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Robust Empirical Study of the Moderating Role of Human Capital and Natural Resources on the Effects of COVID-19 and Financial Development on Foreign Direct Investment: Evidence from Sub-Saharan Africa

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Abstract This study explores the moderating role of human capital and natural resources on the effects of Coronavirus Disease 2019 (COVID-19) and financial development on foreign direct investment in 42 sub-Saharan African countries. The analyses were conducted using panel data sourced from the World Bank from 1996 to 2021. The two-step system Generalised Method of Moments (GMM) was adopted as the main estimation strategy, while Driscoll and Kraay's Nonparametric Covariance Matrix and Dynamic Threshold Estimators were employed as robustness analyses to account for dynamic threshold effects and cross-sectional dependencies in the panel. The findings show that COVID-19 acts as a shock that increases investment risk and disrupts supply chains, negatively affecting FDI inflows. In addition, financial development was identified as a positive driver of foreign investment. Furthermore, economies with human capital below a life expectancy of 52 years did not experience the beneficial effects of financial development in attracting foreign investment. Overall, human capital moderates the positive effects of financial development on FDI, whereas the moderating effect of natural resources is insignificant. Therefore, policymakers in the region should prioritise human capital formation by investing in health and education sectors to maximise the benefits of financial development on foreign direct investment inflows into sub-Saharan Africa.

Keywords Financial Development · COVID-19 · Foreign Direct Investment · Natural Resources · Human Capital · Sub-Saharan Africa · Two-Step GMM

JEL Classification F21 · O55 · I15

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In recent times, the government and researchers have begun to pay attention to the financial sector and its development. This trend became notable after the 2008 financial crisis and intensified during the COVID-19 pandemic. Previous studies have demonstrated that a sound financial sector aids economic growth and development (Ibrahim & Alagidede, 2017; Kouki, 2013) as it ensures smooth movement of surplus funds from surplus to deficit sides of the economy. Developing economies strive for financial development, as it has been noted to attract capital inflows in the form of Foreign Direct Investment (FDI) (Desbordes & Wei, 2017). The question is, " Does the receiving country's financial development attract FDI inflows or does it only help improve and distribute FDI *after* the investment has been made?" Many empirical studies have noted a link between finance and FDI; however, the nature of this relationship is inconclusive. Researchers unambiguously agree that financial advancement is a positive driver of FDI in host economies, but they cannot clarify the association between destination economies' financial development (DFD) and FDI (Levine, 1997; Bayar & Gavriletea, 2018).

FDI transfer technology, boosts output, generates jobs, and supplies capital to developing countries. It has also been shown to be safer and more reliable than other capital flows like debt and portfolio investments. FDI complements a well-structured financial sector and spurs the growth of financially dependent sectors. Global economic fluctuations severely affect FDI, despite its many advantages to both the source and destination countries' economies. In recent years, two major economic events have been noted to affect capital flows to developing economies. The 2008 crisis led to an increase in central banks' expansionary monetary policies worldwide and a switch to unconventional policies in a bid to resuscitate aggregate demand and restore the functioning of the financial system. In addition, the COVID-19 pandemic started in 2019 and created a significant shock for the world economy. The COVID-19 pandemic has caused central banks worldwide to engage in expansionary monetary policy to encourage spending. This increased the flow of FDI to emerging economies, as the interest rate was low and stock prices were high (Kaharan & Bayır, 2022). However, countries have been faced with high inflation rates in the post-pandemic era and have been forced to engage in contractionary policies, increasing interest rates and lowering stock prices. These contractionary policies have reduced FDI flows to developing nations (Kaharan & Bayır, 2022).

FDI sometimes goes beyond capital inflows and involves technology transfers and MNEs. Given that FDI tends to flow towards the services and technology-intensive industries, human capital may be a key factor in determining inward FDI, particularly efficiency-seeking FDI. Human capital in the host country can be used to measure the nation's potential to absorb new ideas, which is essential for maximising the advantages of new technology (Miyamoto, 2003; Noorbakhsh et al., 2001). Destination economies require skilled human resources and capital to attract highly value-added Multinational Enterprises (MNEs). An increase in host country's human capital development creates a virtuous circle (Miyamoto, 2003). The first step of this cycle begins with training human capital, which attracts MNEs. MNEs also bring training, education, new skills, and new information and technology. The second part of the cycle starts when MNE benefits are used to develop human capital and transfer skills to other industries. With this new development in human capital and other industries, the economy can attract more FDI.

Therefore, this research aims to take a bird's eye view of the interaction between COVID-19, financial development, and foreign direct investment, using human capital formation and natural resources as

mediating variables. Our focus centers on Africa, a continent with over 70% of the least developed nations and an economy easily affected by global crises. African countries have ambiguous effects of Inward FDI on economic growth (Blomström & Kokko, 2002). This study affirmed that a skilled workforce attracts FDI seeking efficient production and technological advancement. Previous studies confirmed a positive and significant association between human capital and FDI (Bhattacharya & Mitra, 2015; Asiedu, 2017). Therefore, we argue that financial development attracts FDI, but human capital is needed to absorb and utilise these investments effectively. Following Borensztein et al. (1998), investors prioritise locations with skilled workforces that can adopt new technologies, manage complex operations, and generate higher returns. Thus, limited human capital creates an "absorptive capacity trap," where financial resources cannot be optimally utilised, potentially deterring further FDI inflows**.** COVID-19 disruptions to education and healthcare adversely impact human capital, potentially moderating the positive effect of financial development on FDI. SSA is rich in natural resources, attracting resource-seeking FDI. However, reliance on resource exports can create volatile economies and hinder diversification (Dutch disease) (Sachs & Warner, 1995). Thus, exploring how natural resources moderate the financial development-FDI relationship can provide valuable insights for both investors and policymakers.

Literature in the field of international economics and finance has adopted various econometric approaches to examine the link between COVID-19, financial development, and FDI across different regions (Islam, Das, & Hassan, 2021; Camino-Mogro & Armijos, 2020; Heidary, 2022; Liu, *et al*., 2020)). However, most studies used static and ordinary least squares, with reported results susceptible to endogeneity and simultaneity bias problems (Islam, et al., 2021; Karimi, Yusop, Hook, & Chin, 2013). The efficiency of an OLS coefficient is always questionable, especially when the assumptions of normality and constant variance do not hold (Gujarati and Dormar, 2008; Woodridge, 2002). None of the studies combined the effect of COVID-19, Finance-FDI nexus in Sub-Saharan African Countries and other regions. Furthermore, Islam et al. (2021) addressed the finance-capital-FDI trilogy but concentrated only on Belt and Road partner economies. The novelty of this study relied on the adoption of natural resources and human capital as the moderators on the link between COVID-19, financial development, and FDI. Furthermore, from the bulk of the literature reviewed, none has addressed this key economic issue using a two-step system GMM that has the potential to report robustness coefficients, addressed the econometric problem of simultaneity bias, autocorrelation, serial correlation, and other endogeneity issues with the application of instrumental variables (Roodman, 2009a; Arellano & Bond, 1991; Blundell & Bond, 1998). Also, the estimator that accounts for cross-sectional dependence was used as the robustness check to GMM estimates. Thus, the results presented in this study are more robust and reliable than most previous studies in this field. This paper also adds novelty to the extant literature by examining the threshold of raw material needed and human capital to strengthen or mar finance-FDI nexus, which has not been addressed by any previous study. The remaining part of the paper is organised into literature review in section two while section three accounts for methodology and data. Section 4 displays and discusses the findings, and the last section concludes the paper with policy implications.

Literature Review

Theoretical Review

On the theoretical side, a study conducted by Borensztein et al. (1998), who were among the first authors to champion the debate on the FDI-Growth nexus and documented evidence of a positive and significant association, opined that the host economy can only enjoy the benefits of technological diffusion, managerial skills transfer, and other benefits of FDI up to a maximum point when there is sound financial systems and

sufficient stock of human capital formation. Additionally, Coe *et al*. (1997) postulated that FDI positively and significantly influences economic growth. However, this paper concludes that a certain breakpoint in economic development is required to ensure constant stimulation of economic activities and higher yield benefits are necessary for FDI to thrive and positively influence growth. Furthermore, Liu *et al*. (2006) agreed that FDI has positive effects on growth. However, they supported the demand-led hypothesis, implying that FDI influences growth via a series of mechanisms, not in the reverse case. The channels of effect documented are increases in demand for capital to meet growing economic and business activities and investors' demands resulting from a boom. Moreover, Mottaleb (2007) presents an argument from developing economies, postulating that inflows of capital from source economies are biassed and skewed towards environments conducive to business and the existence of raw materials, coupled with a well-structured and sophisticated financial sector, tax incentives, and openness to trade. ODI (2006) postulated that the inflows of FDI into developing countries to exploit an economy's natural resources without economic compensation in terms of employment and reinvestment have adverse consequences on the economic prospects of host economies. Thus, the characteristics of MNCs, the economic stance of the host economies, and trade policies in conjunction with economic policies implemented in the domestic economy determine the influence of FDI on the welfare of citizens in recipient economies.

