IJEEP

INTERNATIONAL JOURNAL OF ENERGY ECONOMICS AND POLICY

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2024, 14(6), 63-79.

A Threshold Effect of Financial Development on Natural Resource Rents-Sustainable Human Development Nexus: Empirical Evidence from Sub-Saharan Africa

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Received: 15 February 2024 **Accepted:** 05 August 2024 **DOI:** https://doi.org/10.32479/ijeep.16027

ABSTRACT

Sub-Saharan African (SSA) nations are falling behind in human development when compared to other regions globally, despite their abundant natural resources. Several Sub-Saharan African states have an underdeveloped financial structure, leading to underutilization of natural resource profits for human development. This research examines how the level of financial development impacts the relationship between natural resource rents and sustainable human development in 40 SSA countries from 2005 to 2019. This research used the dynamic panel threshold (DPT) approach, an advanced econometric methodology designed to address concerns often seen in panel data such as endogeneity, cross-sectional dependence, and heterogeneity. The cointegration findings showed a long-term association among the variables. The dynamic panel threshold analysis showed that natural resource rent had a detrimental influence on human capital development when financial development was below a certain threshold. Conversely, the outcomes were different when financial development exceeded the threshold. Financial system progress in Sub-Saharan African states considerably uses resource windfalls to improve sustainable human development. This research conducted robustness tests by using alternative estimates excluding outlier sample countries and extra proxies. The conclusions remained unchanged. Policy suggestions were introduced to enhance the financial sector and improve institutional quality in order to ensure sustainable growth in the SSA area.

Keywords: Natural Resource Rents, Sustainable Human Development, Financial Development, Dynamic Panel Threshold, Sub-Saharan Africa
JEL Classifications: Q32, O15, E44, C23

1. INTRODUCTION

The Sub-Saharan African (SSA) region has a considerable deposit of the world minerals (30%), oil (12%), natural gas (8%), gold (40%), chromium and platinum (90%), apart from being the largest reserves of cobalt and diamonds (UNEP, 2021). However, more than 42%) of the global deprived people inhabit in the SSA (UNDP, 2021). The International Monetary Fund (2012) defines resource-rich countries as those with a minimum of 20% of GDP or natural resources exports. However, the resource-rich SSA countries such as DR Congo have experienced an increasing prevalence of poverty concentration and inequality despite the rise in natural resources generating additional revenue (Cust and Zeufack, 2023a). This region is also expected to house over 80% of the world's poor people by 2030, with nearly 75% of them living in countries with abundant natural capital (Cust et al., 2022). In 2020, 73% of the population in the DR Congo live below the internationally recognized level of poverty, $1.90/day, despite the country's abundant resources, as reported by the World Bank in 2022. In 2020, the Democratic Republic of Congo saw a rise of 20 million people living in poverty compared to 2003, highlighting the sub-Saharan Africa's inability to effectively harness natural resources for long-term development. According to the latest World Bank statistics from 2022, Sub-Saharan Africa (SSA) has the largest percentage of impoverished individuals across all three poverty categories. Figure 1 illustrates Sub-Saharan Africa (SSA) poverty grounded on how the World Bank defines the international poverty level set at $1.90/day/person. This is the strictest criterion for poverty and is often used to establish the Extreme Poverty Line. Individuals who fall below this criterion are considered to live in severe poverty and struggle to meet their fundamental needs, such for shelter, sustenance, and medical treatment.

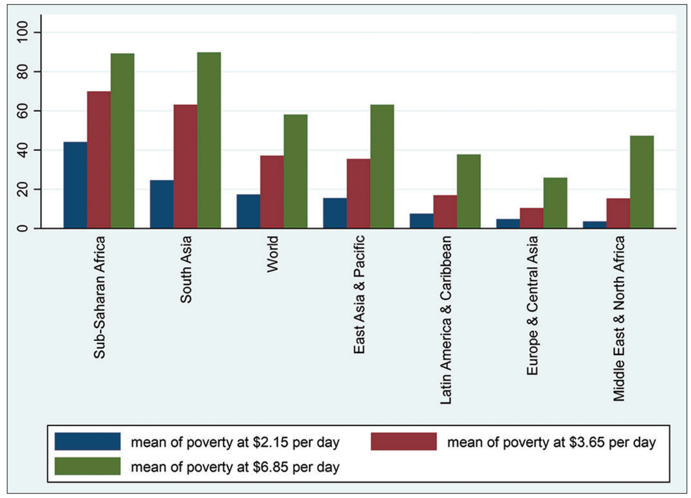
The SSA region's human development has improved by 1.05% each year over the last 30 years, as measured by indicators of education, health, and income (UNDP, 2020). This increase is far more than the global average of 0.7%. 44 out of 49 SSA countries have a low or medium HDI score, which is concerning for policymakers. Countries must achieve the Sustainable Development Goals by 2030, particularly SDG1 (eradicating global poverty) and SDG3 (advancing universal health and well-being). Many SSA nations are falling behind in education, health, and GNI per capita. Sub-Saharan Africa has the largest percentage of children in the world who do not attend schools, at 31.2% (97.5 million children) according to UNESCO in 2019. The COVID19 pandemic caused health services be disrupted and the loss of as much as 6 months of schooling for children (African Development Bank, 2022). With 553 mothers dying for every 100,000 babies born alive, SSA countries record the highest maternal deaths which is 50 times as high as that of wealthy nations (Okonji et al., 2023). SSA's human development is crucial to achieving most if not all, SDGs across all nations and regions, especially developing ones.

New discoveries every year are making Sub-Saharan Africa more resource-rich than it was at the turn of the 21st century. Resource-rich countries increased from 18 to 26 during and after the natural resource boom (Cust and Zeufack, 2023b). Only the hydrocarbon-rich Gulf Cooperation Council (GCC) member states have more extractive resources as a percentage of their total capital than the SSA region (Izvorski et al., 2018). Nigeria, Angola, Congo Republic are among the oil producing members of SSA region with other new comers including Chad, Niger, Ghana Equatorial Guinea and Sudan joining the club of oil-rich nations in the 1990s. Among these SSA oil-producing countries, Nigeria and Angola contributed more than 70% of the oil production in the sub-continent (Copinschi, 2022). The gas industry is still rather minor in the SSA area. Nigeria, Mozambique, Equatorial Guinea, and Angola together account for almost 87.7% of natural gas production in Sub-Saharan Africa, with Nigeria alone responsible for 64% of this total. Minerals and metals make for 27% of Zambia's economy, 26% of South Africa's economy, and 14% of Botswana's economy in the SSA area (World Bank, 2018).

To achieve sustainable development via the efficient use of natural resource rents, it is crucial to include formal financial institutions, particularly banks, in supporting investments in sustainable human development. To optimize the use of income generated from natural resources, it is crucial to create economically advanced systems.

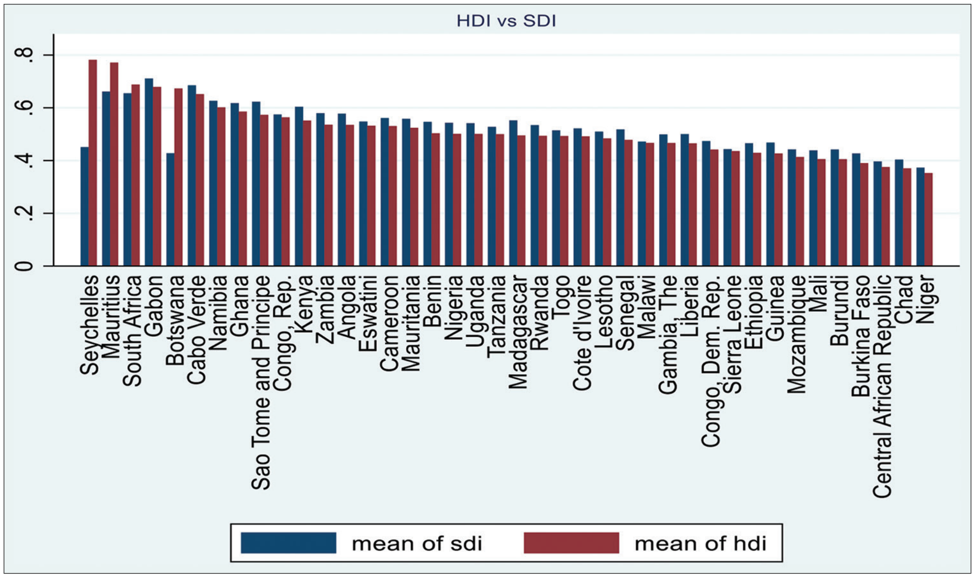
Enhancing financial institutions or intermediaries and markets can foster human capital development (Mukherjee et al., 2021; Sethi et al., 2019; Vo et al., 2021). According to Asif et al. (2020), financial development is indispensable to utilising natural resources. Unfortunately, natural capital and growth in the financial sector demonstrated that natural resource-endowed countries are inclined towards a weak financial sector, which can hurt the economy and human capital growth (Khan et al., 2020; Guan et al., 2020). Literature indicated that natural resource rents boost financial advancement (Dogan et al., 2020), suggesting a financial resource boon. Meanwhile, Dwumfour and Ntow-gyam (2018) revealed that the rents from natural resources and financial development nexus differed depending on the financial development proxy used in the African continent. However, there are limited number of studies regarding the link between natural resources and financial development in the SSA. In a recent bibliometric analysis of the resource-finance linkage, China topped the list of publications (24.2%), followed by Pakistan (15.9%) and Turkey (10%) (Ali et al., 2022). Hence, more studies are required to examine how financial development influences natural resource rents – human capital development nexus.

