil war in many natural resource-rich sub-Saharan African countries.

## 5. Conclusion

The objective of this paper was to estimate the role played by natural resource governance in the effect of economic growth on income inequality in SSA. On the data of 40 SSA countries for the period 2001–2020, the estimation of a dynamic panel model using Two-Step System

Generalized Method of Moments has given two important results. First, economic growth tends to increase income inequality in the SSA. This conclusion withstood three robustness tests (one by using alternative measures of income inequality, one by introducing additional control variables, and the last one by reconsidering the natural resource dependency threshold). Secondly, this inequality-increasing effect of growth can be explained, in part, by the poor quality of governance in general and of natural resource governance in particular. Indeed, our econometric results support that all six dimensions of general governance (control of corruption, political stability, absence of violence over a long period, increased accountability, strict application of the rule of law, improvement of the quality of regulation, and strengthening of the effectiveness of governments) negatively impact income inequality. More particularly, we found that improving natural resource governance, captured by EITI engagement and conformity with EITI requirements directly reduces income inequality and, indirectly, reduces the inequality-increasing impact of economic growth in these SSA countries. We therefore recommend that SSA resource-rich countries in search of development and peace engage in and conform to the EITI initiative.

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