Other studies supported FDI as a significant positive predicator of growth. Hermes and Lensink (2003) documented that a strong financial system is a complementary input that strengthens the positive association between FDI and growth. Other existing literature supported this postulation (Ljungwall & Li, 2007). Contrary to the above theoretical argument of Ljungwall and Li (2007), Alfaro et al. (2004) documented that financial development might not uniformly affect all sectors equally. According to their postulations, resource extraction drives FDI in resource-rich economies, bypassing the local financial system. Similarly, technology driven FDI relies less on traditional financing, thus reducing the impact of financial development. Nevertheless, when the financial ecosystem is well-structured and developed, the interaction between the two influences growth positively and significantly (Aluko, 2020).

On a theoretical background that justifies the link between COVID-19 and FDI, Fua et al. (2021) postulated that the global economic lockdown resulting from COVID-19 diminished greenfield project announcements, cross-border capital flows, and mergers and acquisitions by an average of 26%. Additionally, from their theoretical perspective, it was argued that natural disasters, such as pandemics, earthquakes, floods, and climate change increase future uncertainty and perceived risk, leading to decreased economic activities and hindered free flows of goods and services, ultimately resulting in decreased FDI. COVID-19 was seen as destructive to both domestic and international supply chains, making future investment opportunities in host economies unpredictable. As a result, risk-averse investors reduce their capital inflows into host economies due to uncertainty and perceived risk (Maryam & Mittal, 2020). Anuchitworawong and Thampanishvong (2015) used a time-series analysis on how foreign direct investment inflows can be affected by natural disasters and documented that natural disasters negatively influence FDI through the destruction of physical infrastructure and human capital formation in Thailand, with significant figures. Various economic, natural, and environmental factors influence the investment decisions of multinational corporations (MNCs) to enter new markets. Natural disasters such as COVID-19 constitute risk factors that are typically considered in strengths, weaknesses, opportunities, and Threats (SWOT) analyses during feasibility studies, and capital inflows tend to be negatively skewed towards hazardous environments with high perceived risk (Buckley, Chen, Clegg, & Voss, 2020). Many investors and MNCs were concerned about how market forces would react to the COVID-19 shock and the duration of lockdowns in different economies, which resulted in restrictions on international trade. This uncertainty in the business environment has led to a shrinkage in FDI inflows,

with a greater effect on emerging economies with low absorptive capacities to withstand economic shocks (Camino-Mogro & Armijos, 2020)

Neoclassical theory, which emerged as one of the earliest theories of FDI, was developed based on the Heckscher-Ohlin trade theory. The concept proposes that disparities in factor endowment and flexibility play a crucial role in influencing investors' decisions to expand production activities in host countries (Sookram, Hosein, Boodram & Saridakis, 2022). Phung (2016, p. 3) further explains that due to heterogeneity in countries' resource endowments, foreign firms are motivated to transfer their abundant production factors to locations where they can earn higher returns on these factors.

Buckley and Casson (1976) advocated the internalisation theory, which proposes a significant proposition in contrast to neoclassical theory. Rather than relying on outsourcing production processes, multinational enterprises (MNEs) opt to internalise their production of intermediate goods, aiming for efficient cost minimisation (Phung, 2016, p. 3). This strategy involves the internalisation of operations and knowledge, which helps MNEs overcome market irregularities and enhance their market power (Sookram, Hosein, Boodram & Saridakis, 2022).

Dunning (1988) developed an influential framework called the OLI model, which combines aspects of neoclassical trade theory and internalisation theory. This model has been widely used as an empirical basis for examining capital inflows. The OLI paradigm comprises three sub-paradigms: ownership (O), location (L), and internalisation (I). The ownership paradigm, rooted in the Heckscher-Ohlin theory, posits that competitive advantage, encompassing technological advancements, explicit capabilities, and administrative skills, is a key determinant of foreign investment. The location sub-paradigm focuses on favourable factors within the host country that attract investment inflows, such as cost-effective labour, natural resources, and supportive regulations.

The final sub-paradigm, influenced by Buckley and Casson's work (1976), underscores the advantages of internalising the production process of intermediate goods.
Phung (2016) categorised the motivations of investors into three main groups: market-oriented, resource-oriented, and efficiency-oriented. Customer base and available resources in the host country motivate market-oriented investors. The resource base in which investors are interested is the natural endowment, human capital, and trade openness of the host country. These investors choose countries that are richly endowed and have a favourable trade policy that encourages exportation back to the investor's country. Finally, efficiency-seeking investors seek political stability, quality infrastructure, and higher-quality human capital as requirements for foreign investment. The core proposition of this theory—such as financial development, institutional quality, infrastructure development, macroeconomic stability, human capital development, and natural endowment—can influence foreign direct investment. The major advantage of Dunning's theory is its flexibility in incorporating different factors influencing foreign investment. Gökçeli, Firmus, and Ghosh (2022) examined the effect of FDI on growth and investment in 36 OECD countries and revealed that FDI inflows have a positive effect on the growth of the host country. Specifically, host countries with a well-established financial system, a higher level of human capital, and political freedom can gain more from FDI inflows. This study also indicates that the origin of FDI matters in determining its effects on the host country's economy. FDI inflows from developed countries contribute to host country growth, whereas FDI from developing countries has no significant effect on growth.

Empirical Review

The narrative surrounding FDI is often straightforward: Strong economies with robust financial systems attract more investment (Desbordes & Wei, 2017; Haque, Zhang, & Muhammad, 2022). However, what will

happen when a pandemic disrupts the system and resource-rich nations with varying human capital endowments emerge as unexpected destinations for foreign investors? This section reviews the existing empirical literature on how human capital and natural resources moderate the influence of COVID-19 and financial development on FDI.

Liu et al. (2020) conducted an empirical study on the influence of COVID-19 and the development of financial institutions on FDI in developing countries. They applied a two-step GMM approach. Their findings indicate that COVID-19 discourages foreign direct investment (FDI) inflows, whereas a sound financial system accelerates FDI inflows at a statistically significant level. The authors argued based on a well-tested empirical hypothesis that a strong financial ecosystem plays a key player in foreign direct investment's attractiveness. However, the intensity of the impact is stronger when host economies have high levels of human capital.

In line with the above study, Islam et al. (2021) conducted empirical research to determine the moderating role of human capital development on the effect of a developed financial sector on FDI. The study sampled 79 countries diversified in terms of development stages and cultural differences across the globe that belonged to Belt and Road Initiative partners, using datasets from 1999 to 2017. This study used fixed effect, random effect, and fully generalised least square models and found that the negative and significant effect human capital formation exerted on FDI faded away when interlinked with financial development; the effect became significantly positive at the conventional level. One of the recommendations of the study was that the countries examined should ensure that the level of financial development in their economies must be augmented with human capital to ensure constant inflows of foreign capital from the source economies in the near future. Additionally, it was recommended that investors and source economies should study the key drivers of investment in host economies, especially market size and the business environment. One of the shortcomings of this study is that the Belt countries exhibit significant economic and political heterogeneity. The fixed-effects model does not fully capture this heterogeneity, whereas the random-effects model assumes that it is random, which is not realistic (Wooldridge, 2010).

Using cross-sectional first-quarter data from 43 countries in 2020, Ajide and Osinubi (2020) investigated the economic consequences of COVID-19 on the outward flow of FDI. Through the application of both ordinary least squares (OLS) and quantile regression, their findings demonstrated a direct correlation between the COVID-19 pandemic and investment outflows. The government's mobility restriction policy resulted in a scarcity of competent employees, which hindered supply chains and economic activities. The propensity to invest drastically declined as financial resources to mitigate the pandemic were limited. These results are similar to those of Hyla et al. (2022), who employed quarterly data from 22 European countries in three consecutive quarters during the pandemic to contend with the negative influence of COVID-19 on FDI Outflows. The study argued that a higher rate of interest would increase the cost of investment and therefore discourage investment activities, signalling unemployment. This leads to an outflow of investment. Inflation, economic growth, and business confidence are channels through which COVID-19 affects investment outflows. Contrarily, McKibbin and Fernando (2020) suggested that COVID-19 accelerated digital transformation trends, leading to increased FDI in the technology and e-commerce sectors. According to their argument, the disruptions caused by the pandemic may create new market opportunities or accelerate trends that favour certain industries, leading to increased FDI in those sectors.

In an empirical study by Chadary et *al*. (2020) on the effect of the COVID-19 pandemic on FDI commitment in Nepal, there is an unfavourable correlation between the two variables. This paper documented that the health crisis caused by the pandemic disrupted the economic climate and deterred foreign investment. According to the study, adopting a government-mandated investment policy more effectively would increase foreign investment inflows. Nawo and Njangang (2021) documented that countries with large deposits of

sovereign wealth funds can easily cushion the effects of the pandemic and therefore favourably influence the investment decisions of multinational companies. Nawo and Njangang (2021) extended their investigation of the COVID-19 - FDI relationship to encompass both developed and developing nations, integrating Sovereign wealth funds (SWFs) into their research. The outcomes of their cross-sectional Ordinary Least Square analysis revealed an unfavourable influence of the total number of fatalities and cases on foreign investment inflows. Additionally, the study demonstrated that the pandemic's impact significantly diminished FDI in economies lacking sovereign wealth funds, whereas its effect was inconsequential in countries with such funds. The authors contended that nations with substantial sovereign wealth fund reserves are adept at mitigating the pandemic's repercussions, thereby positively shaping multinational corporations' investment decisions.

