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Remittances And Sustainable Development In Sub Saharan Africa: The Moderating Role Of Financial Development

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Abstarct: *Sub-Saharan Africa which is comprised of developing countries that hold great prospects for sustainable development and remittances remain a viable source of financing its attainment. Financial intermediation is inevitable in facilitating this goal in line with achieving SDGs in the region. This paper examines the moderating role played by financial sector development in the dynamic nexus between remittances and sustainable development in 30 Sub-Saharan African countries using panel data covering the period 2000–2022. The study is premised on the two-gap model theory which emphasises resource mobilisation through remittances to bridge the savings gap and foreign exchange gap for sustainable development and this guides the study's analysis and recommendations. It contributes to current development literature by offering long-run panel data evidence on the moderating role of financial development in the remittances-sustainable development nexus in Africa. The study employed SYS-GMM and two-step dynamic GMM techniques to address the issue of endogeneity. The findings showed that there is a significant positive correlation between the interactive term of remittances and financial development with respect to sustainable development in Sub-Saharan Africa. The study concluded that in the 30 Sub-Saharan African nations, financial development and remittances act as complements to sustainable development. Accordingly, the study recommends strengthening financial institutions as a sound financial system reduces the cost of sending remittances which aligned with SDG 10.c that seeks to reduce transaction costs in sending remittances.*
Keywords: *Financial Development, Remittances, Sustainable Development, Africa.*

INTRODUCTION

Sustainable development remains a topical theme not only in sub-Sahara African countries (hereafter, SSA countries) but across the globe has been a lofty goal that can only be achieved when adequate global resources are mobilized for its attainment. It has been noted that remittances are very important in achieving the SDGs particularly as regard households' welfare, public development agendas, private sector and market capabilities, and inclusive development and more so that sustainable development is a development agenda that is both equitable and inclusive in the short-and long-terms' horizons (Barkat et al., 2024). Interestingly, evidence suggests that remittances promote sustainable development by been a pivotal factor in reducing pollution which

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undoubtedly play a part in the enhancement of ecological sustainability in the long term (Daly et al., 2022).

Remittances as the most resilient capital inflows to developing nations have become a major source of diaspora finance for sustainable development and SDGs attainment (Barakat et al., 2024). Remittance inflows are facilitated by financial intermediaries such as banks and online monetary transfers' platforms. This crucial role played by financial sector development in the seamless facilitation of diaspora remittances could foster a faster attainment of SDGs in the SSA region, which is indispensable for sustainable development (Yadou et al., 2024; Barkat et al., 2024). Various strategies have been proposed by researchers and scholars around the world in an effort to attain the SDGs. One of these strategies is that remittance inflows can be increased and facilitated through financial development. Moreover, empirical literature has put forth a number of arguments to support the idea that financial development is important in encouraging remittance inflows. For instance, remittance costs are reduced by financial development, which enables migrants to send fund to their families back home more easily (Yadou et al., 2024; Barkat et al., 2024).

Remittances are mainly financial transfers and therefore financial intermediaries such as commercial banks and online financial platforms like Western Union and MoneyGram are inevitable in ensuring that they are properly channelled from the migrant workers to their families and loved ones. This underscores the impact that financial development played in moderating the connection between remittances and sustainable development. Current evidence suggests that financial inclusiveness plays a mediating role in the nexus between remittances and sustainable development in the case of 109 developing nations (Barkat et al., 2024).

The foregoing established that fact that financial inclusion played a mediating role in the relationship between remittances and sustainable development in developing countries and this is critical for development outcomes. An interesting question that is worthy of serious consideration is: does financial sector development play a moderating role in the relationship between international remittance inflows and sustainable development in SSA between 2000 and 2022? This the research gap that this study intends to fill empirically.

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In view of the foregoing, it is essential to investigate whether financial sector development played a moderating role in the relationship between remittances and sustainable development in the SSA region. This can be done by exploring the interactive effects of financial development and remittances on sustainable development in 30 SSA countries between 2000 and 2022. By understanding the moderating role played by financial development in the nexus between remittances and sustainable development, the study can enable policymakers in SSA countries to promote SDG attainment using these cross-country transfers through financial sector development.