Figure 1: Poverty rates and number of poor people at the three lines of poverty by regions



In developing countries where indicators for governance are deficient, corruption levels are typically higher, while economic growth is low (Farooque et al., 2022). According to Transparency International, (2021), Sub-Saharan Africa's average control of corruption score of 33 out of 100 demonstrates no substantial progress for the past several years. The region's poor performance dominates the improvements of successful countries (44 of 49 countries score below 50). Moreover, SSA countries' institutional quality has changed less rapidly than in other regions of the globe (Kemoe and Lartey, 2021). To further illustrate that, institutions (both political and economic) in the Middle East and North Africa have changed dramatically, whereas in SSA, change has been relatively small. The World Bank's Country Policy and Institutional Assessment (CPIA) Africa report for 2022 noted that the average score for Sub-Saharan Africa stayed steady at 3.1 in 2021. Similarly, no changes were detected at the subregional level, where the ratings for West and Central Africa and East and Southern Africa remained unchanged at 3.2 and 3.0, respectively

Figure 2: Average value of SDI and HDI of 40 SSA countries from 2005 to 2019



(World Bank, 2022). The above-mentioned figures and facts all implicate the important role of institutional and governance mechanisms particularly for the development of the SSA region.

This study aims to examine the influence of SSA's financial development on natural resource rents – human development relationship. This study was motivated by Salari et al. (2022) which considered the threshold impacts of human development on oil rents – financial development link. However, it seems relevant to further study the role that financial development can play in sustainable human development. A financially strong sector not only acts as the bedrock on which economic development rests, but also can help prevent the occurrences of Resource Curse Hypothesis (RCH) (Rongwei and Xiaoying, 2020; Li et al., 2021). Although financial development is essential for a nation's economy (Ekanayake and Thaver, 2021; Ekanayake and Thaver, 2021), most less-developed nations have inefficient financial systems that fail to contribute effectively to the economy's productive activities (An et al., 2020). Despite vast natural resources, SSA still remains the least economically developed (World Bank, 2022) with the lowest degree of human development (UNDP, 2022).

As shown above, figure 1 compares poverty levels across regions at three thresholds: \$2.15, \$3.65, and \$6.85 per day. Sub-Saharan Africa and South Asia show the highest rates, while East Asia & Pacific and Latin America demonstrate more effective poverty alleviation. Building on this, figure 2 compares HDI and SDI across African countries, indicating that higher human development often correlates with better sustainability, with Seychelles and Mauritius performing well, unlike Niger and Chad. Figure 3 likely displays the values of natural resource rents to demonstrate the economic significance of resource extraction operations in the 40 SSA nations. Higher natural resource rents suggest that a country has significant natural resources and relies heavily on extracting these resources for revenue. Figure 4 displays the financial development index values, indicating the level of progress and complexity of the financial sector in each country. An advanced financial system, characterized by well-functioning banks, capital markets, insurance firms, and other financial institutions, is associated with increased levels of Foreign Direct Investment (FDI).

The implementation of the Human Development Index (HDI) in the 1990s signified a notable change towards a more logical measure of advancement, focusing less on economic expansion and more on societal goals. The HDI has been revised to include an ecological sustainability index while facing criticism. Furthermore, given the escalating global warming and environmental difficulties, this matter has lately been extremely evident. Multiple scholars have studied the environmental boundaries of the Human Development Index (HDI) (Neumayer, 2001; Morse, 2003; Togtokh, 2011; Pelenc et al., 2013). There were efforts to include ecological aspects into the Human Development Index (HDI) (Hirai, 2017; Biggeri and Mauro, 2018). Bravo (2014) incorporates a per capita carbon dioxide emissions index as a geometric mean in addition to the three fundamental HDI indicators. This study contributes to the literature by using the novel index created by Hickel (2020), Sustainable Development Index (SDI). This research will use the SDI index as a measure for sustainable human development since it indicates high sustainability by measuring a nation's environmental efficiency in contributing to human development. This work provides important additions to the current knowledge. The research utilizes the Sustainable Progress Index (SDI) developed by Hickel (2020) as a proxy for human progress. This study is one of the first to analyze the "resource curse hypothesis" using the innovative SDI index. It functions as a substitute measure that is environmentally and socially strong, while meeting the standards of strong sustainability. The research used SDI over HDI because HDI tends to favor countries with high per capita emissions and material utilization, which are major contributors to greenhouse gas emissions and environmental issues. The research utilizes Seo and Shin's (2016) dynamic panel threshold estimation approach as developed by Seo et al. (2019). Panel data models exhibit persistent dependent variables, causing the initial value of the lagged dependent variable to be possibly endogenous. Consequently, the static framework becomes inconsistent, resulting in erroneous conclusions. This research used aggregate

Figure 3: Average value of total resource natural rents of 40 SSA countries from 2005 to 2019

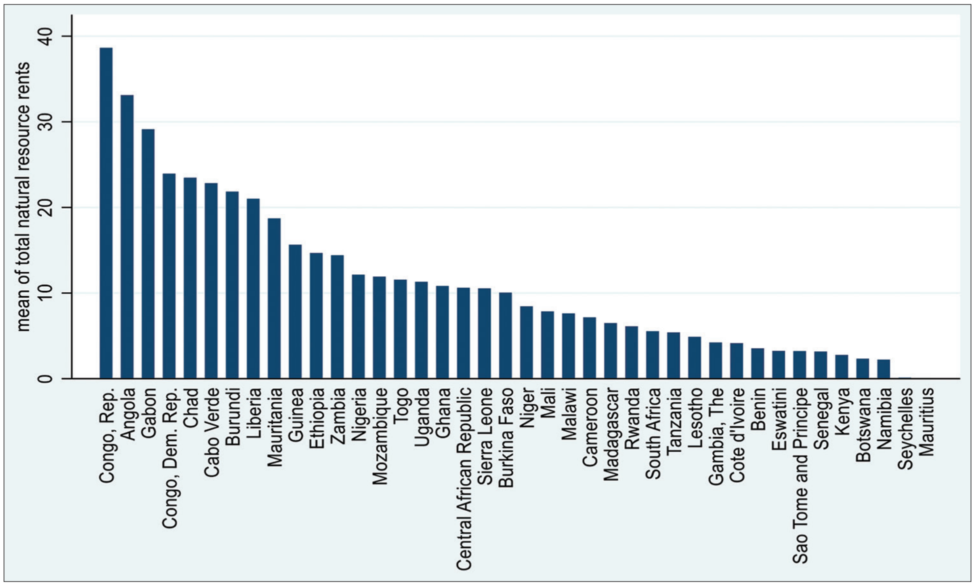
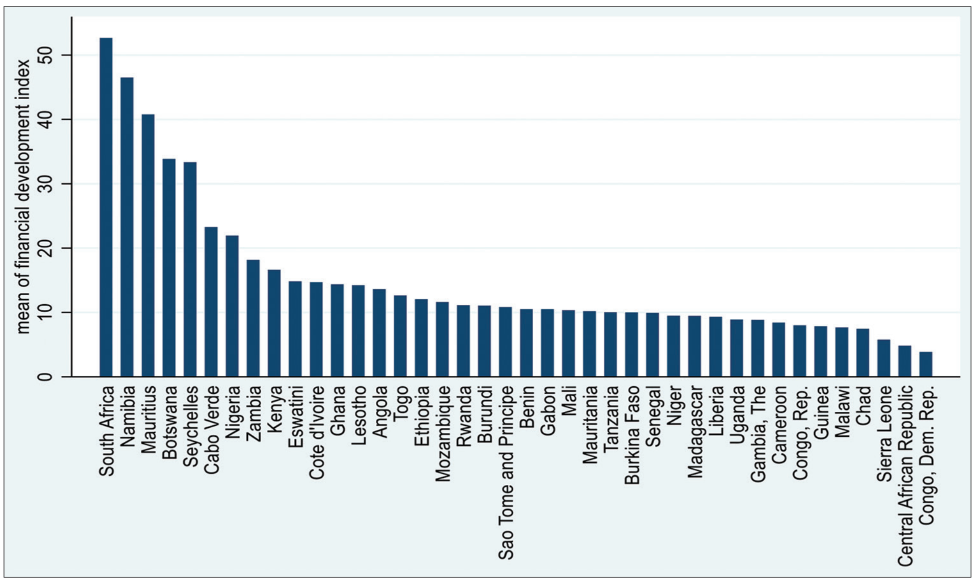


