

# Assessing the Moderating Effect of Natural Resource Rent on China Foreign Direct Investment on Economic Growth in Africa

Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration 2025, 33(1), 2354.  
©The Author(s) 2025. This is an open access article under the CC-BY 4.0 license.  
DOI: 10.46585/sp33012354  
editorial.upce.cz/SciPap

**Kwabena Nsiah Takyi** 

Tomas Bata University, Department of Economics, Czech Republic

**Beata Gavurova** 

Tomas Bata University, Center for Applied Economic Research, Czech Republic

**Martin Mikeska** 

Tomas Bata University, Department of Economics, Czech Republic

**Felix Buabeng-Andoh**

Tomas Bata University, Department of Finance and Accounting, Czech Republic

**Charles Randy Afful**

Tomas Bata University, Department of Business Administration, Czech Republic

## Abstract

In advancing sustainable economic growth, the affiliation between foreign direct investment and economic growth (EGR) has become increasingly prominent given the dual emphasis on attainment of sustainability development goals. The research evaluated the affiliation between China's foreign direct investment inflows (CFDI) and EGR in Africa. The research consists of 36 African regions for the period 2003-2023. The econometric model of Common Correlated Effect Mean Group, Driscoll and Kraay standard errors, and fully modified ordinary least square was employed to assess the affiliation between the variables and the direction of affiliation through the Durmitrus Hurlin causality test. The findings indicated that China's foreign investment inflow, human capital (HMC), and technological innovation (TINN) had a significant positive effect on EGR. However, trade openness (TRAD) and total natural resources rent (TNRR) had an inverse impact on EGR. Furthermore, total natural resource rents had a positive moderating influence on the affiliation between CFDI and EGR. The current research provides governments and institutions with the ability to develop policies on China's FDI inflows and natural resources to promote economic growth in Africa. By having bilateral cooperation, factors such as human capital, technological innovation, and trade openness will upsurge in the future.

## Keywords

Foreign direct investment, natural resource rent, economic growth, Africa, China

## JEL Classification

C33, F21, F23, F35, O55

## Introduction

The escalating demand for a sustainable economy has pushed nations to share resources for a common goal of development. With the desire to attain a sustainable economy, developing regions received foreign investment to boost their economy (Luo and Chen, 2024). Foreign direct investment inflow (FDI) is a significant component for the progress of the host nations in two ways. a) FDI inflow serves as an injection of capital stock into the host nation to appreciate the economic growth in different sectors (Gui-Diby, 2014; Yeboua, 2021). b) FDI inflow provides a host nation innovation in technologies and shares of human capital experts that are scarce in their industrial sectors (Alvarado et al., 2024; Meka et al., 2024). The last decade has seen an influx of Chinese FDI into the African communities in all sectors. Figure 4 and Figure 5 illustrate the inflow of Chinese enterprise resources into the various regions between the periods 2003 and 2013-2022. The Chinese capital inflow has increased from 12 billion in 2002 to 262 billion compared to the US inflow of 21 billion in 2002 to 69 billion in 2022. Though empirical investigation has shown that this Chinese inflow has become a burden to the region's economic growth (Yimer, 2022), the influence on the economy can't be undermined. The China Yearbook (2022) reported that China's foreign direct investment outflows to Africa were over 40.8 billion US dollars, in contrast to the United States' 1.33

## Corresponding author:

Kwabena Nsiah Takyi, Mostni 5139, Zlin  
Email: takyi@utb.cz

billion dollars. These inflows enhance several key industries, including construction (33.3%), mining (9.72%), manufacturing (12.4%), financial intermediation (10.7%), and technology services (11.2%). Natural resources are a significant component in the economic development of nations, particularly in African regions with abundant resources. Empirical assessment has elicited that the influx of Chinese enterprises in the African communities is due to the region's resources, including gold, oil, diamonds, forests, uranium, and platinum (Ampofo et al., 2020). China's economic engagement in Africa is marked by substantial infrastructure initiatives, resource-for-infrastructure pacts, and foreign direct investment in resource extraction (Yeboua, 2021). Ampofo et al. (2023) investigated resource-rich Sub-Saharan African countries from 1981 to 2017. The empirical findings from the NARDL technique reveal that regions like Congo had a decline in economic growth while being one of the most resource-rich nations. China-Africa relations in FDI flow are considered an exchange of resources for infrastructure development. Additionally, trade openness is considered the gateway for African growth (Nam and Ryu, 2024). The adoption of modern technologies and improved efficiency can promote economic growth, achievable by eliminating foreign exchange restrictions and expanding investment opportunities. The empirical investigation on trade openness and economic progress has highlighted the mixed outcome. Although data indicates that more commerce fosters economic growth, the exact nature of this relationship remains unclear (Abdallah, 2024). In contrast, research on the openness-growth relationship in Africa has produced inconsistent results, with some studies suggesting that different institutional and structural elements affect the nexus (Onafowora and Owoye, 2024). Likewise, in Namibia, Sunde et al. (2023) evaluated the impact of regional exports and imports on national development. The findings demonstrated that export and import do not contribute to the economic growth of Namibia.

Human capital within the African regions continues to improve to achieve their sustainable development goal. Nkemgha et al. (2022) examined SDG 9 in the African setting, focusing on human capital development, industrialisation, and financial growth from 2003 to 2019. The results from 33 nations demonstrated that infrastructure enhancement occurred when financial development and human capital were integrated into industrial processes, leading to an increase in economic growth. In a similar vein, to mitigate the degradation of ecological footprints, Wiradu et al. (2023) assessed rising regions in Africa on the affiliation between renewable energy, economic growth, and human capital. The application of the CS-ARDL economic methodology revealed a positive correlation between human capital and both renewable energy and economic growth. Finally, FDI inflow from host nations is tied with the transfer of technical knowledge and soft skills, which are scant in the African nations. China has been classified as one of the recent technology hubs for developing countries (Obeng-Odoom, 2024). These transferred technologies have helped in the development of several communities in Africa (China Yearbook, 2023; John Hopkins Report, 2024). Numerous literary analyses have demonstrated the correlation between technical innovation, foreign direct investment, and economic progress in Africa. Meka'a et al. (2024) investigated the relationship between energy poverty and foreign direct investment in Sub-Saharan Africa through green technological innovation. The empirical analysis using an econometric approach has shown that, collectively, foreign direct investment and green technological innovation mitigate energy poverty in the long term, fostering the growth of these areas. Similarly, in BRICS nations, Labidi et al. (2023) evaluated the impact of foreign direct investment on technical innovation from 2000 to 2020. The research findings indicated that foreign direct investment, commerce, and economic development significantly influenced technological innovation. Therefore, assessing the affiliation between FDI inflow, trade openness, human capital, technological innovation, natural resource rent, and economic progress is crucial for the African economy as the region targets to achieve its sustainable development goals.

### **Assessment gaps, Motivations, and Contributions**

The empirical evaluations have revealed varying outcomes regarding the relationship between foreign direct investment, natural resource rent, technological innovation, human capital, trade openness, and the economic progress of African nations. a) It is evident that previous assessments have shown mixed results regarding the relationships between the variables, leading to contradictions in the theoretical and policy implications for African regions concerning economic growth decisions. b) Limited investigations have examined the influence of foreign direct investment, natural resource rent, technological innovation, human capital, and trade openness on economic progress within the African regions. Existing investigations often isolate one or two variables instead of assessing them in an integrated model. c) This paper provides the first panel causal analysis of how natural resource rents moderate the impact of Chinese FDI on African economic growth and whether that moderation is itself conditional when controlled with technological innovation, trade openness, and human capital. No prior casual panel analyses have focused on how resource rents condition Chinese FDI's impact on economic growth in Africa. d) Despite China's significant and rising role in investment presence in Africa, its unique role in shaping African growth trajectories has not been fully addressed in literary works. Most literary works either treat FDI broadly or compare multiple sources without isolating China's influence. Therefore, the assessment closes the empirical gaps on the variables employing the Common Correlated Effect Mean Group (CCE-MG), Fully Modified Ordinary Least Square (FMOLS), Driscoll and Kraay Standard Errors (DSK), and Dumitrescu and Hurlin causality evaluation for the period 2000-2023.

The purpose of the research is to explore the effect of Chinese foreign direct investment, natural resource rent, technological innovation, human capital, and trade openness on economic progress in Africa. Also, findings from the empirical investigations have shown that the influx of Chinese foreign direct investment in Africa is because of the region's abundance in natural resources. Thus, we examined the moderating influence of natural resource rent on the affiliation between Chinese foreign direct investment and economic progress to present institutions and government policy direction on the exploration of these natural resources in Africa. These research questions guide the achievement of the objectives:

- 1) What is the affiliation between Chinese foreign direct investment and economic progress?
- 2) What factors influence the influx of Chinese foreign direct investment to Africa?
- 3) What is the moderating influence of natural resource rent on the nexus between Chinese foreign direct investment and economic progress?

The resource curse theory was employed to answer the research question on the variable's affiliation. This contradiction is especially pertinent in Africa, where resource rents may hinder development while concurrently drawing foreign direct investment. This study examines the interplay between Chinese foreign direct investment, natural resource rents, human capital, technical innovation, and trade openness, utilising the resource curse framework to ascertain whether Africa's resources serve as an impediment to progress or a catalyst for sustainable development. Figure 1 illustrates the conceptual approach to achieving the research objectives.