By adjusting for GDP, GDP per capita, aggregate private investment, trade openness, inflation and foreign direct investment in the model based on system GMM and two-step dynamic GMM approaches, the paper's primary goal is to examine the moderating role played by financial development in the relationship between remittances and sustainable development in the SSA. We analyze the moderating role impact by also testing the robustness of the results with panel two stage least squares technique.

The study's motivation stems from a number of significant reasons. First is the potential of evidence that may proceed forth from the exploration of the moderating role played by financial development in the relationship between remittances and sustainable development in SSA in the light of greater financial inclusion in the region.

Second, the moderating roleplayed by financial development in the relationship between remittances and sustainable development in SSA with implications on areas such as poverty elimination, zero hunger, good health and well-being, and quality education, etc. is an understudied area. The prospects of evidence from this empirical issue becomes a major attraction for research by development economists.

Given the foregoing, this study has made the following contributions to the body of existing literature: First, as far as we are aware, no research has examined the moderating role played by financial development in the relationship between remittances and sustainability in Africa. Because the subcontinent seeks the pursuit of SDGs achievement and sustainable development which primarily is centred on ending poverty, protecting the planet and ensure peace and prosperity

for all by 2030, this study focuses on the moderating role played by financial development in the remittances - sustainable development nexus in the SSA region thereby revealing the interactions and impacts using the latest data.

Second, unlike other studies, the paper also investigates the moderating role played by financial development in the relationship between remittances and sustainable development in 30 SSA countries using SDGI dataset, which is the most robust proxy for sustainable development (Al-Thani & Koç, 2024; Barkat et al., 2024).

Third, the paper contributes to extant literature by exploring the moderating role played by financial development in the relationship between remittances and sustainable development via control variables such as GDP, GDP per capita, aggregate private investment, trade openness, inflation and foreign direct investment given the fact that these variables may explain the interactive impact of the moderating role played by financial sector development in the remittances- sustainable development nexus in SSA.

Fourth, the study provides long-run panel evidence from 30 Sub-Saharan African countries covering the period 2000–2022. This will undoubtedly grant policymaker with new understanding on the subject-matter in the light of up-to-date empirical evidence.

Finally, the study employed dynamic panel estimation techniques (SYS-GMM and two-step GMM) to address endogeneity. These methodologies are the most appropriate techniques for analysing the moderating role played by financial development in the dynamic relationship between remittances and sustainable development as they offer robust and efficient framework for analysing complex relationships in panel data, making them valuable approaches for researchers and scholars investigating this kind of empirical issue.

The paper is organised as follows: Section 2 examines a review of related literature immediately after this introduction. The theoretical framework and model specification, along with the data and their sources, are presented in Section 3. Section 4 provides the empirical results, analysis, and discussion while Section 5 offers the concluding remarks and some policy recommendations

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Empirical Review & Conceptual Framework

Review of Related Literature

Since the 1990s and the early 2000s, there has been a large body of studies that have examined remittances and financial development/financial inclusion and/or economic growth among other variables such as domestic investment underscoring the relevancy of studying financial sector development in dynamics involving remittances and other variables (see, e.g., the multi-country studies by Rehman & Hysa (2021), Forhad *et al*. (2023), Keho (2024), Topxhiu & Krasniqi (2025)). In these studies, evidence shows that financial development is *sine qua non* in the remittances-economic growth nexus and vice versa. Since 2000, many studies in the literature have also explored the moderating role played by financial development in the relationship between remittances and economic growth (Ojeyinka & Osinubi, 2026; Karim *et al*., 2025; Khan *et al*., 2023; Panthi & Devkota, 2024). Ojeyinka & Osinubi (2026) for instance, found that remittances and financial development play a substitutable role in influencing entrepreneurial activities in Sub-Saharan Africa. The moderating influence of financial development in the relationship between remittances and economic growth is confirmed in panel data estimations in 79 developing countries for the period 2011 to 2021 (Khan *et al*., 2025). Empirical studies such Odionye *et al*. (2025) show that financial development played a significant moderating role in the nexus between remittances and household income in Nigeria. This undoubtedly highlight the significant moderating role that financial sector development can play in the remittances-sustainable development nexus. To this end, interestingly, Barkat *et al*. (2024) examined the mediating role played by financial inclusion in the remittances-sustainable development nexus by employing data for up to 109 developing countries. The results of the study show that financial inclusion is a mediating variable in the correlation between remittances and sustainable development, and also showed that remittances had a significant positive impact on the SDGs. Additionally, the authors demonstrated how remittances play complementary roles in the achievement of the SDGs.