Figure 4: Average value of financial development index of 40 SSA countries from 2005 to 2019



data from Sub-Saharan African nations due to the absence of empirical studies on the correlation between natural resource rents, sustainable human development, and financial growth in the region. The research utilizes the Driscol-Kraay estimator to do a sub-regional analysis on the panel data, separating it into 4 areas of the SSA region (West Africa, South Africa, East Africa and Central Africa) to provide valuable insights for policymakers.

2. LITERATURE REVIEW

This study is grounded on the notion of the "natural resource curse," which suggests that there are negative correlations between economic development and resource reliance. Several notable works, including those authored by Gelb (1988), Auty, (1993) and Sachs and Warner (1995), established a theoretical basis for the connections between natural resources and economic development. The scholars held the belief that natural resources hindered economic expansion. The "Natural Resource Curse" hypothesis (NRCH) posits that extractive resources are inclined to hamper economic development. This theory posits that resource-intensive countries are less developed than resource-scarce ones (Badeeb et al., 2017), discourage investment in education (Gylfason et al., 1999) and reduce human development (Gylfason, 2001; Birdsall et al., 2000a; Stijns, 2006; Séraphin and Cyrille, 2024). Most natural resource-rich countries assume their windfalls will never end, leading to unsustainable fiscal policies (Liu et al., 2022). Accordingly, "resource curse" scholars investigated why resource-rich Countries struggle to grow economically.

Several studies analyzed the effect of natural resource rents on economic development (Badeeb et al., 2017; Sharma and Pal, 2020; Haseeb et al., 2021), whereas relatively fewer studies examined the natural resource curse (RCH) from the standpoint of human development (Sinha and Sengupta, 2019; Noumba and Gilbert, 2022). Natural resource abundance may impact socioeconomic development via many pathways. Some studies analyze the correlation between natural resource rents and institutional quality, while others investigate the link between real GDP growth and natural resource availability and reliance. Furthermore, sustainable human development must include a range of socio-ecological elements in its design.

Various studies have shown conflicting findings when examining the connection between global socioeconomic development, institutional integrity, human growth, and natural resource availability. Rahim et al. (2021) analyzed the impact of natural resources on the economic growth of N-11 countries from 1990 to 2019 by investigating the indirect impacts of human capital development on economic growth. The findings confirm the existence of the resource curse phenomenon and show that the relationship between human capital and natural resources may enhance economic development. The resource curse and corruption have been analyzed in 125 countries based on average variable values from 2012 to 2016 by Shadabi and Adkisson (2021). Natural resource rents alone lead to corruption, whereas natural resources when combined with authoritarian administration further encourages corruption. Most recent studies on the resource curse indicate that natural resources have a detrimental impact on institutions, perhaps leading to the curse. This research employs system GMM in Sub-Saharan Africa (SSA). Asiamah et al. (2022) provides evidence for the rent-seeking concept by demonstrating that reliance on natural resources reduces quality of institutions in SSA.

Considering the focus on the environment in the 2015 United Nations Universal Agenda for Sustainable Development, Wang et al. (2023) investigated the impact of natural resource rent and renewable energy on CO_2 emissions using the environmental Kuznets curve (EKC) theory. Utilizing a dataset that combines information from 208 countries between 1990 and 2018, advanced econometric tests such as GMM and FMOLS estimators were used. The data showed a "inverted U-shaped" link between world income and CO_2 emissions. Renewable energy consumption was more effective in reducing CO_2 emissions before Environmental Kuznets Curve (EKC) turning point, but human capital was more effective in reducing emissions thereafter. In five South Asian nations, Voumik et al. (2023) applied cross-sectional autoregressive distributive lag analysis to investigate the dynamic impact of urbanization, industrialization, and energy consumption on CO_2 emissions. Carbon dioxide emissions increase with economic expansion, urban development, and industrial growth. Electrification, population growth, and natural resource rent have decreased CO_2 emissions in South Asia. Research was conducted on 23 resource-dependent Sub-Saharan African (SSA) nations. Erdoğan et al. (2020) found that depending on natural resources and having an excess of them decreases environmental health. In SSA nations, human capital and globalization were discovered to enhance environmental quality, whereas natural resources were proven to have a detrimental effect on it. These results support the Environmental Kuznets Curve (EKC) theory, which suggests that increased economic expansion leads to environmental degradation.

Unlike earlier studies that focused on explaining non-inclusive human development, current research in the development sector now focuses on identifying the primary factors that promote inclusive human welfare. Several research works have focused on the impact of globalization (Sinha and Sengupta, 2019; Noumba and Gilbert, 2022; Nathaniel, 2021; Radmehr et al., 2022), information and communication technology (ICT) and environmental deterioration (Tchamyou et al., 2019; Shobande and Asongu, 2022; Khan et al., 2019) in boosting human capital inclusivity. Haseeb et al. (2019) explores how ICT and globalization affect BRICS environmental quality. Aljarallah (2019) argues that, in contrast to natural resources, having a detrimental impact on environmental quality, advancements in human capital and globalization have a positive influence on the environmental quality of SSA countries. Ganda (2022) also found financial development, natural resource rents, energy consumption, and human capital have a beneficial impact on CO_2 emissions, creating a U-shaped relationship between economic growth and CO_2 emissions. Financial institutions and markets interacting with natural resource rent significantly lower emissions. Noumba and Gilbert (2022b) explored how natural resource rents, globalization, good governance, and strong institutions impact human development favourably.

Currently, a significant change has been observed in global awareness of the development program, especially concerning sustainable development. The 2030 global plan for sustainable development is charted by the Sustainable Development Goals (SDGs), which include several practical categories and numerous indicators (United Nations, 2015). Thus, while considering economic aspects, especially the indicators of economic development, policy makers aiming for "sustainable development" should also focus on the social component, such as enhancing human capital via top-notch healthcare and education (Raheem et al., 2018; Ogundari and Awokuse 2018; Jayadevan 2021; Ali et al., 2020) in addition to maintaining ecological sustainability (Sarkodie et al. 2020; Erdogan et al., 2020; Hassan et al. 2020; Zhang et al. 2021). Moreover, since governance indices such as corruption and the rule of law are important in this context, Sala-i-martin and Subramanian (2012), Zallé (2019) and Nchofoung et al. (2021) examined the influence of institutional as well as environmental quality on the economy. Financial development is a crucial factor in the connection between sustainable human expansion and natural resource rentals. Resource rents may be efficiently directed into investments in health, education, and skill development via a strong financial sector. To fully use the positive impact of natural resource profits on human capital development, certain policies and reforms are needed to strengthen financial institutions and promote financial inclusion.

The above information indicates a lack of consensus among scholars about the connection between natural resource rents and human progress. Furthermore, only very few studies investigated the resource rents and sustainable development, especially sustainable human development in Sub-Saharan Africa. Globalization has often been the primary dimension via which natural resource rents affect human development by facilitating exploitation through transmission channels in a number of recent studies. However, given the underwhelming financial sector development in the SSA region and its heavy dependence on natural resource income, it is crucial to examine how financial development influences the connection between natural resource income and sustainable human development.