The current article offers the following contributions: First, it adds to the Chinese foreign direct investment literary evaluations by exploring the Chinese foreign direct investment practices' influence on economic progress perspectives. The research builds on the prior literary works on Chinese foreign direct investment through the resource curse theory by assessing the effect on economic progress. The resource curse theory provides the theoretical direction on foreign direct investment inflow to appreciate the sustainability of African regions. Second, the research offers the Chinese government, African governments, the United Nations, and enterprises that want to invest in Africa an effective policy on natural resource exploration. Third, the investigation adds to the assessment of the relationship between economic progress and human capital development within African communities. The research insight is on how to direct foreign investment in the development of human resources and appreciate their capabilities. Four, the research highlights the significance of technological innovation and trade openness in the development of sustainable economic progress in Africa. Technological innovation and trade in renewable energy, export of semi-processed goods, and decrease in trade tariffs. Finally, the research presents the unique moderating influence of natural resource rent on the affiliation between Chinese foreign direct investment and economic progress in African communities. This closes the literature gaps existing on the variables assessment.

The reminder of the assessment is as follows: section 2 presents the underpinning theory, literatures, and hypothesis with developed conceptual mode. Section 3 cover the inspection method and the econometric techniques. Section 4 revealed the outcomes from the analysis and discussions. Finally, section 5 highlights the theoretical and practical contributions with its conclusion and ends with limitation and further research directions.

## Literature Review

### ***Resource curse theory***

The research was premised on the resource curse theory, or the paradox of plenty. Which indicated that nations that are rich in natural resources seem to experience a down surge in growth compared to regions that are less endowed with natural resources (Auty, 1994). Rather than fostering prosperity, resource abundance can generate macroeconomic and institutional challenges such as overdependence on commodity export, vulnerability to global price shocks, the Dutch disease effect on competitiveness, and rent-seeking behaviours that undermine government and diversification. Consequently, resource rents may weaken investment in human capital and technological innovation, reinforcing structural dependence on extractive industries (Zajontz, 2023). The research of Sambiri et al. (2025) within sub-Saharan Africa on China financing established that natural resource rents had a weak impact on economic growth. Governments opt for Chinese financing compared to traditional loans or finances that come with strict policies on their consumption. As several Chinese finances are resources for infrastructure, normally these finances end up in unproductive sectors (Timbe et al., 2024). Two sector-specific methods that are crucial for combating the resource curse are targeted FDI acquisition and targeted industrial strategies, with a general focus on manufacturing. Strategies for economic growth might enhance the applicability of these broad recommendations for individual nations. These instruments enable governments to ascertain whether FDI and industrial policies target (sub-)industries that facilitate or impede national economic growth, hence determining their impact on the onset of the resource curse. In the context of this assessment, the resource curse theory provides a useful lens for interpreting the relationship between Chinese FDI, natural resource rent, and Africa's economic progress.

### **Foreign direct investment and economic growth**

With the pace of the increase in development of economics in Africa, the region's demand of capital injection is significant. The China-Africa bilateral affiliation is considered one that offer these regions with foreign direct investment (see Figure 5). FDI delivers cutting-edge tech and procedures, boosts digitization, and enhances industrial processes with cost-effective and efficient enterprise solutions. According to Sakyi and Egyir (2017) the regions enterprises have insufficient fundings to support their growth and investment in research into innovation products. Luo and Chen (2024) explored nations with weak environment and the decision of China outflow of FDI to these regions. The outcome from the investigation indicated that communities with low wages, resources abundance, poor patent application was the decision to invest in these regions. On favourable positive affiliation of FDI to improve economic progress in fifty Africa nations, Gui-Diby (2014) concluded in an econometric evaluation that FDI appreciate the economic growth between the period 1994-2009. Similarly, Yeboua (2021) asserts that, for FDI to appreciate the economic progress of communities in Africa, this research should be above the sixty-five per cent threshold requirement. The China yearbook (2022) established that China out flows of FDI to Africa accounted for about 40.8billion US dollar compared to that of the United States of 1.33billion dollar. These inflows help improve the various major sectors including construction (33.3%), mining (9.72%), manufacturing (12.4%), financial intermediation (10.7%), and technological services (11.2%). Employing the econometric approach of the ARDL bounds test on MENA regions dataset for the period 1990-2012, Abdallah (2024) explored the influence of FDI inflows in these communities. The empirical outcome indicated that FDI appreciate the economic progress in these communities. The article recommended good institutions and policies on foreign direct investment should be implemented to support the less developed regions. Again, Obeng-Odoom (2024) evaluated "The Economist" newspaper for the period 2019-2021 on the issue of China-Africa affiliations. The findings established that the China-Africa affiliations is a controlling on one side, Africa indebtedness, and imperial side from China. In Indonesia, Ali (2024) examined the provincial and different sectors of with the effect of FDI inflows on economic progress. The conclusion from the article analysis of thirty-three provinces indicates that FDI had no effect on agricultural production. However, mining, construction, and manufacturing had a material nexus with FDI flows in the provinces. Therefore, it of significant to indicates that FDI flow from China improve the GDP of these countries.

### **Trade openness, FDI, and economic growth**

In recent years, China's increasing influence in Africa, particularly in business and investment, has been a central concern. The capacity for developing nations' economies to gain from enhanced trade openness has been recognized for an extended period (Nam and Ryu, 2024). The implementation of advanced technology and enhanced efficiency can foster economic advancement, which can be realized by removing constraints on foreign exchange and broadening investment prospects. Several literary investigations on the studies and discussions have concentrated on the affiliation between trade openness and GDP growth in Africa. While there is evidence suggesting that more commerce contributes to economic growth, the precise nature of this relationship remains ambiguous (Abdallah (2024). Conversely, investigations into the openness-growth nexus in Africa have yielded incongruous findings, with certain studies indicating that various institutional and structural factors influence the association (Onafowora and Owoye, 2024). The African Development Report identifies trade as a powerful mechanism for disseminating the advantages of globalization both domestically and internationally. As illustrated in Figure 4, China trade with Africa amounted to 250 billion dollars in 2023 compared to that US with around the amount of 69 billion dollar. An empirical study on openness and economic progress on low and middle regions for the years ranges from 2000-2019. The findings depicted trade openness in low-income regions had favourable affiliation economic growth. Whiles in high communities the effect had an inverse association (Kumari and Singh, 2024). Likewise, Abdi et al. (2024) evaluated the influence of trade and economic growth through the nonlinear ARDL on dataset from Somalia for the years 1990-2020. The economic results indicates that Somalia decline in trade depreciate in the economic progress during those periods. Again, trade openness had a uni-directional association with economic growth in the long term. Further, in Namibia, Sunde et al (2023) assessed the region export and import to the development of the nation. The findings revealed that, these constructs had an immaterial influence on the community. Literary work has indicated that proper policy initiatives can help improve the association between trade and economic growth especially natural resource abundant (oil, gold, cocoa, and gas) in low-income regions (Ghazouani and Maktout, 2023; Namahoro et al., 2023).

### **Technological innovation, FDI, and economic growth**

With the escalation in pollution and desire to develop a sustainable green economy, the role of technological innovation has become the cornerstone of discussion recently. However, this innovation required investment, which benefited from when there was an inflow of FDI from well-endowed economies (Alvarado et al., 2024). Several literary evaluations have established the affiliation between technological innovation, FDI, and economic growth in Africa. In Sub-Saharan Africa, Meka'a et al. (2024) explored the nexus between energy poverty and FDI through green technological innovation. The empirical investigation using an econometric approach demonstrated that FDI and green technological innovation together reduce energy poverty in the long-un, leading to the development of these nations. Likewise, in BRICS communities, Ali et al. (2023) examined FDI influence on technological innovation for the period 2000-2020. The outcome of the research established that FDI, trade, and economic progress materially impacted technological innovation. By employing the pollution halo model in thirty provinces of

China, Hao et al. (2020) investigated the significant role of FDI in supporting the reduction of sulphur dioxide and appreciating the quality of the economy. China has been classified as one of the recent technology hubs for developing countries (Obeng-Odoom, 2024). These transferred technologies have helped in the development of several communities in Africa (China Yearbook, 2023; John Hopkins report, 2024). The empirical research in European communities by Nuta et al. (2024) employing the Konya model indicated long-term causality between the variables. They recommended that emerging regions in the European communities with population ageing should have a policy direction to attract FDI through technological innovation. Environmental evaluation of technological innovation and FDI has established the technical significance of nations adopting innovative technologies. As expounded in the research work of Abid et al. (2022) on G8 carbon emissions for the period 1990-2019. The results from the FMOLS estimator affirmed that FDI and technological innovation depreciate the emission levels of these regions in the long term. As nations can't do away with economic progress, the development of an innovative approach to economic development and the utilisation of resources are material in policy development. With the pace in the development of African nations, the FDI and technological flow could be an absorber for their economies and reduce negative environmental externalities such as water and air pollution.

### ***Human capital development and economic growth***

How well a nation invests in its human capital capabilities is a key factor in economic development. Literary work has established a community with a high level of years of schooling, educational enrolment, and training and development of both hard and soft skills (Githaiga and Githaiga, 2023). As agreed by the nation on the attainment of quality education (SDG4, 2015), Bakele et al. (2024) examined the regions of 30 Sub-Saharan African nations. With the robustness of the ARDL econometric estimator, the findings exhibited that human capital inversely impedes the appreciation of the economic growth of these regions. Rajab and Zouheir (2023) explored African underdeveloped communities for the period 2000-2019 on the mediating influence of human capital on the affiliation between FDI and growth in the economy. Employing the GMM, the empirical evaluation established human capital had an inverse mediating effect on the nexus between FDI and economic growth among the fifteen investigated regions. Utilising the ARDL model, Almutairi (2023) assessed the impact of human capital of countries rich in oil on economic growth. The outcome indicated that human capital measured through years of schooling had an inverse immaterial affiliation with economic growth. However, oil wealth appreciates the region's economic development with an interaction influence on human capital still being negative. In the context of Africa, Nkemgha et al. (2022) inspected SDG 9 through human capital development, industrialisation, and financial development between the periods 2003 and 2019. The findings from 33 regions indicated that infrastructure improved in these regions when financial development and human capital were considered in the industrialisation processes, which led to appreciation in economic growth. Similarly, to reduce the dilapidation of ecological footprint, Wiradu et al. (2023) evaluated emerging regions in Africa on the relationship between renewable energy, economic growth, and human capital. Employing the economic technique of CS-ARDL, the estimation indicated that human capital had a favourable link with renewable and economic growth.