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Conceptual Framework

Remittances impact on sustainable development is anticipated to be positive by reason of its direct impact on the investment and infrastructure (Ramachandran & Crush, 2021).

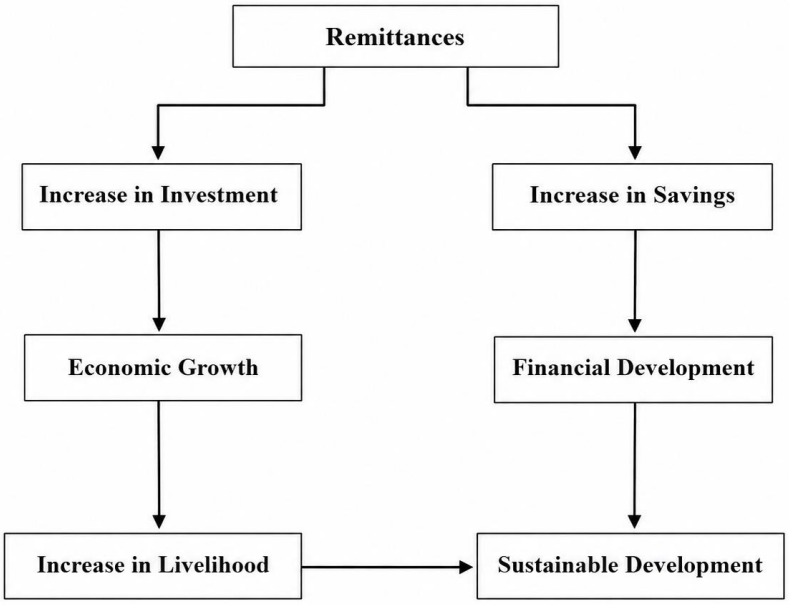

Figure 1: *Schematic Diagram of Conceptual Framework Source: Author's Conceptualisation based on empirical literature*

As remittances increase and grow, the capital accumulation and growth are the inevitable outcomes which foster sustainable development. Remittances spur financial development in an economy and this translates to positive outcomes for growth (Olayungbo & Quadri, 2019). Economic theory states that an upsurge in remittances influences household earning, that in turn encourages savings and the economy's goods and services consumption (Neog & Yadava, 2020). Savings improves the economy's investment climate, whereas consumption raises the amount of aggregate demand (Lartey *et al.*, 2012). Remittances thus encourage sustainable development and production growth. However, financial institutions play a major role in its overall influence (Giuliano & Ruiz-Arranz, 2005). Remittances encourage financial development, which in turn encourages economic investment (Neog & Yadava, 2020). Businesses will find it simpler to obtain investment loans if the banking sector is developed (Mensah & Abdul-Mumuni, 2023). Fig. 1 shows the direct, linear relationships connecting remittances, financial development and sustainable development.

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METHOD

Theoretical Framework

The current and extant literature has not offered a viable theoretical framework for the moderating role of financial development the in the remittances-sustainable development nexus, perhaps because it is a relatively recent topical theme. Moreover, developing a theoretical framework on the moderating role of financial sector development in the relationship between remittances and sustainable development is a daunting task, as there are no explicit theories on this moderating role dynamics in relation to the remittances-sustainable development nexus by reason of the fact that sustainable development is a recent empirical theme. Studies have shown that remittances do not fundamentally and consistently support sustainable development. Remittances must be intentionally redirected in order to do achieve sustainable development (Mills, 2023).

This study is theoretically grounded in the Two-Gap Theory and the Financial Intermediation Theory, which, when jointly considered, provide a coherent framework for understanding how financial sector development can play a moderating role in the relationship between remittances and sustainable development in the SSA region. The integration of these two theories allows the study to conceptualize financial development as the transmission mechanism and intermediary through which resources (remittances) can be mobilised for sustainable development. In doing so, the study viewed remittances as gap-filling resources and financial sector development as the intermediary through which the resources (remittances) are mobilised and channelled towards achieving sustainable development.