3. METHODOLOGY

The methods segment of this paper employs second-generation unit root, cointegration, and dynamic panel threshold testing. The analytical approaches were selected to provide strong and thorough insights into the study goals. The research analyzes the long-term equilibrium linkages among variables by means of second-generation unit root and cointegration tests to provide accurate estimate while considering cross-sectional dependency. The dynamic panel threshold approach is used to analyze nonlinear relationships and threshold effects in panel data. This technique detects crucial thresholds that have the potential to drastically alter variable interactions. Advanced analytical approaches are used to uncover detailed and thorough results that are very dependable and strong.

3.1. Theoretical Foundation

It is crucial to lay down a theoretical foundation before discussing economic modelling to select study variables. The resource curse theory (RCT) act as the groundwork for the theoretical framework of this study. The RCT claims that resource-intensive countries typically develop at a slower rate than resource-scarce ones (Sachs and Warner, 1995; Rodriguez and Sachs, 1999; Sachs and Warner, 2001; Gylfason, 2001) because of things such an excessive reliance on resource exports (Coxhead and Shrestha 2016), weak institutions (Mehlum et al., 2006), rent-seeking (Wick and Bulte, 2006), and a lack of diversification (Dutch disease) (Asiamah et al., 2022). However, there are numerous connections between sustainable human development and natural resources (Sinha and Sengupta, 2019; Noumba and Gilbert, 2022; Zheng et al., 2023). Natural resources take a crucial part in sustainable human development by generating revenue. This investment enhances human development by increasing the population's access to high-quality healthcare and education. Natural resource extraction and processing provide employment opportunities in many sectors such as manufacturing and mining, contributing to human advancement.

Theoretically, there are linkages between natural resource rents and sustainable human development crucial to a nation's societal and economic success. This study explores the relationships between these concepts, highlighting their significance and consequences. The concept of the resource curse is a central theoretical foundation regarding the development of sustainable human development and natural resource revenues. This concept suggests that resource-intensive countries often struggle to achieve sustainable economic development. To avoid the negative impact of the resource curse, an economy must focus on enhancing its financial sector to effectually manage the exploitation of natural resources for the welfare of its people (Su et al., 2022; Hong et al., 2022).

Progress in finance is crucial for the evolution of the economy and, therefore, for mankind. An efficient allocation of resources is facilitated by a sophisticated financial system including stock markets, banks, and other financial institutions. It provides access to financing for individuals and businesses, allowing them to expand their activities and participate in lucrative ventures. This leads to increased job prospects, better income, and elevated quality of life. Financial development promotes economic progress by encouraging investment and savings. Financial institutions provide various saving and investing choices such as mutual funds, term deposits, and savings accounts to motivate individuals to save and invest their money wisely. These investments lead to sustained economic growth by stimulating economic activity and creating a multiplier effect in industries such as manufacturing, infrastructure, and technology.

3.2. Empirical Model and Variable Description

As illustrated below, the empirical model of the "dynamic panel threshold" between "natural resource rents" and "human capital development" is signified by:

$$HCD_{it}= \mu_i+\delta_1 TNRR_{it}(FDI_{it}\leq\lambda)+\delta_2 TNRR_{it} I\,(FDI_{it}>\lambda)+\alpha X_{it}+\theta_t+\varepsilon_{it} \quad (1)$$

In eq (1), SHD_{it} is the explained variable which is proxied by Sustainable Development Index (SDI). It comprises five dimensions: schooling, lifespan, GNI per capita, CO_2 releases, and ecological footprint Hickel (2020). The SDI was calculated by dividing two components: (1) a development indicator determined to be the average value of the "education index", the "life expectancy index", and the "modified income index"; and (2) an "ecological impact index" equated as the mean overshoot of carbon dioxide releases and "material footprint", indexed on a natural exponential scale. This study is among the first to employ a sustainable development index instead of the Human Development Index (HDI) to measure sustainable human development. The total natural resource rent (TNRRit) is the primary regressor variable. This statistic quantifies the discrepancy between the overall production cost and the global market value of extracting natural resources. It encompasses several types of rents, such as those derived from coal, oil, natural gas, minerals, and woodlands. The publication "The Changing Wealth of Nations: Measuring Sustainable Development in the New Millennium" by the World Bank in 2011 provides the calculations and methodologies used to determine these estimates. FDI stands for Foreign Direct Investment, which serves as the critical variable for financial growth. Conventional financial development measurements like the stock market capitalization to GDP ratio or domestic lending to the private sector do not fully represent the many strategies for financial growth. This research utilizes a novel variable to measure financial growth. The data of the financial development indicator is sourced from the International Monetary Fund (IMF). The vector of control variables, which consists of industrialization, globalization, urbanization, and the lagged dependent variable, is represented as X_{it} in equation (1). Industrialization, urbanization, and globalization are measured by the percent of GDP, share of the total population, and KOF Index of Globalization (Dreher, 2006) respectively. Country-fixed effects, denoted as μi, account for heterogeneity. Time effects are represented by θt. I (.) is the indicator function, and the threshold of financial development is marked by λ. Simply put, the threshold variable, FDit, differentiates between two regimes based on whether they are more or less than the threshold value of λ, shown by distinct slope coefficients, symbolized as δ_1 and δ_2. The 'dynamic panel threshold' was used in this work to address potential endogeneity concerns and mitigate estimate bias. Seo and Shin (2016) developed a dynamic panel threshold regression model estimator that relies on Arellano and Bond's (1991) first-differenced GMM estimate. The estimator uses an asymptotic distribution and takes into account endogenous and threshold variables. The threshold effect is identified by the computationally reliable bootstrap approach developed by Seo et al. (2019). To detect a threshold effect, the bootstrap p-value for a "supremum statistic" should be below 1%, 5%, or 10%, despite the null hypothesis suggesting otherwise.

3.3. Unit Root Test

Cross-sectional dependence is a prevalent issue in panel datasets due to the interconnectedness of nations at local and global levels. As such, (Phillips and Sul, 2003) said that estimators might exhibit bias and inconsistency if cross-sectional dependence is not taken into account. Second-generation unit root tests are important in economics research since first-generation tests are ineffective when panel units exhibit cross-sectional dependence (Dogan and Seker, 2020). The study used the "cross-sectionally augmented" Im, Pesaran and Shin (CIPS) and "cross-sectionally augmented" Dickey Fuller (CADF) methods to evaluate the stationary properties of the variables.

3.4. Cointegration Test

Panel cointegration techniques examine the enduring connections between variables in a model using two test procedures. According to Mccoskey and Kao (1998) and Westerlund (2005), the first category employs cointegration as the null hypothesis. Based on the models of Granger and Engle (1987), the second technique proposes the null hypothesis that cointegration is absent. This research used the Westerlund cointegration approach to determine the long-term relationship between model variables. No restrictions were imposed on common factors due to the panel cointegration test (Westerlund, 2007). The proposal is founded on the principles of "structural dynamics." This cointegration test demonstrated resilience against cross-sectional dependence, shown by the significance of the error-correction term and the p-values derived from bootstrapping.

3.5. The Dynamic Panel Threshold

This study employed the "dynamic panel threshold" model created by Seo and Shin (2016) to determine the "financial development" threshold point with "natural resource rents" and "human capital development" (Seo et al., 2019). The dynamic panel threshold technique outperforms the static panel threshold strategy in two aspects (Hansen, 1999). The dynamic panel threshold technique tackles issues related to endogeneity and the common simultaneity bias seen in panel modelling. This technique deals with regression persistence by including a temporal lag into the dependent variable. Seo and Shin (2016) created the "dynamic panel threshold" model by including the inherent components into Hansen's (1999) original static model. This model is shown by:

$$Y_{it}=(1,X_{it})\,\delta 1\{q_{it}\leq\gamma\}+(1,X_{it})\,\delta 2\{q_{it}>\gamma\}+\mu_i+\varepsilon_{it}, i=1,\ldots,n;\ t=1,\ldots T., \quad (2)$$

The equation includes Y_{it} as the dependent variable with a time lag, X_{it} as time-varying regressors that include the delayed dependent variable, and qit as the threshold variable. T remains constant, while n represents the sample size, which is anticipated to increase indefinitely. The first differencing transformation eliminates the country-specific impact. The GMM is used to estimate the unknown parameters $\theta = (\delta 1, \delta 2, \gamma)$.