On the COVID-19 and FDI link throughout various economic sectors, Syarifuddin and Setiawan (2022) used Indonesia as a case study and employed the local projection estimation technique to capture the pandemic-FDI nexus. They argued that the effect of the pandemic on FDI flows varied across sectors and quarters. For instance, the adverse effects of the pandemic on FDI inflows are more pronounced in most subsectors in the primary, utility, and service sectors. However, minimal manufacturing subsectors have a negative effect. In a related study, Hayakawa, Lee, and Park (2022) conducted a comprehensive study to assess the extent of COVID-19's impact on both source and host nations. The research used trimestral data from 2019 to 2021, focusing on two-sided investment flows involving 173 home countries and 192 host countries. This study incorporated the rigidity index of government policies that restrict people's activities as an explanatory variable. Additionally, FDI inflows were categorised into two entry modes: Greenfield FDI and Merger and Acquisition FDI. The findings revealed a mixed effect of COVID-19 on FDI, varying by sector and mode of entry. In the host country, the pandemic negatively affected FDI in the manufacturing sector, regardless of the mode of entry. In the service sector, the pandemic had an adverse impact solely on Greenfield FDI in both the host and home countries. However, the effect of the pandemic on the home country was not found to be statistically significant. Lu, Alleyne, and Mu (2021) argued that FDI flows in the agricultural and mining sectors were insignificantly affected by the pandemic. Mobility restriction during the pandemic affected the FDI of some businesses in the service sector like education and tourism.

Khan, Khan, and Shafiq (2021) conducted a comprehensive comparative study of the impacts of COVID-19 on macroeconomic variables across nations. The results reveal that the global pandemic has had a significant detrimental effect on several key areas of the economy, including international trade, foreign direct investment, healthcare, employment levels, travel, and tourism. The study found that the severity of the effects was more pronounced in Europe and America than in Asia. The researchers classified the economic costs of the pandemic into both short- and long-term effects, and tangible and intangible impacts. The transmission mechanisms identified included the loss of human capital, disruption to the health of skilled workers, and a decline in productive activities.

Similarly, Jaworski, Karczewski, and Kuczmarska (2020) examined how Polish investors assess and incorporate risks related to foreign direct investment using primary and secondary data from Polish enterprises. The findings revealed that natural epidemics and pandemics, such as COVID-19, were not considered by Polish investors in their risk assessments. The study found that Polish investors primarily considered price, trade, legal, market, and credit risk in the host country when assessing investment risks. The report noted that disruptions in supply chains were ranked 12th by Polish investors in risk analysis.

By employing the World Pandemic Uncertainty Index as a representation of the COVID-19 Pandemic, the research analysed the economic consequences of the outbreak on foreign direct investment in 12 emerging regions between 2014 and 2021. Koçak and BarşTüzemen (2022) used panel quantile regression to assert

that the pandemic was more catastrophic in countries with low and average investment inflows, while the influence was insubstantial in countries with high direct investments. They justified their argument by claiming that there are no good economic environments, such as competitiveness, political and economic stability, or conducive business policies, in low- and middle-investment recipient countries, making them more susceptible to the global epidemic than high-investment countries.

Fang, Collins, and Yao's (2021) research outcomes indicate that the COVID-19 pandemic despite its far-reaching presence in the Chinese economy, the COVID-19 pandemic positively impacted the nation's investment inflows. This could be attributed to the utilisation of the concept of dual circulation, which successfully absorbed the external shocks caused by the pandemic. However, Camino-Mogro and Armijos (2020) postulated a contrasting viewpoint, positing that the lockdown and mobility restriction policies implemented globally to counteract the adverse effects of COVID-19 had a detrimental impact on Ecuadorian firms. This negative outcome was especially pronounced in North and South America. Furthermore, they asserted that the partial resumption of productive activities in the absence of business confidence and economic stability did not improve investment inflows.

Hayakawa and Park (2022) conducted an economic modelling on the influence of COVID-19 on FDI, used panel data from 96 economies sampled from emerging market economies and OECD countries. The study was conducted between January 2019 and June 2020. The findings from the Heckman two-stage bias selection approach revealed an inverse relationship between COVID-19 and FDI. Further analysis showed that multinational corporations' (MNCs) investment decisions regarding FDI display higher reactivity to the COVID-19 pandemic in host economies compared to source economies. The papers argued, based on empirical findings, that the negative effect of COVID-19 on FDI in host economies resulted from reductions in the announcements of new greenfield projects and mergers and acquisitions. COVID-19 was seen as diminishing the economic outlook of host economies, leading to difficulties in ascertaining cash flows and hindering new investment decisions (UNCTAD, 2020).

UNTCAD (2020) presented an argument that COVID-19 impacts on both host and source economies are negative. It was documented that COVID-19 had detrimental impacts on the business environment, posed financial constraints to affiliate investors in domestic economies, and reduced investment returns and profit margins. Additionally, a decrease in capital formation resulting from plummeting profits was another channel through which COVID-19 affected FDI, as it reduced dividend payments to investors and reinvestment (Camino-Mogro & Armijos, 2020).

Camino-Mogro and Armijos (2020) applied a discontinuity-in-time design regression approach to examine the magnitude of the effect of the COVID-19 economic lockdown on FDI inflows in Ecuador. The findings reveal a negative impact of economic lockdown policies and COVID-19 on FDI, resulting in a 63% decline in FDI inflows. The authors argued that COVID-19 not only destroyed the health ecosystem but also severely affected the world economy through increased unemployment, heightened inequality, decreased purchasing power, and a reduction in the world market size due to high mortality rates. As of February 8, 2021, a total death rate of 2.31 million people worldwide was recorded due to COVID-19 (Fang, Collins, & Yaoa, 2021). The study unaccounted-for factors like market size, global trade dynamics, and human capital, which influence COVID-19, financial development, and FDI decisions. Excluding these variables created spurious correlations in their findings, where the estimated relationships were driven by omitted factors rather than true causal effects.

Heidary (2022) used a system dynamic model to examine the economic consequences of COVID-19 on FDI. The empirical study found that FDI responds negatively to an increase in COVID-19, via the channels of global supply chain disruption, reduced capital investments, and a decrease in the number of potential investors.

However, the authors noted that FDI outflows increased because of COVID-19, leading to positive effects in foreign economies and negative effects in domestic economies. It was recommended that production capacity flexibility is needed to diminish the harmful effects of COVID-19 on the distribution chain and FDI (Fang, Collins, & Yaoa, 2021).

Koçak, Barış and Tüzemen (2022) presented an empirical argument on the COVID-19-FDI nexus in 12 emerging economies between 2014 and 2021, using data sourced from the OECD database. A panel quantile regression approach was used, with COVID-19 proxied by a dummy variable. The findings identified the pandemic as a negative driver of FDI in low-FDI receiving economies. However, the effect remains positive but statistically insignificant in high-FDI receiving economies. The study documented that the COVID-19 outbreak reduced purchasing power due to unemployment and reduced working hours resulting from lockdown measures. As a result, the demand for industrial goods and services drastically decreased, leading to a contraction in MNC profits and a decline in domestic capital formation. The study concluded that countries with weaker absorptive capacities primarily influenced the economic shock of COVID-19.

Previous studies have examined the finance-FDI nexus (Viana Duart, Kedong & Xuemei, 2017; Oseia & Kim, 2023; Adam, 2022) and the human capital-FDI association (Oyamendan, 2022 and Shamsan and Samikon, 2022). Some research has gone as far as analysing how a global crisis affects the inflow and outflow of FDI. However, little or no research has been done on how human capital formation and natural resources can moderate COVID-19-finance-FDI nexus while simultaneously looking at the changes that occur pre- and post a global economic shock. This study adopted an estimator that reports robust estimates and accounts for cross-sectional dependencies in endogeneity and simultaneity bias.