The Two-Gap Theory (also known as the Dual-Gap Theory) propounded by Hollis Chenery (Chenery,1955) posits that developing countries face two fundamental constraints to growth and sustainable development: insufficient domestic savings and inadequate foreign exchange. These constraints limit investment capacity, particularly in capital-intensive and technologically advanced sectors, thereby reinforcing dependence on primary commodities (Kazembe *et al.*, 2026). Within this framework, external financial inflows are viewed as complements to domestic resource mobilization, enabling countries to finance investment and import capital goods essential for sustainable development (Diwan, 1968). Empirical applications of the theory have extended

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beyond foreign aid and foreign direct investment to include remittances, which are increasingly recognized as stable and countercyclical sources of foreign exchange (Giuliano & Ruiz-Arranz, 2005). However, while the Two-Gap Theory explains why remittances can enable investment by relaxing binding constraints, it is less explicit about how these resources can be channelled towards achieving sustainable development through financial institutions. This limitation motivates the incorporation of the Financial Intermediation Theory. Financial intermediation is the process by which financial institutions, such as commercial banks, insurance companies and investment firms act as intermediaries between savers and borrowers. The Financial Intermediation Theory explains how these institutions facilitate the flow of funds from those who have excess funds (savers) to those who need funds (Allen & Santomero, 1998; Hester, 1994). Since remittances are sent by migrant workers to their families and loved ones through financial intermediaries such as commercial banks, these financial institutions channelled these resources to where they are needed most in a market economy which facilitate investment capacity and sustainable development.

Econometric Model Specification

The study specifies the econometric model by first postulating a Cobb-Douglas-type aggregate production function that links capital stock, technology and labour to output written as:

$$Y_t = A_t L_t{}^{1-\alpha} K_t{}^{\alpha}$$

Where Y_t is the output, L_t is labour and K_t denotes the capital stock. In per capita terms, Equation [1] can be written as:

$$\frac{Y_t}{L_t} = \frac{A_t L_t{}^{1-\alpha} K_t{}^{\alpha}}{L_t}$$

$$\frac{Y_t}{L_t} = A\left(\frac{K_t}{L_t}\right)^{\alpha}$$

Equation [3] can further be written as:

$$y = Ak^{\alpha}$$

with $y = Y/L$ or output per unit of labour or output per capita, $k = K/L$ denotes the physical capital–labour ratio, and A is the exogenous technology taken as given. Following previous studies such as Heilmann (2006) and Haller *et al*. (2018) and the two-gap theoretical postulate that adaptably modelled remittance inflows (REM) as adding to mobilized domestic savings available

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for sustainable development through the medium of financial institutions (financial development) in developing economies. Hence, remittances is hereby best captured by the capital-labour ratio, k – being a capital inflow in essence. Equation [4] is hereby re-written as:

$$y = A(REM)^{\alpha}$$

Where y which stands for output per capita shall hereafter be adapted and expressed as embodying and representing sustainable development. This is because economic literature has shown that output per capita (y) can be modelled as sustainable development as adapted by this study (Pardi *et al*., 2015:275). Hence, this study captures the two-gap theoretical postulate within a framework of the neoclassical Cobb-Douglas model such that cross-country remittances' impact on socially inclusive green growth (or sustainable development) is theoretically and empirically incorporated.

Following from [5], sustainable development, can be presumed to be a function of remittances, financial development, and other covariates, x_{it}. This correlation can thus be expressed as:

$$SD = f(REMS, FD, x_{it})$$

Where REM stands for remittances, FD for financial development, x_{it} for a vector of other control variables. In line with Hess (2013), the study employed sustainable development proxied by the SDGI based on the fact that it remains the most recent and empirically plausible proxy for sustainable development (Barkat *et al*., 2024; Al-Thani & Koç, 2024).

To this end, in order to estimate remittances impact on sustainable development with financial development playing a moderating role, the study specifies a dynamic model of remittances-sustainable development nexus in line with Equation [6] as:

$$SD_{it} = \vartheta g_{it} + 1 + \theta REM_{it} + \phi FD_{it} + x'_{it}\beta + \eta_i + u_{it}$$

Where SD_{it} is the dependent variable-sustainable development proxied by SDGI for country i at time t; $g_{it} + 1$ is the lagged value of sustainable development; REM_{it} denotes remittances (personal remittances as % of GDP); FD_{it} is the log value of financial development measure; x'_{it} represents a vector of other control variables; η_i is the individual country fixed effect; u_{it} is an idiosyncratic random error term; while ϑ, θ, ϕ, and β are parameters to be estimated. The key coefficients of interest are θ and ϕ which measure remittances and financial development effects

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on sustainable development. Control variables included in the regression are: GDP, GDP per capita, inflation, aggregate private investment, and trade openness.