### ***Natural resources rent moderating nexus on FDI and ECP***

The last decades have shown pace in the investigation on the affiliation between natural resource and economic progress (Ben-Salha et al., 2021). Revenues from natural resources significantly influence economic performance, potentially yielding divergent outcomes. Shahbaz et al. (2024) assert that they possess the capacity to generate essential capital for developmental projects. The "resource curse" denotes the peril that nations may develop excessive reliance on extractive sectors, rendering them susceptible to price volatility. China's economic involvement in Africa is characterised by extensive infrastructure projects, resource-for-infrastructure agreements, and foreign direct investment in resource extraction (Yeboua, 2021). Advocates and opponents of this plan have highlighted its deficiencies in addressing Africa's infrastructural challenges and its propensity to increase dependence on natural resources. Ampofo et al. (2023) explored Sub-Saharan African nations rich in resources between the period 1981-2017. The empirical results from the NARDL approach indicates that regions such as Congo had a deteriorated economics growth those the region is among the most resource endowed nation. On a sample of seventy-nine economics, Okolo et al. (2023) adopted the Driscoll-Kraay and Fixed effect econometric model on the investigation of the affiliation between human capital, technological innovation, and natural resource rent. The findings depicted that natural resource communities had an increase in trademark and patent application. These comes in as a form of investment flow to cushion the economics of these nations' development. In the context of Europe, Simionescu et al. (2024) examined the sustainability of natural resource and electronic governance. The results from the investigation illustrated that resource rent impact negatively on economic growth, however, coal exploration had an increase in the financial development of these regions. Saudi Arabia one of the oil resource rent communities was investigated in the period 171-2016 (Agboola et al., 2021). The findings had a favourable material association with carbon emissions. With a 1% appreciation economic progress leads to ninety-five and sixty-two per cent rise in emission levels from the utilization of natural resources in short and long run respectively. China-Africa relation in FDI flow is considered an exchange of resources for infrastructure development. As depicted in Figure 1, China's commerce with Africa reached 250 billion dollars in 2023, whilst trade with the United States was approximately 69 billion dollars. Yimer (2023) evaluation in African regions indicated that communities in transition and with poor institutions had a negative effect with the inflow of FDI on

their economics.

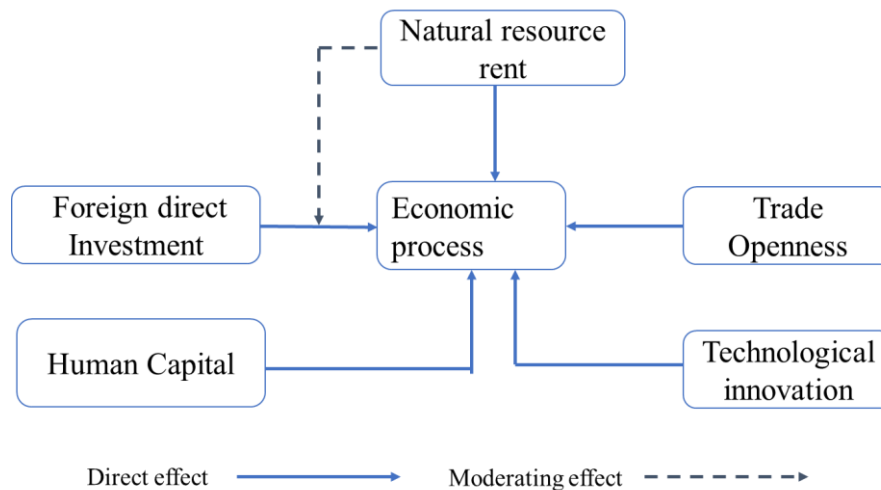


Fig. 1. Theoretical model.

## Methods

### Data and variables strategy

The article was focus on African regions economic growth and China FDI inflows. The research covers a period of 2003-2023 on 36 African nations. The exclusion was as results of these nations had not received FDI from China for the research period. Also, some nations were having data gaps which was removed to provide a comprehensive policy for governments on the inflow of China FDI to the region. The variable under investigation is presented in Table 1, providing the measurements and references for the research. Empirical literary works have shown that other factors elucidate the affiliation between economic growth and FDI inflow. For instance, the research work of Wiredu et al. (2023) revealed that human capital plays a significant role in economic development through FDI inflow into Africa. Similarly, Rajab and Zouheir (2023) explored African underdeveloped communities for the period 2000 -2019 on the mediating influence of human capital on the affiliation between FDI and growth in the economy. Employing the GMM, the empirical evaluation established human capital had an inverse mediating effect on the nexus between FDI and economic growth among the fifteen investigated regions. Furthermore, technological innovation which come in the form of research and development, innovation transfer and share of technical knowledge among nations (Alvarado et al., 2024; Meka'a et al., 2023). Additionally, trade openness has approving in literary works to appreciate economic growth of developing nations (Abdalla, 2024; Onafowora and Owoye, 2024). Finally, natural resources rent, and economic growth have been explored in the empirical literature due to the African region's abundance in rich natural resources (Ben-Salha et al.,2021; Agboola et al., 2021). We assessed the moderating effect of natural resources rent on China FDI inflow and economic growth.

### Econometric Assessment

We developed the mathematical function from the resource curse model on the examination of the variables of economic growth, China FDI inflow, technological innovation, human capital, trade openness, and natural resources rent. The preliminary model was created as

$$EGR = f(CFDI, HMC, TRAD, TINN, TNRR) \quad (1)$$

The variables were converted into its logarithm form for variable uniformity.

$$EGR_{it} = \gamma_0 + \gamma_1 \ln CFDI_{it} + \gamma_2 \ln HMC_{it} + \gamma_3 \ln TRAD_{it} + \gamma_4 \ln TIN_{it} + \gamma_5 \ln TNRR_{it} + \varepsilon_{it} \quad (2)$$

The equation slope is  $\gamma_0$ , with the white noise  $\varepsilon_{it}$ , the coefficients are  $\gamma_1 - \gamma_5$ ,  $i$  illustrates the African nations and  $t$  is the period of the investigation 2003-2023.  $\ln$  is the log transformation for the regression model. The variables under assessment are EGR - economic growth, CFDI – China foreign direct investment inflow, HMC – human capital, TRAD – trade openness, TINN – technological innovation, TNRR – total natural resource rent.

We model the moderating effect of total natural resource rent on the affiliation between economic growth and China FDI inflow. Equation 3 depicted the econometric technique of moderation influence.

$$EGR_{(i,t)} = \gamma_0 + \gamma_1 \ln CFDI_{(i,t)} + \gamma_2 \ln HMC_{(i,t)} + \gamma_3 \ln TRAD_{(i,t)} + \gamma_4 \ln TINN_{(i,t)} + \gamma_5 \ln TNRR_{(i,t)} + \gamma_6 (\ln TNRR_{(i,t)} * \ln CFDI_{(i,t)}) + \varepsilon_{(i,t)} \quad (3)$$

Where  $\gamma_6 (\ln TNRR_{(i,t)} * \ln CFDI_{(i,t)})$  produced the moderating function of the research model.

**Table 1.** Variables of assessment.

Series	Abbrev.	Measurement	Database	Reference
Economic growth	EGR	GDP (annual %)	WDI	(Olorogun, 2024; Nuta et al., 2024)
China Foreign direct investment inflow	CFDI	Foreign direct investment stock (US\$ billion)	China yearbook	
Technological innovation	TINN	Research and development expenditure (% of GDP)	WDI	Alvarado et al., 2024
Trade openness	TRAD	Total sum of imports and exports divided by GDP per capita	WDI	Labidi et al. (2023); Rajab and Zouheir (2023)
Human capital	HMC	Measures the aggregation of education, health and better living standards of people (Index)	UNDP	Wiredu et al., 2023;
Natural resources rent	TNRR	Total natural resources as a % of GDP	WDI	(Ben-Salha et al., 2021; Ampofo et al., 2023)

Note: Algeria, Benin, Botswana, Burundi, Cabo Verde, Cameroon, Chad, Cote d'Ivoire, Egypt, Congo, Rep, Equatorial Guinea, Ethiopia, Ghana, Guinea, Kenya, Libya, Lesotho, Madagascar, Mali, Mauritania, Mozambique, Morocco, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Seychelles, Sudan, Tanzania, Togo, Tunisia, Uganda, Zimbabwe, Zambia.