Data and Methodology

Data Source and Variable Measurements

This paper relies on panel data for 42 SSA economies over a time frame spanning 1996 to 2021. The countries were selected based on data availability, and the data used for the analysis were sourced from the World Development Indicators (World Bank, 2021). The variables used in the empirical analysis include foreign direct investment, financial development, life expectancy, secondary school enrolment (as measures of human capital), natural resources, macroeconomic stability, market size, and trade openness. Foreign direct investment inflow normalised by GDP followed the measurement used in previous studies (Aluko, 2020; Hermes & Lensink, 2003; Ojeka, et al., 2023). Financial development is the ratio of domestic credit extended to the private sector relative to GDP and the ratio of broad money supply relative to GDP. In the preliminary stages, the Authors initially aimed to employ the financial development Index provided by the International Monetary Fund (IMF), but due to a significant loss of observations, this study applied the two main indicators widely used in the literature. Financial development was measured using the ratio of domestic credit allocated to the private sector in relation to GDP (Ojeka, etal, 2023; Cheng, Chien, & Lee, 2020; Desbordes & Wei, 2017). Islam et al. (2021) adopted the ratio of broad money supply normalised by the GDP as a proxy for financial development. The former was argued to help measure financial institutions' efficiency, while the latter measures the depth and effectiveness of the financial sector (Ojeka, et al, 2023). Life expectancy and gross secondary school enrolment were adopted as proxy variables for human capital, following Islam et al. (2021). Macroeconomic stability was measured using the annual inflation rate, in line with Islam et al. (2021). The authors postulated that instability increases exchange risk premiums and financial risk for investors and thus tends to delay capital inflows when high (Islam et al., 2021). The ratio of the aggregation of exports and imports normalised by GDP was used to measure trade openness, following the approach of Ojeka et *al*. (2023) and Islam et *al*. (2021). Natural resources as a percentage of rent were used to measure

availability, in line with Hussain et al. (2020). Purchasing power was measured using income per capita, and it was normalised by taking the natural logarithm to remove outliers in the panel. COVID-19 was measured with a dummy variable, where 1 indicates the COVID-19 period, and 0 indicates no COVID-19 period. This study follows the path of (Fua, Alleyne, & Mu, 2021; Koçak & Barış-Tüzemen, 2022; Gujarati & Porter, 2008; Wooldridge, 2002)

Estimation Strategy

In modelling equation that shows how natural resources and human capital moderate the influence of COVID-19 and financial development on FDI, the study goes in the spirit of the preceding investigations (Syarifuddin & Setiawan, 2022; Islam, *et al.,* 2021; Liu, *et al.,* 2020; Desbordes & Wei, 2017). The baseline equation of the empirical analysis is thus formulated as follows:

$$FDI_{it} = \alpha + \beta FDI_{it-1} + \gamma FD_{it} + \theta LE_{it} + \vartheta CP_{it} + \pi LGDPPC_{it} + \rho POP_{it} + \varphi GFCF_{it} + \omega NAR_{it} + \Delta OPN_{it} + \underset{t}{\in} + \varepsilon_{it} \quad (1)$$

Where FDI represents the response variable, FD is financial development, LE is life expectancy, which is the proxy for human capital, CP is macroeconomic stability measured by annual rate of inflation, LGDPPC is purchasing power measured by per capita income, POP is market size measured by annual population growth rate, GFCF is business environment measured by gross fixed capital formation, NAR is available natural resources, OPN is trade openness, and country-specific effects are denoted by $\underset{t}{\in}$. ε_{it} is the stochastic error with the assumption of no constant variance and an expected mean of zero, that is, $\varepsilon \sim N(\sigma^2, 0)$. The index in subscript i are countries within the sample ($i = 1, 2, 3, ..., 42$) and the period is denoted by t (1996, 1997, 1997, ..., 2021). The theoretical expectation and parameters to be empirically estimated are identified thus$\beta > 0$, $\gamma > 0$, $\theta > 0$, $\vartheta < 0$, $\pi > 0$, $\varphi > 0$, $\omega > 0$, and $\Delta > 0$. The linear and individual form of COVID-19-finance-FDI trilogy is expressed by equation (1). To achieve one of the objectives of this paper—examining the moderating role of resource and human capital on the influence of COVID-19 and financial development on FDI—the two variables interacted in the spirit of existing investigations (Egbetunde & Akinlo, 2019; Hussain, et al., 2020; Islam, et al, 2021; Ojeka, Odey, Adebayo, & Amodu, 2023; Olaniyi, 2020). The equation that incorporates the interactive variables is re-formulated in equation (2)

$$FDI_{it} = \alpha + \beta FDI_{it-1} + \gamma FD_{it} + \varnothing_i \sum_{j=1}^{2} FD_{it}{}^{*}HC_{it} + \tau_i\, FD_{it}{}^{*}NAR_{it} + \theta LE_{it} + \vartheta CP_{it} + \pi LGDPPC_{it} + \rho POP_{it} + \varphi GFCF_{it} + \omega NAR_{it} + \Delta OPN_{it} + \nabla POP_{it} + \in_t + \varepsilon_{it} \quad (2)$$

An empirical analysis of the interplay between resources, human capital, COVID-19, sound financial systems, and FDI is tested using equation (2). Following in the footsteps of previous studies (Egbetunde & Akinlo, 2019; Hussain, et al., 2020; Islam, et al., 2021; Ojeka, et al, 2023; Olaniyi, 2020). The marginal effects of financial development on FDI are obtained by taking the first partial differentiation of equation (2) to arrive at equation (3) and equation (4), respectively.

$$\frac{\partial FDI_{it}}{\partial FD_{it}} = \gamma + \varnothing HC_{it} \quad (3)$$

$$\frac{\partial FDI_{it}}{\partial FD_{it}} = \gamma + \omega NAR_{it} \quad (4)$$

The effects of resource and human capital in catalysing and mediating the influence of financial development on FDI depend on the coefficient $\gamma, \varnothing\, and\, \omega$ respectively. According to arguments documented in previous studies (Ojeka, et al, 2023; Olaniyi & Oladeji, 2020; Olaniyi, 2020), four interpretations can be

generated from Equation (4) by considering the sign, magnitude, and significance of $\gamma, \varnothing \; and \; \omega$, and the four possible ways are thus interpreted as follows:

a. If $\gamma > 0$ and $\varnothing > 0$, this implies that a sound financial system positively influences FDI, whereas human capital acts as an essential trigger that helps the economy reap the growth benefits of financial development on FDI.

b. $\gamma > 0$ and$\varnothing < 0$, this implies that financial development is a positive driver of FDI, whereas human capital drains the benefits of financial development on FDI.

c. $\gamma < 0$ and$\varnothing > 0$, this suggests that FDI is negatively influenced by financial development, and human capital mitigates this negative influence by providing the necessary impetus that addresses vulnerabilities and unscrupulous practises in the financial sector to enhance its efficiency.

d. $\gamma < 0$ and$\varnothing < 0$, it points that financial development negatively influences FDI, and human capital intensifies the adverse consequences of financial advancement on FDI.

The argument in the literature suggests that where γ and $\varnothing$ indicated different signs and both are statistically significant within the conventional level (10%, 5% and 1% respectively), there is a strong indication of the existence of a threshold (Ojeka, Odey, Adebayo, & Amodu, 2023; Olaniyi, 2020; Olaniyi & Oladeji, 2020). However, the above threshold analysis has been documented in the existing literature and has been argued to have many shortcomings (Ojeka, Odey, Adebayo, & Amodu, 2023; Olaniyi, 2020; Olaniyi & Oladeji, 2020). Thus, this study estimates the dynamic threshold regression, treading upon the paths of Seo and Shin (2016), applying the Stata algorithm provided by Seo, et al. (2019) as the robustness check for the main empirical analysis. The static threshold value is obtained by setting $\frac{\partial FDI_{it}}{\partial FD_{it}}$ to be equal to zero, meaning $\frac{\partial FDI_{it}}{\partial FD_{it}} = \gamma + \varnothing HC_{it} = 0$.

The econometric model showing the dynamic threshold in the spirit of Seo and Shin (2016) using the algorithm proposed by Seo et al. (2019) is developed as follows:

$$FDI_{it} = (1, X'_{it})\alpha_1 1(LE_{it} \leq \delta) + \alpha_2 1(LE_{it} > \delta) + \varepsilon_{it} \tag{5}$$

Where $\varepsilon_{it} = \gamma_i + v_{it}$

Where FDI is the net inflows of FDI, and it is the response variable in the model, X' is a K *1 vector of the dynamic predicator, where the lagged of the dependent variable (FDI_{it-1}), main dependent variables and control variables are included. 1{.} connotes indicators function; δ is the threshold value and LE_{it} measured human capital, and it is our transition variable. The slope coefficients associated with the two regimes are denoted by α_1 and α_2, respectively and ε_{it} is the unobserved country-specific fixed effect (γ_i) and stochastic random error term (v_t)

The equation (5) shows the dynamic panel threshold estimator, a continuation of Arellano and Bond's (1991) GMM method by taking the first difference of their equation, as documented in previous studies (Olaniyi, 2020; Ojeka, Odey, Adebayo, & Amodu, 2023; Seo & Shin, 2016; Seo, Kim, & Kim, 2019). This estimator has advantages over a static threshold estimator because it incorporates endogenous regressors to resolve simultaneity bias and endogeneity (Seo, Kim, & Kim, 2019). Additionally, the threshold variable follows an asymptotic standard distribution. The validity of the threshold effect is determined by the bootstrap p-value, which should be statistically significant at conventional levels of significance (1%, 5%, and 10%) (Seo and Shin, 2016; Aluko, 2020).