Data from 38 Sub-Saharan African states were gathered between 2005 and 2019 owing to data limitations. The data for the variables under examination were obtained from the databases of the World Bank, the United Nations Development Programme (UNDP), and the International Monetary Fund (IMF). The dependent variable, denoted by the sustainable development index, was acquired from Hickel (2020). The important explanatory variable, "natural resource rents," was sourced from the World Bank World Development Indicators database. Four unique financial development indicators were used in this research. The data for Broad Money was sourced from the World Bank, while the new "multidimensional index for financial development" was created by Svirydzenka (2016) data was gained from the IMF. Furthermore, the Global Financial Development Database (GFDD) was used to get two more financial development indicators: private credit by deposit money banks to GDP (%) and liquid liabilities to GDP (%). Similarly, Financial development refers to the policies, factors, and institutions that facilitate efficient intermediation and the functioning of effective financial markets (Adnan, 2011). Industrialization and urbanization were the control variables derived from the World Bank database. Globalization originated from the Dreher (2006) database.

Based on current research, natural resource rents are linked to negative impacts on economic growth, as shown by the natural resource curse theory. Some few studies have shown a favorable effect of natural resource rents on economic growth. The anticipated effect of natural resource rents on sustainable human development in this research is negative (Zhang et al., 2023; Li et al., 2023). Conversely, financial growth is anticipated to have a beneficial impact on human development. Viewed from a financial development perspective, the adverse effect of natural resources is anticipated to transform into a positive outcome (Li and Wu, 2023; Huang and Meng, 2023). Urbanization is projected to favourably impact sustainable human development due to its association with GDP, employment, infrastructure availability, basic service supply, and decreased poverty (Khan et al., 2019; Tripathi, 2021). Research suggests that industrialization, albeit being limited in the SSA area, has a crucial part in fostering economic growth (Opoku and Yan 2018). The research anticipates that industrialization will have a beneficial impact on sustainable human growth. Globalization may accelerate human growth by increasing the revenue generated from natural resources (Sinha and Sengupta, 2019; Noumba and Gilbert 2022).

4. RESULTS AND DISCUSSION

Table 1 displays the comparative descriptive statistics of the variables for both the whole sample and the four sub-regions. The average sustainable development index (SDI) for the whole sample is 0.5501. Gabon had the highest SDI at 0.748 in 2019, while Niger had the lowest at 0.316 in 2005. Similarly, the average SDI varies from 0.316 in West Africa to 0.792 in West Africa across several regional classifications. The average total natural resource rents (TNRR) are greatest in Congo, Rep. in Central Africa at 53.315 and lowest in Mauritius in East Africa at 0.002, indicating the varying levels of natural resource rents in these areas. Mauritius has the highest average globalization value of 69.843, followed by South Africa at 68.2139. Central Africa has the greatest average industrial value added (% of GDP) at 56.3997, while West Africa has the lowest at 9.3916. The average urban population in East Africa is 11.2619%, the lowest among regions, while West Africa has the highest at 86.4297%. Gabon has the biggest proportion of urban population in West Africa, with percentages of 89.741%, 89.37%, 88.976%, 88.559%, and 88.118% for the years 2019, 2018, 2017, 2016, and 2015 respectively. South Africa had the greatest average score of 0.593 on the financial development index in 2019, whilst Central Africa had the lowest average value of 0.026 in 2006.

The correlation matrix in Table 2 indicates that financial development, globalization, industrialization, and urbanization are positively and significantly correlated with sustainable human development (SDI). However, total natural resource rents (TOTRENTS) do not exhibit statistical significance, despite having a positive correlation coefficient. An adverse relationship exists between individual natural resource rents and sustainable human growth. The correlation coefficients indicated the degree of the linear relationship between the variables under examination. Increased correlation among the explanatory variables may result in multicollinearity, thus undermining the validity of regression analysis results. Shrestha (2020) said that a Pearson correlation coefficient absolute value of 0.8 indicates probable multicollinearity. The model is considered good when the coefficients are below 0.8.

According to Table 2, the correlation coefficients were <0.80. The correlation coefficients between some financial development variables, such as wide money and domestic credit, showed high relationships, while the rest of the correlations were within the typical range of 0.80 or below.

Table 3 summarises the unit root tests, cross-sectionally augmented ADF (CADF test) devised by Pesaran (2007). Traditional unit root tests are susceptible to cross-sectional dependency and heterogeneity across panel series. Second-generation unit root tests are more effective in addressing these econometric challenges. Variables achieved stationarity after the first differencing. Stationarity in the variables allows for the estimate of the cointegration test.

The cointegration test by Pedroni (1999) the other initial models of cointegration lack the ability to effectively deal with econometric challenges such heteroscedasticity and cross-sectional dependency, which might cause systemic disturbances in the panel components. The Westerlund's (2007) cointegration test was employed by this study to examine the long-run association between the variables (Wang et al., 2021). The second-generation cointegration test addresses cross-sectional and heterogeneity concerns (Mohanty

Table 1: Descriptive analysis results (full sample versus sub-regional analysis)

Variables	N	Mean	SD	Min	Max	Skew.	Kurt.
SDI	600	52.527	8.782	31.6	74.8	0.191	2.511
TOTRENT	600	11.377	10.298	0.002	53.315	1.611	5.565
OIL	600	3.433	9.307	0	52.101	3.192	12.639
MIN	600	1.502	3.197	0	24.834	3.57	19.599
FOREST	600	5.598	5.416	0.001	32.658	1.746	6.609
GAS	585	0.108	0.369	0	3.04	5.113	31.496
FDI	600	14.989	11.273	2.644	59.252	2.076	6.87
DCPS	561	21.425	23.474	0.003	142.422	3.071	13.007
BM	586	31.256	19.74	4.53	117.548	1.919	6.647
INDUST	594	25.480	11.579	4.429	66.179	1.218	4.5895
GLOB	600	48.981	7.625	29.279	72.047	0.634	3.786
URBAN	600	40.898	17.105	9.375	89.741	0.3283	2.6993

SDI: Sustainable human development, TOTRENTS: Total natural resource rents, INDUST: Industrialization, URBAN: Urbanization, GLOB: Globalization, DCPS: Domestic credit by private sector, FD: Financial development index, BM: Broad money

Table 2: Correlation analysis coefficients

Variables	(1)	(2)	(3)	(4)	(5)	(6)
1) LSDI	1.000					
2) LTOTRENT	−0.1317	1.000				
	(0.001)					
3) LFD	0.4275	−0.5461	1.000			
	(0.000)	(0.000)				
4) LINDUST	0.1745	0.1926	0.0242	1.000		
	(0.000)	(0.000)	(0.555)			
5) LURBAN	0.4892	−0.0870	0.2527	0.2221	1.000	
	(0.000)	(0.033)	(0.000)	(0.000)		
6) LGLOB	0.5959	−0.5208	0.7147	0.1056	0.4434	1.000
	(0.000)	(0.000)	(0.000)	(0.010)	(0.000)	

The P values which indicate the level of significance are the figures in parenthesis

Table 3: The outcomes of panel unit root tests

Variables	CD test	IPS test		CADF test	
		Level	1st difference	Level	1st difference
Sdi	82.00***	−1.9309**	−7.4302***	−1.648**	−2.533***
Fd	31.55***	−1.8971**	−9.8907***	−2.805***	−6.160***
Totrents	24.58***	−0.5950	−9.6119***	−1.238	−4.417***
Indust	3.97***	−4.5812***	−9.8024***	1.437	−5.605***
Glob	81.50***	−2.8472***	−9.3352***	−4.372***	−5.202***
Urban	93.59***	12.203	4.6210	5.934	6.297

The notations ***, **, and * denote degrees of significance that are 1%, 5%, and 10%, respectively

Table 4: Kao, Pedroni and Westerlund co-integration tests

Kao cointegration test		Pedroni cointegration test		Westerlund cointegration test	
Statistic	P-value	Statistic	P-value	Statistic	P-value
3.5719	0.005	−8.1046	0.000	7.3166	0.000
3.2646	0.000	6.909	0.000		
3.0930	0.000	−3.6640	0.000		
1.7121	0.020	−3.9459	0.000		
1.0563	0.000				

The notations ***, **, and * denote degrees of significance that are, respectively, 1%, 5%, and 10%

and Sethi, 2022).

The cointegration test results are shown in Table 4. All three tests (Kao, Pedroni, and Westerlund) yielded statistically significant findings. According to Table 4, a significance level of 1% rejects the null hypothesis, signifying long-term cointegration among the variables. During the robustness test, Pedroni and Kao cointegration tests indicated that the model variables are linked in the analysis.