### Cross-section dependence Assessment

In the article inspection, we first evaluated the issues of cross-sectional dependence assessment which is a material significance when dealing with panel data curation assessment. Empirical literary evaluations have recommended three robustness checks such as the Breusch–Pagan LM, Pesaran- CSDa, and Pesaran scale LM (Takyi et al., 2024; Sampene et al., 2024). The Pesaran (2007) CSDA is presented in the equation 4. Table 3 exhibited the outcome of the Pesaran cross-sectional dependence findings with a favourable p-value of <0.01, indicating that the data had a CSD issue; the null model of no CSDA is rejected, and the alternative is acceptable. The results affirm that an economic recession in one African region may affect the other regions.

$$CSDA = \sqrt{\frac{2p}{s(s-1)}} \sum_{i=0}^{s-1} \sum_{j=i+1}^s \sigma_{ij}^t \quad (4)$$

### Panel Unit Root Evaluation

In the evaluation of panel data, it is crucial to consider the stationarity of the data to reduce inaccurate model selection and estimation errors. Literary works (Wiredu et al., 2023; Takyi et al., 2025) has indicated that the normal logarithm examination of construct will produce error outcome when the variables are not stationary first. As result, we employed the second-generation unit root test developed by (Pesaran, 2007) CIPS and CADF which accounts for CSDa in panel data evaluation. The mathematical equation of illustrated as

$$CADF = \gamma x_{it} = \alpha_{it} + \beta_{it-1} + \delta_i T + \sum_{j=1}^N \gamma_{ij} \gamma x_{it-j} + \varepsilon_{it} \quad (5)$$

Here  $\gamma$  represents the disparities among the indicators,  $x_{it}$  captures the variables assessed in this research.

$$CIPS = \frac{1}{N} \sum_{i=1}^N \varphi_i (N, T) \quad (6)$$

Here N denote the research period, and T captures the cross-sections among the indicators.

### Panel Cointegration Assessment

The test of cointegration in panel data is significant as series across regions share common economic metrics. Avoiding cointegration in panel data evaluations would lead to bias long term policy implementation. Therefore, this research employed the Westerlund (2007) sturdiness cointegration estimator to analyse the long-term affiliation between FDI inflow, huma capital, trade openness, technological innovation, and natural resource rent on economic growth in Africa. We utilized four econometric equations to assess the affiliation of the cointegration as outlined in Equ 7a-8b.

$$G_t = \frac{1}{N} \sum_{i=1}^N \frac{\eta_i}{S.E(\hat{\eta}_i)} \quad (7a)$$

$$G_a = \frac{1}{N} \sum_{i=1}^N \frac{T\eta_i}{1 - \sum_{j=1}^k \widehat{\eta}_{ij}} \quad (7b)$$

$$P_\tau = \frac{\widehat{\eta}_i}{S.E(\widehat{\eta}_i)} \quad (8a)$$

$$P_a = T\eta_i \quad (8b)$$

Here the mean for the group statistics is depicted by  $t(G_t - G_a)$  and the co-integration is denoted by  $(P_t - P_a)$ .

### Model Assessment

To establish the affiliation between the CFDI, HMC, TINN, TRAD, TNRR on EGR the econometric technique of Common Correlated Effect Mean Group (CCE-MG) was employed. The model can handle the crucial issues of cross-sectional dependence and heterogeneity in panel data assessment. Empirical evaluation has indicated that the CCEMG is sturdiness over other traditional estimators like the AMG which accounts for the variables effect on marginal units and not cross-sectional dependence. Also, dynamic ordinary least square is considered to estimate long run affiliation between variables in panel data. However, it cannot handle heterogeneity materially compared to CCEMG approach. Therefore, the CCEMG was employed to estimate the econometric model as it seen as more sturdiness and general-purpose technique when cross-sectional dependence and heterogeneity are exhibited, outperforming the other traditional modes like DOLS and AMG. The mathematical function is presented as follows

$$Y_{it} = \alpha_{1i} + \beta_i X_{it} + \theta_i n_{it} + \mu_{it} \quad (9)$$

Such that  $Y_{it}$  and  $X_{it}$  are showed as observed variables,  $\alpha_{1i}$  specify the definite group effect,  $\beta_i$  denotes the steep of cross-sectional estimators,  $n_i$  illustrates the unidentified common component that loads with  $\theta_i$  heterogenous and  $\mu_{it}$  depicts the model's probabilistic error term. Equation (10) represents the enhanced model with a mean cross-section of the described and unknown parameters:

$$Y_{it} = \alpha_{1i} + \beta_i Z_{it} + \varphi_i \bar{y}_{it} + \bar{z}_{it} + \theta_i n_{it} + \mu_{it} \quad (10)$$

For each cross-section, this regression was computed using the ordinary least squares approach. The equation (11) provides a rigorous solution for estimating the country-wise co-efficient used by linear models:

$$CCEMG = N^{-1} \sum_{i=1}^N \widehat{\theta}_i \quad (11)$$

### Sturdiness Evaluation

In this evaluation we employed that fully modified ordinary least square (FMOLS) and the Driscoll and Kraay (DSK) as the sturdiness test for the CCEMG assessment. The FMOLS and DSK are significant for econometric estimation because it presents a more nuanced and robust approach to understanding the affiliation between CFDI, HMC, TRAD, TNRR, TINN on EGR, as the panel data may have issues of outliers, heteroskedasticity, or non-normal distribution in data. While the traditional OLS focus on assessing the conditional mean of the dependent construct, FMOLS and DSK provide a more comprehensive view of data distribution. The estimation outcome will validate the initial findings in order to present a significant policy suggestions for government and enterprises.

### Causality Estimation

In recent years, the advent of sophisticated econometric assessment techniques, such as the Dumitrescu and Hurlin (2012) method, has broadened the approach to panel data estimation. The model proposes a robust evaluation for variables exhibiting cross-sectional dependence and collinearity concerns. The Dumitrescu and Hurlin (2012) model eliminate the affiliation bias issues associated with conventional regression analysis. Rather, it presents the concepts through bidirectional and unidirectional causality evaluations. Table 1 exhibited the variables, measurement, and reference adopted. The model provides a more nuanced understanding of individual unit behaviour while also elucidating broader trends and patterns that may exist at the aggregate level. Equation 12 delineates the model:

$$Y_{it} = \alpha_i + \sum_{m=1}^M \vartheta_i^m Y_{i(m-t)} + \sum_{m=1}^M \lambda_i^m Z_{i(m-t)} \quad (12)$$

## Empirical evaluation

### Descriptive statistics

The descriptive analysis is presented in Table 2. The findings revealed that the African regions has a mean Coeff value of EGR (4.148), CFDI (591.073), HMC (12.602), TINN (1.07E+08), TRAD (71.381), and TNRR (11.994). The standard deviation of all the variables were high depicting that the data is not normally distributed. With EGR (6.536) having the lowest and TINN (84.249) with the highest standard deviation. Also, the J-Bera had a significant value with less than 1% probability depicting that the data curation is normally distributed. Nest, we test correlation

assessment of all the variable with the pair wise correlation. The findings revealed that CFDI, HMC, and TNRR had an inverse affiliation with EGR. the results implies that CFDI, HMC, and TNRR does not appreciate the economic growth of African regions. However, TINN and TRAD had a favourable nexus with EGR.

**Table 2.** Descriptive statistics.

Series	EGR	CFDI	HMC	TINN	TNRR	TRAD
Mean	4.148	591.073	12.602	1.07E+08	11.994	71.381
Median	4.500	143.565	7.926	87020000	7.930	62.391
Maximum	86.827	7472.770	64.621	5.55E+08	66.059	222.178
Minimum	-50.338	0.000	0.352	1190000	0.066	2.473
Stand.dv	6.536	10.473	12.530	84.249	11.579	37.732
Skewness	1.640	3.070	1.996	1.072	1.980	1.441
Kurtosis	46.307	14.343	7.004	4.412	7.236	5.161
Jarque-Bera	5941.030	521.147	1005.739	207.601	105.529	452.271
Prob.	0.000	0.000	0.000	0.000	0.000	0.000
Observation	756	756	756	756	756	756
Correlation Assessment						
EGR	1					
CFDI	-0.106	1				
HMC	-0.115	0.159	1			
TINN	0.077	0.163	0.161	1		
TNRR	-0.357	-0.050	0.125	-0.253	1	
TRAD	0.199	-0.016	0.207	-0.263	0.158	1

Source: Author compilation from STATA 18.

### **Cross-sectional dependence assessment**

Next, we test for data dependency through the four model of Breusch-Pagan LM, Pesaran Scale LM, Bias-Corrected Scale LM, and Pesaran CSD on the variable of EGR, CFDI, HMC, TINN, TNNR, and TRAD among the regions in Africa. The findings presented in Table 3 established a cross-sectional dependency among the variables at 1% significance, thereby rejecting null hypothesis indicating a heterogeneity. The test of Blomquist and Westerlund (2013) heterogeneity was employed as displayed in Table 3, the coefficient across units of delta and p. value were below 1% significance level. Therefore, demonstrating heterogeneity of units across all the panels

**Table 3.** Cross-sectional dependence assessment.

CSDa	EGR	CFDI	HMC	TINN	TNRR	TRAD
Breusch–Pagan LM	152.994*	810.222*	784.930*	188.154*	288.676*	278.685*
Pesaran scale LM	25.354*	210.646*	193.031*	35.359*	63.433*	60.757*
Bias-Corrected scale LM	24.454*	209.746*	192.131*	34.459*	62.533*	59857*
Pesaran CSD	22.822*	87.347*	70.642*	13.770*	27.403*	11.218*
Blomquist and Westerlund (2013) heterogeneity						
lnEGR = F (CFDI, HMC, TINN, TNNR, TRAD)						
Delta	26.156*					
Adj.Delta	29.345*					

Noted: \* denote the significance level for rejection of the null and accepting the alternative hypothesis. Source: Author compilation from STATA 18.

### **Panel unit root**

Table 4 encapsulated the CIPS and CADF stationarity test of the panel data of FDI inflow, human capital, technological innovation, trade openness, natural resource rent, and economic growth. The findings indicated EGR, TRAD, and TNRR were at level for the two estimations with the values above the critical level. We procedure with the first order assessment of all the variables and the outcome shows that all the variables were at I (I). Hence, we accept the alternative theory and reject the null of stationarity.