The main estimator used in this study is chosen carefully to avoid simultaneity bias, as previous studies have identified the possibility of a bi-directional relationship between financial development and FDI (Desbordes & Wei, 2017). Moreover, other factors, such as institutional quality, infrastructure, exchange rate volatility, unemployment, risk premiums, interest rates, and other macroeconomic variables, were found to

be determinants of FDI and were not captured in our empirical analysis (Islam, et al., 2021; Fu, Alleyne, & Mu, 2021; Fang, Collins, & Yaoa, 2021). Omitting these variables may lead to biassed and inefficient estimates and may introduce endogeneity issues (Olaniyi, 2020; Wooldridge, 2002).

Furthermore, there is a possibility of endogeneity in our response variable (FDI), which can cause simultaneity problems. Therefore, employing an estimator that addresses endogeneity in equation (3) is essential, as documented by Olaniyi (2020).

This paper applies a two-step GMM, following the approaches of Arellano and Bond (1991) and Blundell and Bond (1998). This econometric method is suitable for panel analysis when the number of groups in the panel (N) exceeds the number of time series observations (Roodman, 2009; Arellano & Bond, 1991; Olaniyi, 2020). It is well-suited to address potential endogeneity, serial correlation, and heteroscedasticity issues (Roodman, 2009; Blundell & Bond, 1998). The Hansen Test reveals the instrument's validity, and it must not be significant at conventional levels of significance (1%, 5%, and 10%) (Roodman, 2009). Additionally, the presence of second-order serial correlation (AR(2)) should be absent in the model for the estimates to be valid and robust to second-order serial correlation, as argued by Arellano and Bond (1991). However, this methodology has been criticised for its inability to account for cross-sectional dependence in panel analysis (Ojeka, et al, 2023; Olaniyi, 2020; Roodman, 2009). Therefore, this study follows the approaches of existing studies (Pesaran, 2004; Frees, 1995; Friedman, 1937) and utilises the Stata computational algorithm provided by Hoechle (2006) to address cross-sectional dependence. Olaniyi (2020) documented that the Driscoll-Kraay nonparametric covariance matrix estimator should be adopted when the panel has cross-sectional dependence. This estimator not only helps to report consistent estimates that are robust to heteroscedasticity and serial correlation and accounts for general cross-sectional and temporal dependence. It is adopted as a robustness check for two-step GMM estimates.

Results and Discussion

This section of the paper summarises and provides the empirical findings from the econometric and statistical strategies applied to explore the moderating role of raw materials and human capital on COVID-19, finance, and FDI links in sub-Saharan African countries between 1990 and 2020. This section begins with the presentation and interpretation of the descriptive statistics. This section is followed by the baseline model, the main empirical results, and a robustness check for these results. The final section discusses the results and their policy implications.

Descriptive Statistics

Summary statistics of the series are necessary in empirical studies in economics and statistics. They help determine the central tendency, dispersion, and normality of the series in the model (Gujarati, 2008; Wooldridge, 2002). These statistics enable researchers to detect and eliminate outliers, if present, before conducting the main empirical analysis, making them a crucial part of pre-econometric analysis. Table 1 lists the results.

Table 1

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
FDI	1,269	3919	9195	−18918	161824
DCP	1,12	18288	21614	0.000	142422
BM	1,203	28491	20288	2857	156843
CP	1,17	90280	95432	0.000	2725310

Variable	Obs	Mean	Std. Dev.	Min	Max
GDPPC	1,269	1,974.968	2,765.050	204024	16,990.000
GFCF	1,036	20869	9601	−2424	93548
POP	1,302	2538	1496	−16881	16626
SE	788	43627	29785	5221	156551
LE	1,302	56147	7556	14098	77237
NAR	1,232	12703	11555	0.001	62001
OPN	1,143	65843	31900	16352	225023

Source: Authors' computation from STATA 15

Panel unit test outcomes

Because the cross sections are interdependent (see Table 4.7), we conduct second-generation stationarity tests. Table 2 presents the results, which indicate stationarity and integration of the same order for all cross-sections (implying I(0) series). Consequently, SGMM is a more suitable estimator than Pooled OLS or Fixed Effects for modelling this association (Roodman , 2009; Wooldridge, 2002). This is because SGMM leverages moment conditions that are independent of the time dimension (T), focusing instead on relationships within each cross-sectional unit, which is advantageous in our case due to the large number of cross-sections compared to time periods.

Table 2

Panel stationary test outcomes at each level

Series	IPS Test	ADF
FDI	−6.640***(0.000)	−31.495***(0.000)
DCP	−11.118***(0.000)	−41.099***(0.000)
GDPPC	−7.426***(0.000)	−35.778***(0.000)
GFCF	−5.834***(0.000)	−27.391***(0.000)
POP	−7.098***(0.000)	−33.990***(0.000)
SE	−4.159***(0.000)	−17.167***(0.000)
LE	−6.046***(0.000)	−28.587***(0.000)
NAR	−5.845***(0.000)	−27.487***(0.000)
OPN	−6.596***(0.000)	−31.488***(0.000)

Note: *** denotes the level of significance at 1%. The numbers in brackets represent the probability values corresponding to the t and z statistics in the IPS and ADF tests, respectively.

Table 1 provides a summary of descriptive statistics and reveals that the average FDI inflows in this study were 3.92%, with a minimum value of −18.92 and a maximum value of 161.882 within the scope of the study. The standard deviation, which measures the variability of the series from its mean value, is relatively low at 9.20. This suggests that FDI inflows into the SSA region did not exhibit significant fluctuations over time. The low value of FDI inflows in the SSA region, as indicated by the mean value, aligns with the theoretical grounds of weak institutional quality, high transaction costs, low human capital formation, and a hostile business environment (Islam, et al., 2021). Financial development, measured by the ratio of credit allotted to the private sector normalised by GDP, has a mean value of 18.29 with a lower bound of 0.00 and an upper bound of 142.42. The purchasing power, using income per capita, shows a possibility of outliers in the series, so the natural logarithm of the variable was taken for normalisation purposes (Gujarati, 2008). Overall, there is a high level of consistency in the series used for the analysis, as evidenced by the lower and upper bounds

of each series. This provides strong evidence that the series satisfied the necessary conditions for further empirical testing (Gujarati, 2008; Wooldridge, 2002; Liu, et al., 2020). This paper proceeds to examine the baseline equation for this study, which is summarised and reported in Table 3.

Table 3

Baseline Equation from the Two-Step System -GMM

Variable	FDI	FDI	FDI	FDI
FDI_{t-1}	0.377 (8.82)***	0.168(21.82)***	0.462(7.06)***	0.216(24.47)***
DCP	−0.097(-1.91)*	0.625(7.74)***		
BM			−0.427(5.97)***	0.162(7.67)***
COVID	−0.972(-3.68) ***	−1.225(-4.23)***	1.640(6.69)***	2.492(29.95)***
CP	0.062(5.62)***	−0.005(-0.62)	0.118(6.18)***	−0.017(-3.42)***
LGDPPC	−0.296(0.828)	−11.129(-11.27)***	13.156(4.35)***	−4.930(-10.47)***
GFCF	0.581(27.78)***	0.164(27.95)***	0.530(9.03)***	0.014(1.90)*
POP	0.550(1.88)*	3.085(12.28)***	−1.924(-2.63)***	0.397(1.58)
SE	−0.123(-2.82)***		−0.321(-2.29)**	
LE		−0.345(-2.68)***		−0.053(1.32)
NAR	−0.217(-12.23)***	−0.269(-20.46)***	−0.031(-2.00)**	−0.308(-29.54)***
OPN	0.091(6.24)***	0.211(34.11)***	0.148(6.58)***	0.158(38.37)***
CONS	−10.288(-1.39)	69.126(22.86)***	−89.510(-5.72)***	29.816(9.57)***
Number of Instruments	32	32	32	33
Number of Groups	33	35	34	35
AR(1)	−2.60(0.009)***	−1.67 (0.096)*	−2.41(0.016)**	−1.78(0.075)*
AR(2)	−1.33(0.185)	−1.61(0.108)	−0.42(0.672)	−1.37(0.170)
Hansen Test	21.24(0.445)	17.57(676)	21.19(0.448)	23.29(0.386)

*, **, and ** suggest failure to support the null hypothesis at 10%, 5%, and 1%, respectively. The number in parentheses denotes the t-statistic. The number in parentheses for AR (1), AR (2), and the Hansen test implies the probability value. The result summarised and provided are based on the collapsed option in line with Roodman(2009b).

The baseline models estimated and summarised in Table 3 clearly indicate that the choice of variables and their measurements are crucial in modelling the consequences of financial development on FDI inflows within the sub-Saharan African region. All four models show divergence in the steady growth of FDI, and they are statistically significant at 1%, confirming the validity of the adopted two-step system GMM that accounts for dynamic effects. The results also reveal a consistent positive and highly significant association between financial development (measured by credit to the private sector or broad money supply as a fraction of GDP) and FDI inflows when human capital is measured by life expectancy.

Column 1 infers that FDI inflows respond inversely to changes in financial development and is weakly significant at a 10% level. The magnitude of the effect indicates that a 1% increase in financial sector development leads to a 0.097% decrease in FDI inflows. The coefficient of the dummy variable for COVID-19 indicates that FDI inflows were higher in the pre-COVID-19 period than in the COVID-19 period. Macroeconomic stability, business environment, and market size are positive determinants of FDI. However, contrary to expectations, natural resources and human capital formation are negative drivers of FDI inflows.