In the light of the objective of this study which is to investigate the moderating role played by FD in the remittances-sustainable development nexus, the study used the two-step dynamic GMM technique to achieve the goal. The two-step dynamic GMM model functional form is specified as:

$$SD_{it} = X_{it}\beta + \psi SD_{it} - 1 \ + \phi_i + \varepsilon_{it}$$

If a dependent variable appears as a lagged variable, the OLS is no longer an appropriate estimate technique. However, the estimations may not be statistically significant because the 2SLS estimator can estimate greater variances for the computed coefficients, which is a known issue when employing this modeling approach (Arellano & Bond 1991). Thus, this work follows Arellano and Bond (1991), who offer GMM as a solution to the aforementioned difficulties. Besides, GMM would be used by reason of the fact that the cross-sections (N) exceed the number of periods (T), with N = 30 and T = 23. Because approaches like the GMM estimator are less efficient than the two-step dynamic GMM technique, the study employed the two-step dynamic GMM estimator to improve the dependability of the results (Blundell & Bond, 1998).

$$SD_{it} = \alpha_0 + \beta_1 SD_{it} - 1 + \beta_2 FD_{it} + \beta_3 REM_{it} + \beta_4 (REM_{it} XFD_{it}) + \beta_5 InGDP_{it} + \beta_6 InGDP^2{}_{it} + \beta_7 FDI_{it} + +\beta_8 INV_{it} + +\beta_9 INF_{it} + +\beta_{10} GDPPC_{it} + +\beta_{11} OPEN_{it} + \varepsilon_{it}$$

The robust theoretical foundation of the variables employed in economic literature is the major motivation for their inclusion in Equation [9]. FD denotes financial development. Following Aggarwal *et al*. (2011), the connection between financial development and sustainable development is anticipated to be positive, according to Din *et al*. (2021) as well as Koirala & Pradhan (2019), i.e. $\beta_2 = \frac{d(SD_{it})}{dFD_{it}} > 0$. REM denotes remittances, which is crucial in fostering sustainable development. Following Heilmann (2006) and Dash *et al*. (2024), the nexus of remittances and sustainable development is *a priori* anticipated to be positive, i.e. $\beta_3 = \frac{d(SD_{it})}{dREM_{it}} > 0$. $REM_{it} XFD_{it}$ (The interactive nexus between remittances and financial development), which can be a fundamental factor in influencing sustainable development, is anticipated to be unswervingly

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connected with sustainable development, i.e. $\beta_4 = \frac{d(SD_{it})}{d(REM_{it}XFD_{it})} > 0$. GDP and GDP^2 denote output growth and output growth squared, respectively. According to Perveen & Khan (2021), the study can deduce that GDP and GDP^2 are expected to have unintended and intended connections with sustainable development levels, correspondingly, i.e. $\beta_5 = \frac{d(SD_{it})}{dGDP_{it}} > 0$ and $\beta_6 = \frac{d(SD_{it})}{dGDP^2_{it}} < 0$. Finally, FDI is considered as one of the most influential variables in impacting financial development spurred by remittances for sustainable development. Following Azam *et al*. (2021), foreign direct investment is expected to negatively impact sustainable development, i.e. $\beta_7 = \frac{d(SD_{it})}{dFDI_{it}} < 0$.