**Table 4.** Panel Unit Assessment.

series	CIPS		CADF	
	I (0)	I(1)	I (0)	I(1)
EGR	-8.355***	17.546***	-8.569***	-20.329***
CFDI	4.106*	-9.385***	3.941*	-9.444***
HMC	2.620*	-10.587	2.691*	-9.911***
TINN	-2.475***	13.228***	-2.649***	-12.488***
TRAD	-0.698*	-14.074***	-0.678*	-13.181***
TNRR	-2.085***	-13.575***	-2.201***	-13.169

Note: \*\*\* 1% and 5% significance. **Source:** Author compilation from STATA 18.

### **Westerlund cointegration**

For empirical assessment, it is significant to explore the presence of long-run affiliation between the variables with both (t) time dimension and cross-sections (i). For this, we employed the robust Westerlund (2007) test which is based on the structure rather than on the residual dynamics, so this does not impose common factor restrictions. Two tests are structured to test the null hypothesis against the alternative hypothesis of full panels while the other two are integrated at least one panel.  $G_t$  and  $G_a$  depicts the group statistics with  $P_t$  and  $P_a$  demonstrating the panels. As presented in Table 5, our outcomes affirm a long run affiliation among the variables as the panels are all integrated. As such it is therefore suitable to select and estimate the regression model developed.

**Table 5.** Westerlund cointegration.

Series	Statis	Probability
GT	-0.456***	0.000
Ga	-18.611***	0.000
PT	-22.347***	0.000
Pa	37.804***	0.000
Variance ratio	88.903***	0.000

Note: The decision of no cointegration was rejected as 1%\*\*\* for the null hypothesis. **Source:** Author compilation from STATA 18.

### **CCE-MG estimation**

Table 6 presented the CCEMG empirical estimation for the direct (model 1) and moderating (model 2) results after Westerlund cointegration analysis of the null hypothesis of no cointegration was rejected. The findings in model 1 revealed that CFDI inflow has a positive material affiliation with EGR in Africa. This implies that with a 1% upsurge in CFDI inflow will lead to 56.7% (0.567) appreciation in EGR for the investigated regions (see Fig. for graphical outcome).

**Table 6.** CCE-MG Assessment.

	Model 1		Model 2 (Moderating -TNRR)	
	Coeff	P. value	Coeff	P. value
CCE-MG				
CFDI	0.567***	0.000	0.612***	0.000
HMC	0.313***	0.000	0.364***	0.000
TINN	0.252*	0.061	0.279***	0.007
TRAD	-0.113***	0.000	-0.191***	0.000
TNRR	-0.527***	0.000	-0.601***	0.000
TNRR*CFDI->EGR	-	-	0.762***	0.000

Note: \*, \*\*, \*\*\* illustrates at 10%, 5%, 1% respectively. **Source:** Author compilation from STATA 18.

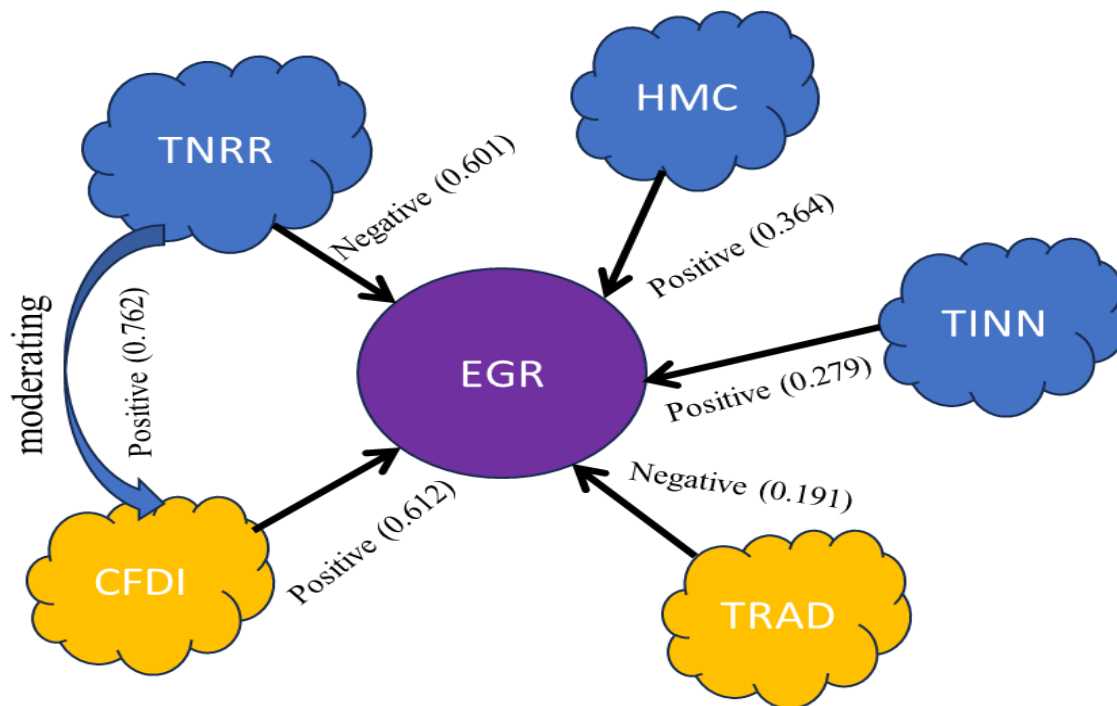


Fig. 2. Common correlated effect means group estimation outcome.

**Robustness Assessment**

The analysis of the robustness estimation is presented in Table 7. The outcome demonstrates for both FMOLS and DSK approach. The findings are in line with the CCEMG in Table 6 with favourable and significant affiliation between CFD, HMC, and TINN with EGR. Again, TRAD and TNRR confirm with the inverse nexus with economic growth. Moreover, the moderating effect of TNRR on CFDI was affirmed. Furthermore, the high exploratory value of the R square for FMOLS (0.812) and DSK (0.799) validates the initial assessment of the variable’s affiliation.

Table 7. Robustness Assessment.

Series	Fully Modified Ordinary Least Square		Driscoll and Kraay standard Errors (DSK)	
	Coeff	Std. dev	Coeff	Std. dev
CFDI	0.634***	0.148	0.585***	0.131
HMC	0.422***	0.193	0.475***	0.186
TINN	0.309***	0.137	0.353***	0.142
TRAD	-0.166***	0.054	-0.159***	0.068
TNRR	-0.481***	0.185	-0.557***	0.134
CFDI*TNRR	0.693***	0.139	0.741***	0.246
Cons.	1.136	0.101	1.025	0.130
		R <sup>2</sup> = 0.812		R <sup>2</sup> = 0.799

Note: \*, \*\*, \*\*\* illustrates at 10%, 5%, 1% respectively. Source: Author compilation from STATA 18.

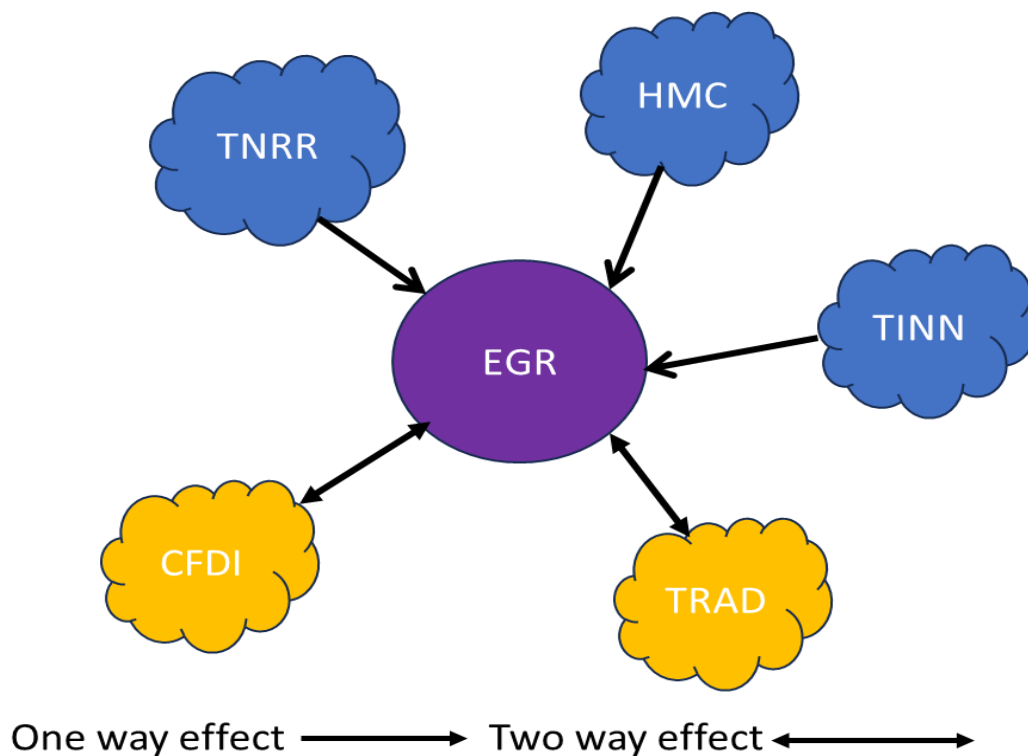
**Causality Assessment**

Table 8 and Fig. Fig. outline the findings of the causality assessment between the exogenous and endogenous variables. The empirical estimates shows that CFDI inflow and TRAD to African had a two-way effect with economic growth. Affirming that China FDI has a significant contribution to the development of the region and that economics with stable environmental are likely to attract the resources from China. Also, trade openness and economic growth can affect each other. Establishing that regions in African should developed policies on export and import into their economy to promote and accelerate development. Furthermore, human capital, technological innovation, and total natural resource rent had a one-way direct with economic growth. In totality, the outcome presents the significance of CFDI, HMC, TINN, TRAD, and TNRR as key contributors to economics growth in Africa.