In column 2, where life expectancy proxies human capital, no significant changes emerge. The influence of financial development on FDI becomes positive and statistically significant. This aligns with expectations, as efficient financial markets distribute and diversify risk, lower transaction costs, and facilitate business transactions. The dummy variable continues to indicate lower FDI inflows during the COVID-19 pandemic.

Macroeconomic instability and purchasing power are negatively and significantly associated. Trade openness, business environment, and market size remain positive and statistically significant drivers of FDI inflows. Human capital (measured by life expectancy) and natural resources are again found to be negative drivers of FDI inflows.

In column 3, the results indicate that financial development (proxied by broad money supply as a fraction of GDP) has a negative and significant effect on FDI inflows. The coefficient indicates that a 1% increase in financial development leads to a 0.427% decrease in FDI inflows. This aligns with the findings of the first model, in which gross secondary school enrolment was used as a proxy for human capital formation. The dummy variable indicates higher FDI inflows during the COVID-19 pandemic, contradicting the results of the first two models. Macroeconomic stability, purchasing power, and openness to trade are positive determinants of FDI inflows, whereas market size, natural resources, and human capital formation are negative drivers.

In column 4, financial development quantified by the ratio of broad money supply normalised by GDP indicates a positive driver of FDI inflows. Such that a 1% increase in financial development leads to an average increase of 0.162% in FDI inflows. The dummy variable indicates higher FDI inflows during the COVID-19 pandemic. Market size, business environment, and trade openness are also positive drivers of FDI inflows. Conversely, macroeconomic stability, real income per capita, natural resources, and human capital formation (measured by life expectancy) are negative determinants of FDI inflows.

In summary, out of the four baseline models examined, two models concur that financial development is a positive driver of FDI, while the other two models consider it a positive driver. All four models agreed that human capital formation and natural resources are negative determinants of FDI inflows. Findings failed to establish whether FDI inflows were higher in the pre-COVID-19 period relative to the COVID-19 period because two models report lower FDI inflows during the COVID-19 period and the other two claims otherwise. Given these findings, this paper acknowledges the difficulty of drawing conclusive policy implications solely based on baseline models and proceeds to include additional control variables and moderators in the model, which are summarised and displays in Table 4.

Table 4

Main Model from two-step system GMM

Variable	FDI	FDI	FDI
FDI_{t-1}	0.417(12.15)***	0.442(9.13)***	0.097(7.13)***
DCP	0.242(5.30)***	−0.449(-2.41)**	1.986(2.45)**
COVID	−1.057(-3.38)***	−0.933(-3.45)***	−0.589(-2.22)**
CP	0.059(6.52)***	0.053(5.19)***	0.014(3.12)***
LGDPPC	−7.338(-3.69)***	0.230(0.17)	8.539(-6.40)***
GFCF	0.596(24.88)***	0.548(25.44)***	0.328(32.74)***
POP	0.907(3.69)***	−0.140(-0.51)	4.415(8.64)***
SE	−0.068(-1.89)*	−0.154(-4.13)***	
LE			0.566(2.30)**
NAR	0.090(2.02)**	−0.189(-5.61)***	−0.176(-13.86)***
OPN	0.068(3.89)***	0.070(3.83)***	0.148(30.58)***
DCPNAR	−0.016(-4.49)***		
DCPSE		0.005(2.27)**	
DCPLE			−0.031(-2.34)**

Variable	FDI	FDI	FDI
CONS	29.385(2.25)**	–7.899(-0.88)	2.061(0.10)
Number of Instruments	32	32	33
Number of Groups	33	33	35
AR(1)	–2.67(0.008)***	–2.68(0.007)	–1.71(0.088)**
AR(2)	–1.32(0.186)	–1.25(0.210)	–1.51(0.130)
Hansen Test	18.98(0.523)	21.39(0.374)	26.32(0.194)

Note: *, **, and ** indicate failure to support the null hypothesis at 10%, 5%, and 1%, respectively. The number in parentheses denotes the t-statistic. The number in parentheses for AR (1), AR (2), and the Hansen test implies the probability value. The result summarised and provided are based on the collapsed option in line with Roodman(2009b). The static threshold value was obtained by setting the partial-differential equation of model 1 to zero meaning $\frac{\partial FDI_{it}}{\partial FD_{it}} = \beta_{FD} + \beta_{FD*NAR} NAR_{it}$=0)

The main results on the moderating influence of natural resources and human capital on the effects of COVID-19 and financial development on FDI in SSA are presented in Table 4. The findings in Column 1 indicate the existence of divergence in FDI inflows. Furthermore, evidence shows that for every 1% increase in previous FDI inflows, holding other exogenous variables constant, a 0.417 increase in current FDI inflows. The strong and statistically significant influence of the past on the current inflows of FDI confirms the necessity and validity of employing a two-step GMM approach in the analysis. Financial development, measured by the ratio of credit allocated to the private sector relative to GDP, was identified as a positive driver of FDI, and it is highly significant at 1%. The coefficient implies that on average, for every 1% increase in financial development, there is a 0.242% increase in FDI inflows. This finding supports the supply-led hypothesis, which suggests that the development of the financial sector creates stability in the macroeconomic environment, diversifies financial risk, and facilitates financial intermediation, influencing foreign and domestic investors' investment decisions. The coefficient of the dummy variable for COVID-19 is negative and statistically significant at 1%, indicating that FDI inflows into the SSA region were higher before COVID-19 than during the post-COVID-19 period. This trend can be attributed to the increased uncertainty and perceived risk associated with COVID-19, leading to decreased economic activities and reduced FDI in the region. The interaction variable between natural resources and financial development indicates that natural resources mitigate the benefits financial development exacts on FDI inflows. This variable is important for determining the threshold value at which natural resources must attain before the positive effects of financial development on FDI inflows in the SSA region are eroded. The coefficient implies that financial development positively influences FDI inflows, whereas natural resources act as a negative driver that weakens the positive effect of financial development on FDI inflows. The finding implies that when natural resource availability (measured by natural resource rent as a share of GDP) exceeds 15.125, the positive effect of financial development on FDI inflows is mitigated. Macroeconomic instability, proxied by consumer price index, business environment, market size, measured by population growth, natural resources, and trade openness, was found to be a positive driver of FDI inflows into the SSA region. For instance, the responsiveness of FDI inflows to changes in population is relatively stable and positive. The coefficient implies that FDI inflows increase on average by 0.907% for every 1% increase in population growth (market size). Empirical studies have validated this finding, which aligns with the theoretical postulation that investors consider the size of the market before investing funds and establishing their businesses in an environment. Contrary to our theoretical expectation, purchasing power (measured by GDP per capita) and human capital (measured by gross secondary school enrolment) were found to be negative determinants of FDI inflows. For instance, for every $1 increase in per capita income, on average, FDI inflows diminish by 0.073%.

The results in Column 2 indicate that the last FDI inflow is a positive predictor of the current FDI inflow. Contrary to expectations, the influence of financial development on FDI inflows becomes negative and statistically significant when human capita (secondary school enrolment) interacts with financial development. The coefficient of the dummy variable for COVID-19 indicates that FDI inflow was higher before COVID-19 than in the post-pandemic era. Macroeconomic instability, purchasing power, domestic investment, and openness to trade were identified as positive predictors of FDI inflows into the SSA region. For instance, for every 1% increase in gross fixed capital formation, a 0.548% rise in FDI inflows into the SSA region is likely, while all other exogenous variables remain constant. The responsiveness of FDI inflows to changes in trade openness is positive and highly significant at the 1% level. The coefficient shows that for every 1% increase in trade openness, FDI inflows are triggered by 0.070%. Contrary to expectations, natural resources, market size (population growth), and human capital (secondary school enrolment) were identified as negative drivers of FDI inflows. For instance, for every 1% increase in natural resources, FDI inflows diminish by 0.189%. The interaction variable between financial development and human capital reveals the possibility that financial development is a negative driver of FDI inflows, whereas human capital weakens the harmful effect of financial development on FDI inflows in the SSA region.

In column 3, financial development remains a positive driver of FDI inflows as a statistical measure when life expectancy is introduced into the model. The interaction variable indicates that financial development is a positive predictor of FDI inflows, whereas human capital weakens the positive effect of financial development on FDI inflows in the SSA region. The interaction term indicates that 64 years is the threshold value at which human capital (life expectancy) begins strengthening the positive effect of financial development on FDI inflows in the SSA region. Macroeconomic instability, purchasing power (income per capita), business environment (gross fixed capital formation), market size (population growth), human capital (life expectancy), and trade openness were theoretically signed and identified as positive determinants of FDI inflows into the SSA region. For instance, the magnitude of the effect of the business environment measured by gross fixed capital formation reveals that FDI inflows tend to rise by 0.328%. For every 1% increase in the business environment. In contrast, only natural resources were found to be a significant negative driver of FDI inflows at 1%. The degree of effects indicates that FDI inflows decline at a rate of 0.176% for every 1% increase in harnessed natural resources.