Net effects are calculated to evaluate the comprehensive impact of financial advancement on natural resource earnings and sustainable human development. Marginal effects refer to the estimated coefficients of the interaction between natural resource rent and financial development. Table 5's second column displays a net effect of 0.01956 resulting from the impact of financial development on natural resource rents sustainable development nexus. The average value of financial development is 0.148917. Natural resource rents have a direct effect of −0.0247 and an interaction effect of 0.0345.

Table 5 facilitates the creation of the connections shown below. Where the impacts are the same (third through fifth columns), the overall impact of financial development aligns with the outcome of the second column in the regression analysis. Financial development and natural resource rents combine to enhance sustainable human development.

If financial development exceeds 9.6% in Azerbaijan and 15.5% in Kazakhstan, then the same amount of oil rents might lead to greater non-oil growth (Hasanov et al., 2023). The research conducted by Moradbeigi and Law (2017); Li et al. (2021); Liu et al. (2022) are consistent with the results of the present research Moreover, the significant control variables of industrialization, urbanization, and globalization show the expected symptoms.

As shown in table 6, we want to do a heterogeneity study to see whether the impacts revealed in our previous results for the whole sample are also applicable to the SSA sub-regions. We analyzed how financial development and resource rents affect sustainable human development in 40 SSA states. Studying the whole sample of SSA countries with lower human development index scores may not provide a thorough portrayal, making this attempt important. Countries in Sub-Saharan Africa prioritize sustainable human well-being due to North Africa being the most developed sub-region on the African continent.

Table 6 displays the findings of the composite financial development index regression analysis for the whole sub-sample. This research shows a statistically significant correlation between FD and SHD, with FD leading to a 0.495%, 0.649%, and 0.218% rise in SHD in Central Africa (CA), South Africa (SA), and West Africa (WA) sub-regions, respectively.

The results illustrate that financial development enhances sustainable human development in SSA sub-regions. These findings are in line with Ha et al. (2022), Asongu and Nting (2022). This link demonstrates a clear connection between FD and sustainable human growth. The positive correlation between FD and SHD indicates the potential for FD to drive economic advancement in selected countries by facilitating capital mobilization, reducing information asymmetry, and encouraging optimal resource allocation. The FD coefficient in East Africa (EA) is −0.196, however it is not statistically significant. This is in line with Ababio et al. (2021), who discovered that low financial inclusion causes low human development in frontier market countries.

Applying the "natural resource curse" theory suggests that natural resource revenues may impede sustainable human development in East Africa, South Africa, and West Africa with coefficients of −0.0984, −0.0545, and −0.00431 correspondingly. The coefficient of natural resource rents for Central Africa is 0.0384, showing a favourable linkage, despite being statistically insignificant. This research offers more proof of the presence of the resource curse phenomenon. Conversely, the interaction term is positively associated with EA, SA, and WA, indicating that financial development mitigates the resource curse in SSA sub-regions.

This study has comparably similar results as Erdoğan et al. (2020). The discovery was made that the economic benefits of exporting natural resources are contingent upon the expansion of the banking system. However, they also propose that effectively investing oil

Table 5: Baseline regression analysis results

Variables	(Pooled OLS)	(Pooled OLS)	(FE)	(Driscol-Kraay)	(GMM)
	lsdi	lsdi	Lsdi	lsdi	Lsdi
L.lsdi					0.893***
					(0.0119)
lfd	0.340***	0.0127	−0.0677*	0.0127	−0.0417***
	(0.0250)	(0.0412)	(0.0356)	(0.0273)	(0.00834)
ltotrent	0.0179***	−0.0247	−0.0560***	−0.0247	−0.0203***
	(0.00618)	(0.0191)	(0.0128)	(0.0192)	(0.00359)
lindust		0.0167	0.0186**	0.0167**	0.00699***
		(0.0116)	(0.00941)	(0.00761)	(0.00174)
lurban		0.0948***	0.431***	0.0948***	−0.0402***
		(0.0143)	(0.0341)	(0.00599)	(0.00559)
lglob		0.536***	0.565***	0.536***	0.0909***
		(0.0627)	(0.0385)	(0.0469)	(0.0175)
ltotrent_lfd		0.0345**	0.0491***	0.0345**	0.0149***
		(0.0138)	(0.00917)	(0.0153)	(0.00261)
Constant	3.543***	1.442***	0.232*	1.442***	0.258***
	(0.0342)	(0.203)	(0.123)	(0.182)	(0.0413)
Observations	600	594	594	594	556
R-squared	0.208	0.453	0.712	0.453	
Number of c_id			40		40
AR1 test P value					0.0522
AR2 test P value					0.5006
Sargan test P value					0.3309

Robust standard errors in parentheses; *** P<0.01, **P<0.05, *P<0.1

Table 6: Pooled OLS results of the sub-regional analysis

Variables	Central Africa	East Africa	South Africa	West Africa
	lsdi	Lsdi	Lsdi	lsdi
ltotrent	0.0384	−0.0984**	−0.0545	−0.000431
	(0.0479)	(0.0338)	(0.0902)	(0.0406)
lfd	0.495**	−0.196***	0.649***	0.218**
	(0.175)	(0.0367)	(0.101)	(0.0864)
lindust	−0.0224	0.184***	−0.256***	0.0458***
	(0.0228)	(0.0448)	(0.0801)	(0.00905)
lurban	0.210***	−0.170***	−0.505***	0.332***
	(0.0224)	(0.0166)	(0.0516)	(0.0153)
lglob	0.611***	0.845***	0.499**	0.186**
	(0.0482)	(0.117)	(0.192)	(0.0682)
ltotrent_lfd	−0.0715	0.0617**	0.0607	0.0243
	(0.0429)	(0.0214)	(0.0600)	(0.0349)
Constant	0.541***	0.931**	3.786***	1.547***
	(0.162)	(0.344)	(0.892)	(0.308)
Observations	101	178	75	240
R-squared	0.926	0.601	0.873	0.880
Number of groups	7	12	5	16

export profits requires a complex financial framework. Additional findings demonstrate the impact of the control variables: globalization, urbanization, and industrialization.

In Table 7, the results of the dynamic panel threshold model estimate are presented, highlighting key variables like natural resource revenues, financial growth, and human development. The bootstrap method confirmed the model linearity by rejecting null hypothesis of no threshold with a statistical significance of <1%. Therefore, financial development connects natural resource rents with sustainable human development in SSA nations. The previous value of the dependent variable had a statistically significant beneficial impact on the present sustainable human development in the Sub-Saharan African environment (P < 0.01). The research used a dynamic panel threshold approach due to the statistical significance of the delayed value (Seo et al., 2019) instead of a static threshold estimating method (Hansen, 1999) to examine the threshold impact of financial development on the links between "natural resource rents" and "sustainable human development." (Salari et al., 2022).

Table 7 includes the different threshold values for financial development indicators. The financial development index (FDI) criterion was calculated to be 10.25 (101.011). Out of the total, 17 nations (42.5%) were below this barrier, while 23 countries (57.5%) were above it. The coefficient of the key explanatory variable, total natural resource rents, varied between −0.0372 and 0.0429, suggesting that the influence of "natural resource rents" on

Table 7: Dynamic panel threshold results

Variables	(Financial development index)	(Domestic credit)	(Broad money)
	Lsdi	Lsdi	lsdi
Lag_y_b	0.764***	0.807***	0.848***
	(0.0887)	(0.0493)	(0.0998)
ltotrent_b	−0.0122*	−0.0126***	−0.00843
	(0.00660)	(0.00353)	(0.00607)
lindust_b	0.0258***	0.0136***	0.0111
	(0.00428)	(0.00236)	(0.0176)
lurban_b	0.154***	0.0591***	−0.200***
	(0.0374)	(0.0209)	(0.0625)
lglob_b	0.162***	0.164**	0.250
	(0.0479)	(0.0786)	(0.189)
cons_d	1.528***	0.716**	−1.778***
	(0.321)	(0.335)	(0.596)
Lag_y_d	−0.211***	−0.0144	−0.0898
	(0.0815)	(0.0649)	(0.127)
ltotrent_d	0.0185***	0.0154***	0.0122*
	(0.00694)	(0.00378)	(0.00698)
lindust_d	−0.0226***	−0.0266**	0.0548
	(0.00816)	(0.0122)	(0.0334)
lurban_d	0.0405*	−0.00340	−0.0990**
	(0.0208)	(0.0151)	(0.0474)
lglob_d	−0.211***	−0.156*	0.594***
	(0.0663)	(0.0803)	(0.109)
kink_slope	0.121***	0.198***	0.0665***
	(0.0382)	(0.0248)	(0.0129)
Slope linearity (P-value)	0.000	0.000	0.000
r	1.011***	1.075***	1.512***
	(0.0705)	(0.231)	(0.156)
Observations	38	36	35

The notations ***, **, and *denote degrees of significance that are, respectively, 1%, 5%, and 10

sustainable human development differs between less financially developed sectors and more financially developed sectors. The natural resource rents coefficient significantly impacts sustainable human growth in less financially developed nations, leading to a resource curse in the lower regime. In wealthier countries, the detrimental impact was reversed when there was a clear abundance of natural resources.