**Table 8.** Causality Assessment.

Series	W-Statist	Zbar. Statist	Prob Figure	Nexus
CFDI <->EGR	5.385	6.632	0.000	Two-ways effect
EGR <->CFDI	4.3523	4.759	0.000	
HMC ->EGR	8.868	1.160	0.000	One-way effect
EGR ->HMC	2.411	0.166	0.867	
TINN ->EGR	3.598	2.748	0.006	One-way effect
EGR ->TINN	2.9774	1.399	0.161	
TRAD <->EGR	9.034	1.451	0.002	Two-ways effect
EGR <->TRAD	7.709	0.816	0.000	
TNRR -> EGR	12.774	0.957	0.000	One-way effect
EGR -> TNRR	2.252	-0.176	0.860	

Source: Author compilation from STATA 18.



**Fig. 3.** Causality assessment of EGR, CFDI, HMC, TRAD, TINN, TNRR.

## Discussion

The objective of this study was to examine the relationship between Chinese foreign direct investment (CFDI) and economic growth (EGR) in Africa, with a particular focus on the moderating role of natural resource rents (TNRR), alongside the contributions of human capital (HMC), technological innovation (TINN), and trade openness (TRAD). The resource curse theory was employed to investigate the variables and provide policy directions for governments and other stakeholders in Africa. Using data from 36 African countries (2003–2023) and robust second-generation econometric techniques (CCE-MG, FMOLS, DSK, and Dumitrescu-Hurlin causality), the results offer several important insights. The econometrics assessment asserts a high positive affiliation between China foreign direct inflow to Africa and EGR activities in the various sectors. This finding is largely due to recent Chinese government bilateral relationship with several African regions. Accordingly, John Hopkins report (2024) indicate that China have increase its investment in African 2002 (12 million) -2022 (262 million). These investments were in the critical sector of the various regions' economics in the areas of construction, mining, manufacturing, and financing. Nations like Zambia (train development) and Ghana (highway roads) which have impacted their economic progress. The investigation support prior assessment that FDI improve productivity through capital injection, technology transfer, and infrastructure development (Gui-Diby, 2014). Similarly, Yeboua (2021) indicated in their research that FDI

upsurge economic growth in African nations with good institutional development. Therefore, governments with poor institutions will have a low FDI impact on economic growth. The outcome was affirmed with the research work of Ologun (2024), which established that FDI improve the long-term sustainability of economic growth in Africa. In accordance with the relationship between TNRR and EGR, the findings illustrated that total natural resources rents had a negative influence on economic growth. This align with the resource curse theory which indicates that nations rich in resources face down surge in economic growth. This is because many African nations resources are explored by foreign partners and funds are repatriated into their countries (Ben-Salha et al., 2021). African economies' reliance on resources renders them vulnerable to fluctuations in commodity prices, rent-seeking behaviours, and capital flight. Nonetheless, the moderation outcome indicated that, in conjunction with CFDI, natural resource rents enhanced the FDI–growth affiliation. This indicates that resource endowments, when strategically harnessed through international partnerships, may shift from a burden to a catalyst for growth. Our findings corroborate the studies of Yimer (2023) research in Africa which indicated countries in Africa with weak institutional policies face issues of poor economic growth even with huge FDI inflow. The findings are not in alignment with the resource curse hypothesis when natural resource rent is moderated on FDI. For instead, Ampofo et al. (2023) research on natural resource rent and economic growth indicated that Congo experienced a decreased in economic growth linked with Natural resource extraction. However, Equatorial Guinea exert a significant positive affiliation between natural resource rent and economic growth. Again, the analysis from CCEMG estimation revealed a positive affiliation between HMC and EGR. Allocating resource rents towards human development exacerbates the resource curse. Inadequate investment in education, health, and skills diminishes absorptive capacity, hindering countries from transforming foreign direct investment and resource rents into sustainable growth. With an upsurge in human capital development will lead to an acceleration in the EGR of the Africa regions. The results validate the economic theories of the resource curse, demonstrating that human capital, as measured by years of schooling and educational attainment, has a large beneficial impact on economic growth. when foreign direct investment inflows are exchanged for the natural resources of impoverished nations. The findings affirms the prior work of Githaiga and Githaiga, (2023), which recounted that countries with high level of years of schooling, educational enrolment, and training and development of both hard and soft skills has a direct linked to economic growth in Africa. The outcome of this research indicates that, the economy of Africa can be improved through proper human resources development across different sectors when FDI inflow are channel to HMC. Furthermore, the empirical results established a positive significance effect of Technological innovation on economic growth. Resource-dependent economies often neglect innovation, since easy rents reduce incentives to diversify and invest in R&D. The findings show TINN contributes positively to growth, suggesting that technology transfer through CFDI and innovation policy can counteract the curse by diversifying economies beyond extractive sectors. This is not surprised considering the recent pace in technology advance across Africa. Meka'a et al. (2024) established in their research within the Sub-Saharan communities that poverty reduction can be decrease the green technological innovation and directing FDI inflow into building modern technologies. According to recent report by the John Hopkins (2024), China-Africa relationship on transfer of technology has cause a huge shift in various sectors of the economy. Therefore, with the positive effect of TINN on EGR, African nations with weak technological polices can take advance of CFDI inflow and developed their technological capabilities. Finally, TRAD had a negative relationship with EGR. The resource curse model is also applicable to trade openness. African nations abundant in resources frequently depend on the export of basic commodities. This constrains industrialization and exposes them to global price fluctuations, explaining why the findings indicate that TRAD adversely impacts growth. The situation illustrates the "Dutch Disease" phenomenon: resource booms elevate exchange rates, diminishing the competitiveness of manufactured exports and confining economies to low-value exports. This discovery contradicts the normative perspective of trade as a universal catalyst for growth (Nam & Ryu, 2024). It instead backs up what Abdi et al. (2024) and Sunde et al. (2023) found in their article that trade has weak or negative impacts on EGR in Africa. This means that policies should focus more on upgrading and diversifying industries to turn trade flows into long-term growth.

### ***Theoretical and practical suggestions***

The outcome from this current research offers unique contribution to the discourse on economic growth and foreign direct investment through the resource curse theory. The research advances the application of the resource curse theory by establishing that natural resource rents, while directly constraining economic growth, can positively moderate the effect of FDI on development outcomes. The conventional literature on the resource curse highlighted the adverse consequences of resource abundance, including exploration behaviour, weak institutions, and excessive dependence on commodity exports. This research illustrates that the inclusion of Chinese foreign direct investment in the analysis suggests that resource wealth does not invariably result in the "curse." However, when FDI is channelled into productive sectors such as infrastructure, technology, and human capital resource rents can be transformed into growth. The investigation illustrate how African nations can implement policies, such as the ability to attract more CFDI inflow, TINN, and HUM to upsurge the sustainable economic growth. For instance, the outcome of in model 1 indicates that total natural rents had a negative affiliation with EGR, however, when it was moderated on CFDI inflow, the impact shows a positive and a significant moderation effect. Thus, the current study findings enriches the resource curse hypothesis by offering novel insight into these variables' effect on African

nations economic growth. Our research identifies specific contextual factors that influence the material effects of foreign direct investment inflow, and the direct effect of technological innovation, and moderating impact of total natural resource rents. Furthermore, the current investigation adds to the extant literary works on economic growth research by empirically affirming the theoretical model grounded on a unified framework of CFDI inflow, TINN, TRAD, HMC, and TNRR bring the previous literature studies into extensive one. Accordingly, the research findings provide new novel insights into FDI inflow to Africa literature and the resource curse theory by exploring the role of CFDI inflow, trade openness, natural resources rents, technological innovation, and human capital development in adoption, implementation, and continuous upsurge in economic growth. The study enhances the resource curse paradigm by emphasizing the conditional significance of external partnerships and absorptive capacities, providing a more refined comprehension of how African economies might shift from resource reliance to sustainable growth.

The research offers some significant managerial suggestions for African governments, investors, businesses, and other institutional agencies. These include a) the research findings indicates that China foreign direct investment inflow into Africa nation had a positive material affiliation with economic growth. The inference is that governments and institutions can developed and implement a bilateral policy on FDI inflow that comes from China. This will direct the investment into sectors that need these resource injection to improve the economy. b) The findings shows that total natural resources rents had a negative relationship with economic growth in model 1, however, the affiliation changed when it was moderated on the linked between CFDI inflows and EGR. For policy perspective, the study recommend that resources-based nations should focus on benefitting from their natural resources through FDI inflows. In nations afflicted by the resource curse, the article recommends that governments implement prudent fiscal policies to ensure judicious expenditure and borrowing. There must be judicious expenditure on substantial government initiatives or legacy projects, as well as fuel subsidies. To stimulate economic growth, increased funding should be allocated to productive sectors such as education, healthcare, and other social services. c) Our investigation established that technological innovation is crucial for the development of African nation economy. We suggest to governments invest in advanced technologies that are significant to improve clean productivity and green supply chain roots. Policies should be directed on investment in renewable energies and artificial intelligence software to improve the economic growth. Finally, our study discovered that trade openness had an inverse effect on economic growth. We suggest that government develop policies to promote trade in export of semi-and finished goods which have value compared to raw products.