Robustness Analysis

There is a need to conduct robustness checks on our empirical results to determine the sensitivity of our findings to variable measurement and changes in panel econometric methodology. In addition, this section presents the test for cross-sectional dependence (CD).

Table 5

Two-step system GMM Results using share of broad money supply to GDP.

Variable	FDI	FDI	FDI
FDI_{t-1}	0.231(26.70)***	0.413(9.59)***	0.190(16.62)***
BM	−0.132(-5.22)***	−0.269(-1.98)**	−1.052(-5.55)***
COVID	−0.726(-7.59)***	1.540(4.40)***	1.212(8.12)***
CP	−0.009(-2.43)***	0.086(4.52)***	0.00(0.00)
LGDPPC	−5.055(-7.95)***	11.877(5.01)***	−7.386(-13.44)**
GFCF	0.172(17.55)***	0.542(10.65)***	0.0269(2.00)**
POP	2.860(10.83)***	−0.720(-1.30)	3.711(7.20)***
SE		−0.108(-1.89)*	

Variable	FDI	FDI	FDI
LE	0.547(9.42)***		−0.406(-4.44)***
NAR	−0.177(-8.80)***	−0.064(-2.37)**	−0.317(-28.86)***
OPN	0.089(16.86)***	0.132(4.96)	0.253(41.66)***
BMNAR	0.002(2.03)**		
BMSE		−0.002(-1.70)*	
BMLE			0.014(4.73)***
CONS	−3.661(-0.66)	−89.980(-5.61)***	61.035(9.80)***
Number of Instruments	33	33	33
Number of Groups	35	34	35
AR(1)	−1.87(0.061)	−2.65(0.008)***	−1.94(0.053)*
AR(2)	−1.63(0.103)	−0.65(0.514)	−1.49(0.138)
Hansen Test	24.25(0.281)	20.20(0.508)	19.19(0.573)

*, **, and ** imply the rebuttal of the null hypothesis at 10%, 5%, and 1%, respectively. The number in parentheses denotes the t-statistic. The number in parentheses for AR (1), AR (2), and the Hansen test implies the probability value.
Source: Authors' computation from STATA 15.

The results summarised and provided are based on the collapsed option in line with Roodman (2009b). The results in Table 5 align with our main findings, which indicate divergence in FDI inflows. This further validates the application of the SGMM. All instruments used in the analysis were found to be valid, as indicated by the Hansen statistic (Roodman, 2009). Additionally, the results indicate no second-order serial correlation, as indicated by the non-significance of the AR (2) test.

All three models indicate that financial development proxied by the share of M2 relative to GDP is a negative predictor of FDI inflows into the SSA region. Although this contradicts our expectations, it aligns with economic theory (Borensztein, De Gregorio, & Lee, 1998). For instance, in column 1, on average, foreign direct investment declines by 0.132% for every 1% increase in financial development, while other exogenous variables remain constant. There is a slight contradiction between this result and our main finding; therefore, caution is recommended when interpreting these results. Additionally, only model 1 in column 1 shows agreement that FDI inflows were higher before COVID-19 than during the post-COVID-19 period, whereas Columns 2 and 3 indicate otherwise.

All three models agreed that the business environment acts as a positive catalyst for FDI inflows. For instance, in column 2, FDI inflows increase by 0.542% for every 1% increase in domestic investment. Natural resources are consistently found to be negative drivers of FDI inflows in all three models, further strengthening the results presented in Tables 2 and 4.3. Openness to trade positively and significantly affected FDI inflows identified by all three models.

Cross-Sectional Dependence Tests

The financial systems of countries in SSA are debated in the existing literature as interdependent and highly integrated (Olaniyi, 2020; Ojeka et al., 2023). Therefore, the policies of financial systems across SSA countries can trigger actions and reactions among countries. Thus, it is essential to adjust for cross-sectional dependence and avoid misleading policy formulation by reporting biassed estimates (Driscoll & Kraay, 1998; Hoechle, 2006). This study conducts cross-sectional dependence analysis in line with the existing literature, which documented different types of cross-sectional and temporal dependencies in panel data analysis (Hoechle, 2006; Driscoll & Kraay, 1998; Olaoye & Aderajo, 2020; Olaniyi, 2020). The results obtained by different strategies are respectively summarised and provided in Table 6.

Table 6

Tests for cross-sectional dependence from regression

CD-Test	CD-test statistic	P-Value
Pesaran's test	4.428***	0.000
Friedman's test	18.460	0.9953
Frees' test	5.457	0.413

Note: *** indicates rejection of the null hypothesis at the 1% significance level. The assumption of 0 expected value and constant variance of 1 for the cross-sectional dependence stochastic error term holds in the summary of the results reported i.e. CD$\sim N(0,1)$. Also, the reported results were obtained from STATA 15 using the xtcsd algorithm provided by Hoechle (2006).

The results of the CD tests using the three adopted methods are shown in Table 6. The findings revealed that only Pesaran's test validated the existence of CD in the model. However, Friedman and the Free test indicated that there is no CD in the equation. To this end, the study went further to perform a CD test on each series in line with Pesaran (2004), and the results are presented in Table 7.

Table 7

Cross-sectional dependence of the series

Variable	CD Test	P-Value
FDI	26.95***	0.00
BM	66.21***	0.00
CP	134.47***	0.00
LGDPPC	55.37**	0.00
POP	2.01*	0.05
NAR	25.17***	0.00
OPN	20.04***	0.00
LE	125.93***	0.00
SE	66.21***	0.00

Note: * and *** denote that this paper rejects the null hypothesis at 10% and 1%, respectively. The reported results followed the assumption that the error term is normally distributed with a mean of 0 and variance of 1 i.e. CD$\sim N(0,1)$. Also, the summary and reported results were obtained using xmcd STATA code from Hoechle (2006) in line with Pesaran (2004) postulation.

The results of the CD analysis presented in Table 7 reveal the existence of CDs in the series. All series were found to be significant at the 1% level, indicating interdependence and integration between the financial system and FDI in the SSA region. Therefore, CD must be considered in our analysis.

The main results presented in this paper, using the two-step GMM estimation, do not consider CD, which has been identified in the literature as a limitation of this estimation strategy. To address this limitation, this study employs the Driscoll-Kraay estimator as a robustness check for the analysis. The results of this robustness check can be found in Table 8.

Table 8

Regression results from Driscoll-Kraay nonparametric covariance matrix estimator

Variable	Model 1	Model 2
DCP	0.106*(1.68)	
BM		−0.021(-0.47)
COVID-19	−1.699***(-5.00)	−1.594***(-4.42)
CP	0.002(1.26)	0.001(1.20)
LGDPPC	−2.056***(-2.72)	−1.1947***(-2.43)

Variable	Model 1	Model 2
GFCF	0.224***(4.06)	0.226***(3.99)
POP	−0.0355(-0.43)	−0.039(-0.47)
LE	0.145***(3.04)	0.132***(3.35)
NAR	−0.068(-1.26)	−0.077(-1.40)
OPN	0.068***(2.91)	0.069***(2.89)
DCPNAR	0.002(0.81)	0.002(1.33)
DCPLE	−0.001(-1.12)	0.001*(1.73)
CONSTANT	0.420(0.07)	0.977(0.15)

Note: *, **, and *** imply that the null hypothesis was rejected at the 10%, 5%, and 1% significance levels, respectively. The number in parentheses () denotes the t-statistic. The reported results were executed from STATA 15 using scc from the algorithm of Hoechle (2006) algorithm in line with Driscoll and Kraay (1998) regression;. The threshold estimate was obtained using $\frac{\partial FDI_{it}}{\partial DCP_{it}} = 0.1472714 - 0.0021599LE_{it} = 0$. The threshold obtained was 68.18436. In addition, in column 2, the same partial differentiation was applied to obtain the threshold value from column 4 (-36.7093.)

The results of the Driscoll-Kraay nonparametric covariance matrix estimator are presented in Table 8 as robustness estimates to validate the main analysis in Table 4.4. The Driscoll-Kraay confirms that financial development significantly and positively affects FDI at 10% when the ratio of credit allotted to the private sector relative to GDP measures financial development. This finding aligns with existing studies (Islam, et al., 2021) and the GMM findings. The coefficient shows that, for every 1% increase in financial development, assuming all other factors remain constant, FDI inflows tend to increase by 0.106%. However, when financial development is proxied by broad money supply relative to GDP, the responsiveness of FDI to a change in financial development level becomes negative but insignificant at a 10% level. Therefore, caution must be exercised when interpreting the finance-FDI nexus in the SSA region. Additionally, both models agree that COVID-19 acts as a negative driver of FDI, which is consistent with existing studies (Camino-Mogro & Armijos, 2020; Fang, et al, 2021; Fua, et al, 2021). The policy implication of this finding is that FDI flourished more in the pre-COVID-19 period in the SSA region. Contrary to expectations, purchasing power (proxied by income per capita) is a negative determinant of FDI in both models. For instance, the coefficient from model 1 indicates that for every $1 increase in income per capita, assuming all other factors remain constant, FDI declines by 2.065% at a 1% significance level. The two models agreed that business environment and trade openness positively and significantly affected FDI. The magnitude of effect is that for every 1% rise in openness to trade, FDI tends to increase by 0.068% and 0.069% in the first and second columns, respectively. Natural resources appear to be moderate the positive effect on the finance-FDI link but are statistically insignificant in both models. Additionally, human capital tends to strengthen the positive effect of financial development on FDI inflows into the SSA region.