Furthermore, the projected threshold values for other financial development metrics were largely same. Table 7 showed that the coefficients for natural resource rents were mostly negative and statistically significant for the lower regimes, but positive and statistically significant for the higher regime in all other regressions. Our results were corroborated by several other research, particularly how financial development impacts economic development indices. For example, Abeka et al. (2021) found that financial development boosts economic growth. Moreover, Adabor and Buabeng (2021) highlighted the significance of innovative, enduring, and comprehensive financial institutions capable of equitably distributing the advantages of development. Financial development is crucial for nations to effectively use their natural resources for economic growth, particularly in developing human capital. However, (Adabor and Buabeng, 2021) added that poor institutional quality could limit the financial contribution of oil rents.

The research provides empirical support for the "natural resource curse hypothesis" (NRCH) by demonstrating the nonlinear connection between natural resource rents and sustainable human development in African countries. The research utilizes both individual and composite financial development variables to determine threshold levels in Africa. The research investigates whether the threshold levels identified in the literature are not abrupt changes by analyzing if there is a sudden change in the models in accordance with the recent theoretical idea that discontinuity could indicate frequent jumps rather than threshold levels (Hidalgo et al., 2019). The empirical findings of the kink model highlighted the importance of the dynamic panel threshold model as the coefficient of the kink slope was statistically significant at the 1% level. The empirical results of the kink model highlighted the importance of the dynamic panel threshold model as the coefficient of the kink slope was statistically significant at the 1% level. The upward trend in the kink model at 0.121 indicates a growth in financial development, implying that Sub-Saharan African economies who have reached the barrier are maintaining it. The study found that the link between revenue from natural resource rents and sustainable human development growth is nonlinear and depends on a certain degree of financial development. The actual outcome from the models display that kinks are present in all of them. Additionally, the previous value of sustainable human development has a statistically significant effect in all models.

Historical human development patterns have a significant impact on Sub-Saharan Africa's contemporary sustainable human development. Sub-Saharan Africa (SSA) sustainable human development strategies need to include current levels of human development. This finding validates the existing study method by confirming endogeneity issues in the connection. This study validates previous research on heterogeneity, dynamic endogeneity, and simultaneity. Previous research did not examine the threshold influence in variable connections.

Other researchers have claimed that natural resources could help build human capital (Hota and Behera, 2019; Hilmawan and Amalia, 2020; Kim et al., 2020). Contrarily, several other scholars revealed that nnatural resources could harm human capital (Aljarallah, 2020; Qian et al., 2019; Sapuan and Roly, 2020). The dynamic panel threshold model employed in this investigation resolved the contradictory findings. The impact of natural resource rents on human capital development may be influenced by factors like financial development, depending on certain threshold levels. Sinha and Sengupta (2019) found that globalization lessened the adverse impact of natural resource rents on human development in the Asia-Pacific area. Financial development is crucial as it has the potential to address the adverse correlation between natural resource rents and economic growth (Rongwei and Xiaoying, 2020). It was suggested to invest crude export earnings in financial institutions (Ogbonna et al., 2020).

Three control variables were used in this investigation, as shown in Table 7. Urbanization was shown to have a favorable and substantial impact in the lower range of financial growth, but a negative impact over the threshold. The industrialization coefficient was negative and statistically significant below the threshold and positive beyond it. The coefficient of globalization was shown to be positive when financial development was below a certain threshold and negative when it was beyond that barrier.

4.1. Robustness Check

The two-step system GMM dynamic estimator was applied in this study for robustness verification. In Tables 8 and 9, it is shown

Table 8: Results of dynamic panel data estimation, two-step system GMM model (9 dimensions of financial development)

Variables	(fd)	(fi)	(fm)	(fid)	(fia)	(fe)	(fmd)	(fma)	(fme)
	sdi1	sdi1	sdi1	sdi1	sdi1	sdi1	sdi1	sdi1	sdi1
L.sdi1	0.936***	0.931***	0.964***	0.943***	0.943***	0.956***	0.967***	0.952***	0.965***
	(0.00729)	(0.00903)	(0.00721)	(0.00603)	(0.00784)	(0.00893)	(0.00669)	(0.00664)	(0.00788)
fd1	−0.0431***								
	(0.00640)								
totrents	−0.0717***	−0.0697***	−0.00948*	−0.0527***	−0.0394***	−0.0599***	−0.0135***	−0.00927*	−0.00936*
	(0.00636)	(0.00710)	(0.00548)	(0.00519)	(0.00574)	(0.0111)	(0.00456)	(0.00494)	(0.00488)
indust	0.0358***	0.0355***	0.0245***	0.0459***	0.0336***	0.0255***	0.0371***	0.0293***	0.0256***
	(0.00436)	(0.00502)	(0.00500)	(0.00419)	(0.00514)	(0.00477)	(0.00384)	(0.00475)	(0.00514)
urban	−0.0609***	−0.0567***	−0.0639***	−0.0578***	−0.0664***	−0.0602***	−0.0718***	−0.0521***	−0.0637***
	(0.00526)	(0.00560)	(0.00387)	(0.00379)	(0.00484)	(0.00420)	(0.00415)	(0.00391)	(0.00429)
glob	0.0402***	0.0494***	0.0117	0.0299***	0.0377***	0.0190*	0.00359	0.0262***	0.0135
	(0.0104)	(0.0124)	(0.00848)	(0.00719)	(0.0109)	(0.0102)	(0.00919)	(0.00866)	(0.00902)
tot_fd	0.00381***								
	(0.000254)								
fi1		−0.0413***							
		(0.00716)							
tot_fi		0.00189***							
		(0.000198)							
fm1			0.00650						
			(0.00405)						
tot_fm			0.00124***						
			(0.000378)						
fid1				−0.0349***					
				(0.00550)					
tot_fid				0.00420***					
				(0.000447)					
fia1					−0.0161***				
					(0.00393)				
tot_fia					0.000957***				
					(0.000133)				
fie1						−0.0184***			
						(0.00396)			
tot_fie						0.00102***			
						(0.000207)			
fmd1							0.0301***		
							(0.00566)		
tot_fmd							6.68e-05		
							(0.000219)		
fma1								−0.0187***	
								(0.00354)	
tot_fma								0.00104**	
								(0.000491)	
fme1									0.00523
									(0.00466)
tot_fme									0.000767
									(0.000489)
Constant	4.519***	4.470***	3.798***	3.969***	4.078***	4.742***	3.966***	3.398***	3.720***
	(0.558)	(0.601)	(0.397)	(0.505)	(0.579)	(0.527)	(0.415)	(0.468)	(0.418)
Observations	556	556	556	556	556	556	556	556	556
Groups	40	40	40	40	40	40	40	40	40
Instruments	33	33	33	33	33	33	33	33	33
AR1 P values	0.0353	0.0346	0.0330	0.0358	0.0351	0.0320	0.0346	0.0317	0.0319
AR2 P values	0.4630	0.4609	0.3635	0.4585	0.4158	0.4535	0.3644	0.4498	0.3468
Sargan test P values	0.4066	0.4435	0.6100	0.3414	0.5994	0.6588	0.2658	0.5087	0.3468

Utilising the Blundell and Bond dynamic panel system GMM estimations, all models are estimated (Stata xtdpdsys command). Significant levels of 1%, 5%, and 10% are denoted by the symbols (***), (**), and (*), respectively