## Conclusions

The need for sustainable economic growth and development has become ever crucial in Africa, considering the exploitation of the resources through foreign direct investments. This research explored the significant role economic growth in African considering the factors of FDI, trade openness, human capital, technological innovation, and natural resource rent. The period for the investigation was 2003-2023 with 36 African regions. The econometric model of CCEMG, FMOLS, and DSK approaches was used to analyse the relationship between the variables, complemented with the pair wise causality test for the direction of the effects. The econometric findings from CCEMG and the sturdiness assessment from FMOLS and DSK model has presented policy direction for these regions when considering economic growth through CFDI, HMC, TINN, TRAD, and TNRR. The results established a positive and significant affiliation between CFDI TINN HMC, and EGR. This implies that when Africa government makes proper strategic policies on these variables, the region will achieve a sustainable growth and development. However, TRAD and TNRR exhibited an inverse relationship with EGR. Through the region continues to trade, its trade balance had no effect in the development of the regions as the regions export more raw materials than finished goods which attract high income returns. On the part of natural resources, when moderated with foreign direct investment, this relationship reversed to a strong and positive outlook on economic growth. This presents African economies with policy ramifications on the extraction of resources for sustainable growth in the long term. Additionally, the test for causality assessment illustrates that CFDI, TINN, and HMC had a bidirectional nexus with EGR. This implies that with economics that have good institutional policies attract Chinese foreign direct investment inflow to develop their economics. The role of technological innovation and human capital development has well been documented in literatures to promote economic growth. As developed nations are able to effectively utilise technology and the human resource to advance their economies especially in the service and manufacturing sectors. These findings strongly correspond with the resource curse theory. The adverse direct impact of TNRR on growth substantiates the hypothesis that reliance on resources complicates long-term development due to instability and inadequate institutions. Likewise, the adverse consequences of open trade illustrate Africa's dependence on the export of primary commodities. The findings indicate methods to escape the resource curse; specifically, resource rents can facilitate enduring economic transformation when allocated towards productive investment in human capital and innovative technology.

## Limitation and further evaluations

This current research is not devoid of drawbacks. The study was limited to a period of 2003-2023 and a sample of 36 African regions. As such the results cannot be applicable to all the nations in Africa. Future investigation could expand the sample scope to compare the results with the current findings for policy decisions. Also, the research was constrained on the econometric models of CCEMG, FMOLS, and DSK approaches as the analytical method.

We suggest future investigation on the economic growth should employed models such as GMM, PMG, or CS-ARDL.

## Acknowledgement

Internal Grant Agency of FaME TBU No. IGA/FaME/2025/010 and IGA/FaME/2025/003.

## References

- Abdi, A. H., Zaidi, M. A. S., Halane, D. R., & Warsame, A. A. (2024). Asymmetric effects of foreign direct investment and trade openness on economic growth in Somalia: Evidence from a non-linear ARDL approach. *Cogent Economics & Finance*, 12(1), 2305010. <https://doi.org/10.1080/23322039.2024.2305010>
- Abid, A., Mehmood, U., Tariq, S., & Haq, Z. U. (2022). The effect of technological innovation, FDI, and financial development on CO2 emission: evidence from the G8 countries. *Environmental Science and Pollution Research*, 29(8), 11654-11662. <https://doi.org/10.1007/s11356-021-15993-x>
- Agboola, M. O., Bekun, F. V., & Joshua, U. (2021). Pathway to environmental sustainability: Nexus between economic growth, energy consumption, CO2 emission, oil rent and total natural resources rent in Saudi Arabia. *Resources Policy*, 74, 102380. <https://doi.org/10.1016/j.resourpol.2021.102380>
- Ali, N., Phoungthong, K., Khan, A., Abbas, S., Dilanchiev, A., Tariq, S., & Sadiq, M. N. (2023). Does FDI foster technological innovations? Empirical evidence from BRICS economies. *Plos one*, 18(3), e0282498. <https://doi.org/10.1371/journal.pone.0282498>
- Almutairi, N. T. (2024). Does investment in human capital via education stimulate economic growth in an oil-rich country? A case study of Saudi Arabia. *Journal of the Knowledge Economy*, 15(1), 2933-2955. <https://doi.org/10.1007/s13132-023-01265-1>
- Alvarado, R., Tillaguango, B., Toledo, E., Murshed, M., & Işık, C. (2024). Links between technological innovation, financial efficiency and environmental quality using quantile regressions: The role of foreign direct investment, institutional quality and natural resources. *Journal of open Innovation: Technology, market, and complexity*, 10(3), 100360. <https://doi.org/10.1016/j.joitmc.2024.100360>
- Ampofo, G. K. M., Cheng, J., Asante, D. A., & Bosah, P. (2020). Total natural resource rents, trade openness and economic growth in the top mineral-rich countries: New evidence from nonlinear and asymmetric analysis. *Resources Policy*, 68, 101710. <https://doi.org/10.1016/j.resourpol.2020.101710>
- Ampofo, G. M. K., Laari, P. B., Ware, E. O., & Shaw, W. (2023). Further investigation of the total natural resource rents and economic growth nexus in resource-abundant sub-Saharan African countries. *Mineral Economics*, 36(1), 97-121. <https://doi.org/10.1007/s13563-022-00316-4>
- Auty, R.M., 1994. Industrial policy reform in six large newly industrializing countries: the resource curse thesis. *World Dev.* 22 (1), 11–26. [https://doi.org/10.1016/0305-750X\(94\)90165-1](https://doi.org/10.1016/0305-750X(94)90165-1).
- Ben Abdallah, A. (2024). The relationship between trade openness, foreign direct investment inflows, and economic growth in middle east and north of Africa region: autoregressive distributed lag model vs. vector error correction model. *Journal of the Knowledge Economy*, 15(1), 1118-1141. <https://doi.org/10.1007/s13132-023-01099-x>
- Ben-Salha, O., Dachraoui, H., & Sebri, M. (2021). Natural resource rents and economic growth in the top resource-abundant countries: a PMG estimation. *Resources Policy*, 74, 101229. <https://doi.org/10.1016/j.resourpol.2018.07.005>
- Chung, C. Y., & Do, T. T. N. (2024). Triggering Human Capital Aspects of Corporate Social Responsibility via Domestic and Foreign Institutional Investments: Novel Insights from Workplace Safety Initiatives. *Transformations in Business & Economics*, 23(3A).
- Fazaaloh, A. M. (2024). FDI and economic growth in Indonesia: A provincial and sectoral analysis. *Journal of Economic Structures*, 13(1), 3. <https://doi.org/10.1186/s40008-023-00323-w>
- Ghazouani, T., & Maktouf, S. (2024, February). Impact of natural resources, trade openness, and economic growth on CO2 emissions in oil-exporting countries: A panel autoregressive distributed lag analysis. In *Natural resources forum* (Vol. 48, No. 1, pp. 211-231). Oxford, UK: Blackwell Publishing Ltd. <https://orcid.org/0000-0001-5879-100X>
- Githaiga, P. N., & Kilong'i, A. W. (2023). Foreign capital flow, institutional quality and human capital development in sub-Saharan Africa. *Cogent Economics & Finance*, 11(1), 2162689. <https://doi.org/10.1080/23322039.2022.2162689>
- Gui-Diby, S. L. (2014). Impact of foreign direct investments on economic growth in Africa: Evidence from three decades of panel data analyses. *Research in economics*, 68(3), 248-256. <http://dx.doi.org/10.1016/j.rie.2014.04.003>
- Hao, Y., Wu, Y., Wu, H., & Ren, S. (2020). How do FDI and technical innovation affect environmental quality? Evidence from China. *Environmental Science and Pollution Research*, 27(8), 7835-7850. <https://doi.org/10.1007/s11356-019-07411-0>
- Kumari, R., & Singh, S. K. (2024). Impact of ICT infrastructure, financial development, and trade openness on economic growth: New evidence from low-and high-income countries. *Journal of the Knowledge Economy*, 15(2), 7069-7098. <https://doi.org/10.1007/s13132-023-01332-7>
- Labidi, M. A., Ochi, A., & Saidi, Y. (2024). Relationship analysis between FDI and economic growth in African countries: does governance quality matter? *Journal of the Knowledge Economy*, 15(4), 16511-16540. <https://doi.org/10.1007/s13132-023-01710-1>
- Luo, C., & Chen, Z. (2024). Why has China invested heavily in countries with weak market environments? A new explanation and implications for China-Africa economic cooperation. *China Economic Review*, 88, 102245. <https://doi.org/10.1016/j.chieco.2024.102245>
- Meka'a, C. B., Djamen, B. L., & Noufelie, R. (2024). Foreign direct investment, green technological innovation and energy poverty: Empirical evidence from sub-Saharan African countries. *Renewable Energy*, 231, 120831. <https://doi.org/10.1016/j.renene.2024.120831>
- Nam, H. J., & Ryu, D. (2024). Does trade openness promote economic growth in developing countries? *Journal of International*