Threshold of Human Capital in Finance-FDI inflows nexus for Sub-Saharan Africa

This paper follows existing literature (Hussain et al., 2020; Olaniyi, 2020; Ojeka et al., 2023) in estimating the threshold at which human capital positively influences FDI in sub-Saharan Africa. However, this study acknowledges the limitations of static estimation strategies in the literature, which assume strict erogeneity of covariates and threshold variables (Ojeka et al., 2023; Olaniyi, 2020; Seo & Shin, 2016). To address these limitations, this study adopts dynamic threshold regression, following the approach proposed by Seo and Shin (2016) and using the Stata estimation code provided by Seo, Kim, and Kim (2019). The results are presented in Table 9.

Table 9
Dynamic Threshold Regression Results

Linearity test (Bootstrap *p-value*)	0.00***
Threshold estimate	51.870***(0.00)
Constant	−135.676***(0.00)
Lower regime ($q<_{it} \leq \delta$)	
FDI_{t-1}	1.284***(0.00)
LE	−0.063(0.774)
DCP	−0.152**(0.02)
LGDPPC	−6.238*(0.10)
Upper regime ($q<_{it} > \delta$)	
FDI_{t-1}	−1.163***(0.00)
LE	0.674*(0.09)
DCP	0.059(0.50)
LGDPPC	13.907***(0.00)

Note: The hypotheses were decided at 1%, 5%, and 10% significance levels and are denoted by ***, ** and * respectively. The values enclosed in brackets () are the probability values corresponding to each indicator, respectively. The summary results reported were obtained from STATA 15 using the xthenreg algorithm provided by (Seo, Kim, & Kim, 2019) in the spirit of Seo and Shin (2016).

Table 9 displays the dynamic threshold regression, which reveals that the threshold value for human capital is 52 years. Beyond this threshold, human capital stimulates FDI inflows positively in SSA. Additionally, the findings indicate that in countries with low human capital formation, financial development negatively and significantly influences FDI. However, in sub-regions with high human capital formation, financial development positively and significantly influences FDI. This indicate that human capital moderates the favourable influence of financial development on FDI inflows in SSA, specifically when life expectancy is 52 years or above. Furthermore, in the upper regime, purchasing power positively and significantly predicts the outcome of FDI, whereas in the sub-region with low human capital formation, purchasing power is a negative predictor of FDI in a significant measure.

Discussion on the Findings

Financial development: This analysis provides a consensus that financial development is a positive determinant of FDI in the SSA region. This finding is consistent with other empirical studies (Islam, et al., 2021; Desbordes & Wei, 2017; Liu, Islam, *et al.,* 2020). According to Islam et al. *(*2020), developed financial sectors lower transaction costs, reduce information asymmetry, enhance international trade, and prompt financial intermediation, leading to foreign investment. The policy implication of this finding is that a sound financial system ensures financial intermediation, lower risk, and a favourable business environment, which are major factors foreign investors consider in host economies. These factors attract capital inflows from source economies. Additionally, the development of the financial sector increases the demand for financial products, acting as a catalyst to bridge investment gaps. As aggregate demand increases, FDI inflows into the SSA region are expected to increase. It is crucial to acknowledge that financial advancement has a significant role in the attractiveness of FDI; however, excessive financial development can lead to financial bubbles that may drain FDI inflows (Cheng, et al, 2020; Borensztein, et al., 1998).

COVID-19: The coefficient for COVID-19 indicates that FDI inflows thrived more during the pre-pandemic. This finding aligns with the existing literature (Camino-Mogro & Armijos, 2020; Fang, et al, 2021; Fua, et al, 2021; Heidary, 2022). The argument behind this negative effect is that COVID-19 disrupts the global supply chain,

increases risk, and reduces capital investments and the number of potential investors. In addition, many economies in SSA implemented travel restrictions and lockdowns as policies to control the transmission of the virus. These restrictions have limited the mobility of capital and people, including business travellers, investors, and industrial diffusion.

Natural resources: Natural resources negatively and significantly influence FDI. This finding is consistent with Escaleras and Register (2011). According to Dutch disease theory, the availability of natural resources can hinder economic growth and other economic activities if not properly harnessed. This shows that the exploitation of abundant natural resources can lead to an appreciation of the domestic currency, making other sectors, such as manufacturing and services, less competitive. Thus, it can discourage FDI in non-resource sectors and hinder economic diversification. In sub-Saharan Africa, it is observed that many countries underutilise their natural resources, and multinational companies in the region export these resources in raw form to serve European and American industries, often neglecting local value addition, thus negatively influencing capital inflows. In addition, natural resources are often subject to price fluctuations in international markets. High price volatility can create uncertainty and risk for investors, especially in sectors heavily reliant on resource extraction. This uncertainty may deter FDI, as investors prefer stable and predictable returns on their investments.

Human Capital: The overall effect of human capital on FDI inflows is negative and statistically significant within the scope of this study. However, countries with developed human capital are linked to increased FDI inflows. Our findings concur with previous studies (Karimi, et al., 2013; Lucas, 1990), which documented human capital as a positive predictor of FDI. These studies argue that increases in human capital formation, in terms of skills, health, and educational attainment, enhance the productivity of multinational companies and reduce technical and operational risks. This, in turn, signals that investors should direct their portfolios to regions with high-quality human capital. In the spirit of Borensztein et al. (1998), host economies can fully benefit from technological diffusion, managerial skill transfer, and other advantages of FDI when the financial sector is developed and there is sufficient human capital formation.

Purchasing Power: Income level serves as a positive catalyst for FDI in sub-Saharan African regions. Our findings indicate that countries with higher human capital formation in the SSA region are linked to increased FDI inflows. Conversely, in regions with low human capital formation, the effect of purchasing power measured by per capita income becomes negative and highly significant. The overall effect of the two-step GMM results indicates that purchasing power is a positive predictor of FDI. This finding contradicts the conclusions of Islam, Das, and Hassan (2021).

Conclusion and Policy Implications

The impact and extent of a robust financial system's influence on FDI are predominantly shaped by the quality of human capital and the availability of natural resources within the host economy. To uncover more information about this subject, this study investigates the moderating roles of human capital and natural resources in the interplay between COVID-19, financial development, and FDI in SSA. To facilitate this examination, panel data extracted from the WDI database, spanning the temporal span of 1990–2021, were harnessed for econometric analyses. This study employed estimation strategies that accounts for cross-sectional interdependencies, address endogeneity, and yield robust outcomes for standard errors, heteroscedasticity, and serial correlation. As a result, the findings presented carry considerable reliability for policy formulation.

The study's outcomes confirm that financial development acts as a favourable predictor of FDI within sub-Saharan Africa, particularly in regions endowed with high-quality human capital. Conversely, within

areas characterised by inadequate human capital cultivation, the influence of finance on FDI is negatively significant. The study also finds that the quality of human capital begins to moderate the positive influence of financial advancement on FDI once it surpasses a threshold of 52 years (measured in terms of life expectancy). Notably, discernible evidence of threshold effects is not observed within the finance-resources-FDI trilogy given the insignificance of the coefficient in our core models. In contrast, the availability of natural resources was identified as an adverse predictor of FDI inflows.

The policy implications of this study underscore the critical role of bolstering the financial sector to curtail risk premiums, foster heightened demand for goods and services, and reduce interest rates by augmenting money supply. These factors collectively empower a robust financial system to positively shape FDI patterns. Policymakers in the region are also encouraged to prioritise the nurturing of human capital through financial commitment in the health and education sectors, thereby maximising the advantages stemming from financial advancement in terms of FDI inflows within sub-Saharan Africa. Furthermore, directing attention towards implementing reforms that enhance the efficiency, stability, and accessibility of the financial sector within SSA nations remains imperative. This entails measures such as enhancing banking regulations, reinforcing supervisory mechanisms, and advocating financial intermediation.

This study, while contributing significantly to the COVID19-FDI-FD trilogy, is not without its limitations. This study's reliance on aggregate data for Sub-Saharan Africa presents a critical limitation, potentially obscuring crucial differences between individual countries within the region and masking crucial heterogeneity in the relationships investigated. Additionally, the study fails to account for the potential endogeneity of financial development and human capital formation, which introduces a feedback loop that could bias the results. Therefore, future research should address these limitations by utilising more disaggregated data at the country or even subnational level, allowing for a nuanced understanding of individual country experiences and their impact on FDI. Furthermore, employing techniques to address the endogeneity of financial development and human capital formation is crucial. Finally, exploring the influence of other relevant factors like political stability and institutional quality, alongside financial development and human capital can provide a more comprehensive picture of FDI dynamics in Sub-Saharan Africa.

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