Table 9: Results of dynamic panel data estimation, two-step system GMM model (individual natural resource rents)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	sdi1	sdi1	sdi1	sdi1	sdi1	sdi1	sdi1	sdi1	sdi1	sdi1
L.sdi1	0.955***	0.955***	0.954***	0.957***	0.957***	0.936***	0.950***	0.950***	0.957***	0.945***
	(0.00795)	(0.00766)	(0.00735)	(0.00825)	(0.00716)	(0.00729)	(0.00741)	(0.00791)	(0.00822)	(0.00826)
fd1	−0.0131**	−0.017***	−0.0121**	−0.0136**	−0.022***	−0.0431***	−0.0261***	−0.019***	−0.0130**	−0.039***
	(0.00613)	(0.00573)	(0.00505)	(0.00554)	(0.00554)	(0.00640)	(0.00629)	(0.00474)	(0.00579)	(0.00611)
totrents	−0.00758					−0.0717***				
	(0.00506)					(0.00636)				
indust	0.0239***	0.0275***	0.0173***	0.0275***	0.0192***	0.0358***	0.0254***	0.0161***	0.0275***	0.0166***
	(0.00501)	(0.00428)	(0.00318)	(0.00443)	(0.00386)	(0.00436)	(0.00393)	(0.00253)	(0.00445)	(0.00350)
urban	−0.058***	−0.053***	−0.055***	−0.059***	−0.055***	−0.061***	−0.0484***	−0.051***	−0.059***	−0.053***
	(0.00353)	(0.00399)	(0.00405)	(0.00374)	(0.00425)	(0.00526)	(0.00449)	(0.00487)	(0.00381)	(0.00485)
glob	0.0215**	0.0221**	0.0291***	0.0298***	0.0242**	0.0402***	0.0285***	0.0330***	0.0292***	0.0385***
	(0.0109)	(0.0109)	(0.0102)	(0.0107)	(0.0103)	(0.0104)	(0.0105)	(0.0101)	(0.0111)	(0.0106)
oil		−0.023***					−0.0594***			
		(0.00262)					(0.00417)			
gas			0.325					−1.510**		
			(0.307)					(0.593)		
min				−0.031***					−0.0195	
				(0.0114)					(0.0159)	
forest					−0.0136**					−0.0801**
					(0.00605)					(0.0360)
tot_fd						0.00381***				
						(0.000254)				
oil_fd							0.00436***			
							(0.000508)			
gas_fd								0.135**		
								(0.0526)		
min_fd									−0.00106	
									(0.000820)	
forest_fd										0.00695**
										(0.00318)
Constant	3.849***	3.601***	3.443***	3.321***	3.763***	4.519***	3.498***	3.406***	3.345***	3.935***
	(0.501)	(0.484)	(0.434)	(0.490)	(0.483)	(0.558)	(0.431)	(0.419)	(0.501)	(0.421)
Observations	556	556	542	556	556	556	556	542	556	556
Groups	40	40	40	40	40	40	40	40	40	40
Instruments	33	33	33	33	33	33	33	33	33	33
AR1 P value	0.0323	0.0341	0.0330	0.0324	0.0327	0.0353	0.0327	0.0317	0.0323	0.0328
AR2 P value	0.4142	0.4649	0.3454	0.3544	0.4280	0.4630	0.4353	0.3230	0.3382	0.4150
Sargan test P value	0.7165	0.4865	0.2766	0.5303	0.5675	0.4630	0.5354	0.4036	0.5326	0.6212

The notations ***, **, and * denote degrees of significance that are, respectively, 1%, 5%, and 10%

that the expected outcome for the effect of financial development on natural resource rents – human development. The sensitivity of the results was examined by looking at the disaggregated resource rents. We also analyzed several financial development indices. Before analyzing, it is crucial to evaluate the accuracy and consistency of the estimates. The Sargan test indicates that the instruments used meet the exogeneity assumption required for accurate estimations in the models. These tests do not measure instrument validity. The analytical findings confirmed the reliability of the instrumental variables, reinforcing the notion that there is no relationship between the model's instruments and the error term. The Arelano Bond test confirmed the accuracy of the GMM estimates by showing there is no serial correlation in the model according to the AR (2) findings. The F-statistic is a diagnostic tool that verifies the stability and consistency of the model estimations.

This research examined the "resource curse" in terms of human development using the sustainable development index (SDI) as a measure. The study found that the nine financial development indicators had negative effects on human development. Enhancements in finance may counteract the negative effects of natural resource rents, known as the "resource curse." Natural resources impede human development in the presence of low financial development but facilitate it when financial development is high. In Table 8, the study posits 9 measures of financial development, building upon prior study results. The researchers utilised these indicators in the present investigation to further ascertain the accuracy and reliability of the measurement of financial development.

The outcomes of the dynamic Generalized Method of Moments (GMM) model are shown in columns 1-9 of Table 8. The projected threshold values for other financial development indicators were largely same. Table 8 showed that the majority of the coefficients for "natural resource rents" (columns 1-9) were negative with statistical significance in all other regressions. The findings were corroborated by several other research, particularly on the effect of financial development on economic development indices. For example, Abeka et al. (2021) discovered that economic growth is boosted by financial development. Moreover, (Adabor and Buabeng, 2021) Highlighted the significance of innovative, enduring, and comprehensive financial institutions capable of distributing the advantages of progress equitably. Financial development is crucial for countries to effectively use their natural resources for economic growth, particularly in terms of human development. However, (Adabor and Buabeng, 2021) added that poor institutional quality could limit the financial contribution of oil rents.

5. CONCLUSION

The research used financial development threshold effects to assess the impact of natural resource rents on sustainable human development. A unique dynamic panel threshold approach was used in 40 SSA countries from 2005 to 2019. It was found that if financial development indicators fall below a certain threshold estimate, natural resource earnings are not used to improve human development in Sub-Saharan African nations with an inadequate financial system. Natural resource rents may enhance human development if financial development indicators above the estimated threshold. Therefore, SSA nations with robust financial systems may use their natural resource abundance for their benefit.

According to the two-step system GMM technique, SSA nations are affected by a resource curse. The interaction term between financial development and natural resource rents had a favorable impact. Financial development might potentially counteract the negative effects of the resource curse. The findings also revealed an SSA RCH. The financial development indicators transformed the resource curse into a gift. Below a particular threshold of financial development, natural resource rents might hinder the growth of human capital, whereas over that threshold, the opposite is true. The research used other indicators of financial progress to verify the findings, which were consistent both below and beyond the threshold estimate.

This report proposes policy recommendations for optimizing the use of natural resource rents and promoting investment in human capital based on the latest research results. The following recommendations are:

Policymakers in Sub-Saharan African countries should prioritize enhancing their financial sectors to take full use of their natural resource wealth. Higher institutional quality is necessary for financial growth; hence it was suggested that the leaders of these countries prioritize good governance and the rule of law. Furthermore, the notion of cursed natural resources is not certain, since some countries have seen benefits. These economies have successfully transformed the RCH into a benefit. Thus, low-income nations in the SSA area, which possess ample natural resources, should implement beneficial and adaptable economic policies to expand their banking sectors.

Policymakers should enhance financial markets and institutions, such as establishing strong local banking institutions, to ensure efficient use of natural resource earnings. Governments should promote the transfer, savings, and constructive investment of natural resource windfalls. An established financial system might effectively harness natural resource riches for growth.

Policymakers should implement institutional and governance adjustments to increase the government's credibility. This would help maximize the benefits of natural resource revenues on human capital development by reinvesting the profits in further developmental projects. This move might promote the adoption of macroeconomic policies by enhancing the financial sector efficiency and effectiveness. Hence, creditors and borrowers in Sub-Saharan African financial institutions should be prepared for potential dangers.

The research indicated that improving financial accessibility may assist Sub-Saharan African nations in effectively using their resources, promoting macroeconomic stability, and socioeconomic progress. Sustainable finance has the potential to appeal to global investors, raise funding for development, and establish a robust financial institution. Consistent, fair, and readily available financing might enhance prospects for livelihood and lifespan. The paper recommended doing research tailored to particular countries to avoid making broad policy generalizations.

Before ending, it is crucial to acknowledge that the research had notable deficiencies that need further examination. It is challenging to quantify sustainable human growth using only one measure. Furthermore, further empirical study might be carried out by including other social welfare indicators and control factors like technological innovation and research and development. This study suggested that future research should explore other methods in which natural resource rents might impact the growth of human capital. African nations are falling behind affluent countries in fulfilling SDG targets. Despite their abundance in natural resources, they have a poor Human Development Index (HDI). This research may be extended to examine the effect of natural resource rents on Sustainable Development Goals (SDGs).

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