- Financial Markets, Institutions and Money, 93, 101985. <https://doi.org/10.1016/j.intfin.2024.101985>
- Namahoro, J. P., Qiaosheng, W., & Hui, S. (2023). Economic growth, natural resource rents, and business openness nexus in regions and income levels of Africa: evidence from recent panel estimators. *Mineral Economics*, 36(4), 583-598. <https://doi.org/10.1007/s13563-022-00362-y>
- Nkemgha, G. Z., Nchofoung, T. N., & Sundjo, F. (2023). Financial development and human capital thresholds for the infrastructure development-industrialization nexus in Africa. *Cities*, 132, 104108. <https://doi.org/10.1016/j.cities.2022.104108>
- Nuta, F., Shahbaz, M., Khan, I., Cutcu, I., Khan, H., & Eren, M. V. (2024). Dynamic impact of demographic features, FDI, and technological innovations on ecological footprint: evidence from European emerging economies. *Environmental Science and Pollution Research*, 31(12), 18683-18700. <https://doi.org/10.1007/s11356-024-32345-7>
- Obeng-Odoom, F. (2017). China–Africa relations in the economist, 2019–2021. *Journal of Asian and African Studies*, 59(3), 1000-1017. DOI: 10.1177/00219096221125423
- Okolo, C. V., Wen, J., & Susaeta, A. (2024). Maximizing natural resource rent economics: The role of human capital development, financial sector development, and open-trade economies in driving technological innovation. *Environmental Science and Pollution Research*, 31(3), 4453-4477. <https://doi.org/10.1007/s11356-023-31373-z>
- Olorogun, L. A. (2024). Modelling financial development in the private sector, FDI, and sustainable economic growth in sub-Saharan Africa: ARDL bound test-FMOLS, DOLS robust analysis. *Journal of the Knowledge Economy*, 15(2), 8416-8434. <https://doi.org/10.1007/s13132-023-01224-w>
- Prokop, V., Stejskal, J., & Kuba, O. (2019). Effective Financing of Environmentally Adjusted Multifactor Productivity Growth in Sustainable Development Framework—An International Comparative Study. *European Journal of Sustainable Development*, 8(3), 172-172.
- Rajab, B., & Zouheir, A. (2024). Complementarity relationship between foreign direct investment, human capital threshold and economic growth: State of the 15 least developed African countries. *Journal of the Knowledge Economy*, 15(2), 7216-7236. <https://doi.org/10.1007/s13132-023-01314-9>
- Sakya, D., & Egyir, J. (2017). Effects of trade and FDI on economic growth in Africa: an empirical investigation. *Transnational Corporations Review*, 9(2), 66-87. <https://doi.org/10.1080/19186444.2017.1326717>
- Sambiri, B. B., Mutai, N. C., & Osisiogu, O. (2025). Natural Resource Rents, Chinese Financing and Sustainable Economic Growth nexus in sub-Saharan Africa. *BRICS Journal of Economics*, 6(3), 63–85. <https://doi.org/10.3897/brics-econ.6.e145573>
- Shahbaz, M., Aboutorabi, M. A., & Yazdi, F. A. (2024). Foreign capital, natural resource rents and financial development: A new approach. *Global Business Review*, 25(2), 401-420. DOI: 10.1177/0972150920961364
- Simionescu, M., Radulescu, M., & Cifuentes-Faura, J. (2024). The role of natural resources rents and e-government in achieving sustainable development in the European Union. *Resources Policy*, 97, 105278. <https://doi.org/10.1016/j.resourpol.2024.105278>
- Sunde, T., Tafirenyika, B., & Adeyanju, A. (2023). Testing the impact of exports, imports, and trade openness on economic growth in Namibia: Assessment using the ARDL cointegration method. *Economies*, 11(3), 86. <https://doi.org/10.3390/economies11030086>
- Timbe, G., Pinheiro, F. L., Bam, W., Hartmann, D., & De Bruyne, K. (2024). Is natural resource abundance a curse or an opportunity? Economic complexity, FDI, and industrial policies in Mozambique. *Resources Policy*, 98, 105326. <https://doi.org/10.1016/j.resourpol.2024.105326>
- Volejníková, J., & Kuba, O. (2020). An economic analysis of public choice: Theoretical methodological interconnections. *SciPap*, 28(3).
- Wiredu, J., Yang, Q., Inuwa, U. L., & Sampene, A. K. (2023). Energy transition in Africa: the role of human capital, financial development, economic development, and carbon emissions. *Environmental Science & Policy*, 146, 24-36. <https://doi.org/10.1016/j.envsci.2023.04.021>
- Yeboua, K. (2021). Foreign direct investment and economic growth in Africa: New empirical approach on the role of institutional development. *Journal of African Business*, 22(3), 361-378. <https://doi.org/10.1080/15228916.2020.1770040>
- Yimer, A. (2023). The effects of FDI on economic growth in Africa. *The Journal of International Trade & Economic Development*, 32(1), 2-36. <https://doi.org/10.1080/09638199.2022.2079709>
- Zajontz, T. (2023). *The political economy of China's infrastructure development in Africa: Capital, state agency, debt*. Springer International Publishing.

Appendices.

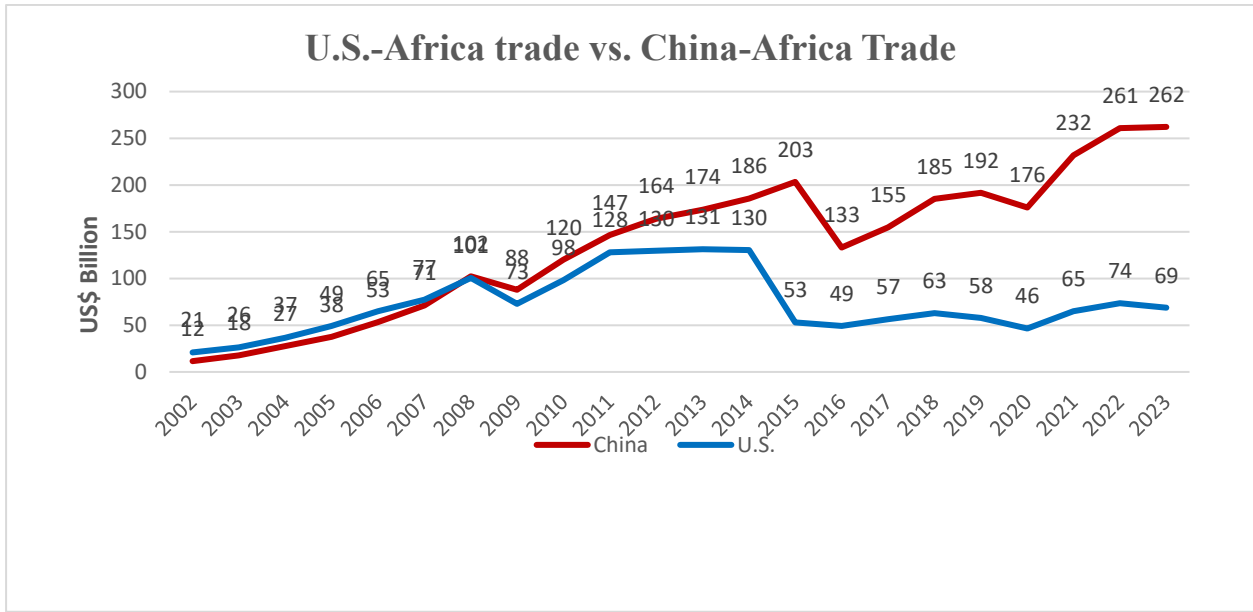


Fig. 4. China-Africa and US-Africa trade.  
Source: Hopkins (2024)

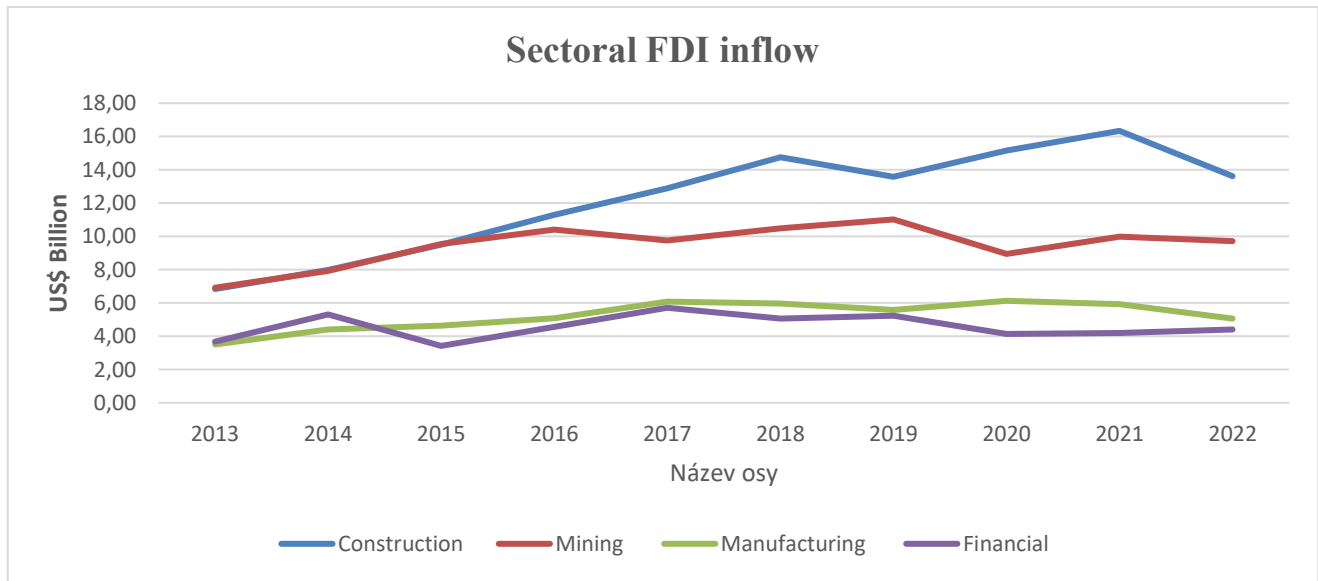


Fig. 5. Sectoral contribution of China FDI inflow to Africa.  
Source: Hopkins (2024)