This study explores the moderating role played by financial development on the relationship between remittances and sustainable development. To this end, in line with Issabayev (2020), this paper modifies Equation [9] in log-form by considering financial development (as a moderating variable) and its interaction with remittances in relation to sustainable development:

$$Log\ (SD_{it}) = \vartheta log(SD_{it\ +\ 1}) + \theta \log(REM_{it}) + \phi \log(FD_{it}) + \lambda(\log(REM_{it}) * \log(FD_{it})) + x'_{it}\beta + \eta_i + u_{it}$$

The study adapted the idea about the interactive role of financial development from Olayungbo & Quadri (2019), where the authors concluded that in Sub-Saharan Africa, financial development spurs the growth of remittances. The remittances' marginal effect on sustainable development in relation to the moderating role of financial development is given as:

$$\frac{\partial \log(SD_{it})}{\partial \log(REM_{it})} = \theta + \lambda \log(FD_{it})$$

The moderating role played by financial development in the nexus between remittances and sustainable development is based on two main postulates: the complementarity proposition and the substitutability postulate. The complementarity theoretical postulate holds that, like any significant external financial basis, remittances through the financial sector development should, in principle, improve financial development for recipient groups or households, particularly in emerging countries (Aggarwal *et al*. 2011). Yet, this proposition is not uniformly accepted by researchers in this field. Certain scholars believe that remittances act as a substitute for credit, relieving financial restrictions—remittances may thus lead to a decline in credit demand, with a credit market's negative effect on development, particularly in poor nations (Bettin *et al*. 2012).

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Estimation Technique

The system GMM and two-step dynamic GMM methodology were used to investigate the moderating role played by financial development in the remittances-sustainable development nexus. Methodologically, system GMM (or SYS-GMM) deals with issues like endogeneity, heteroscedasticity and autocorrelation. Firstly, system GMM addresses endogeneity issues by using lagged levels and differences as instruments. Secondly, it is more efficient than difference GMM especially when the instruments are weak. Thirdly, system GMM accounts for unobserved individual-specific effects. Lastly, SYS-GMM is appropriate for panels with small time dimension (T) and large cross-section dimension (N).

The two-step dynamic GMM approach offers several merits in econometric analysis. Firstly, it provides more efficient estimates compared to the one step GMM approach, especially when dealing with endogenous variables, fixed effects, and heteroscedasticity or autocorrelation within error terms. Secondly, this methodology effectively addresses endogeneity issues using instrumental variables, typically lagged values of the endogenous variables, which are assumed to be uncorrelated with the error term. Thirdly, it is particularly useful for analysing dynamic panel data models where the dependent variable is influenced by its past values, and the independent variables may be endogenous. Fourthly, the two-step dynamic GMM estimator is robust to heteroscedasticity and autocorrelation ensuring consistent and efficient estimates.

Data: Definition, Measurement, and Sources

The study employed panel data between 2000 and 2022 from 30 SSA countries to investigate the moderating role played by FD in the nexus between remittances and sustainable development. The SSA countries are as follows– Nigeria, Kenya, Tanzania, Ghana, Gambia, Sudan, Senegal, Burkina Faso, Guinea Bissau, Mali, Liberia, Togo, Sierra Leone, Ethiopia, Rwanda, Uganda, Angola, Gabon, Democratic Republic of Congo and Cameroon, Botswana, Mozambique, Lesotho, Malawi, Namibia, Zimbabwe, South Africa and Eswatini, Comoros and Cape Verde. Each region of sub-Saharan Africa is well represented.

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The study utilizes data for remittances, financial development, sustainable development, foreign direct investment, aggregate investment. The data are obtained from the World Development Indicators (WDI) Database. However, the study used the SDGs Index (SDGI) as the dependent variable, in which scores are offered on a scale of 0-100 and can be explained and understood as percentage points towards optimal attainment of the SDGs. The SDGI was obtained from the Sustainable Development Report (Sachs *et al*., 2023) and herein offers a valuation of the progress accomplished in the attainment of the SDGs by all the selected SSA countries as member nations of the United Nations. All the variables are in log form. For the list of the variables utilised in the study, their description and measurement, the justification for including them, and the data sources, see Table 1: Measurement of Variables and Sources of Data.

S/N	Variables	Description and Measurement	Data Source
1.	Remittances (REM)	Personal remittances as a percentage of GDP.	WDI 2022
2.	Financial Development (FD)	Banks' domestic lending to the private sector (% of GDP) is the proxy employed to measure financial development.	WDI 2022
3.	Inflation (INF)	Inflation is proxied by the annual inflation rate, consumer prices.	WDI 2022
4.	Aggregate Private Investment (INV)	In 2015 US dollars, the gross fixed capital formation (as a percentage of GDP) is used as a proxy for aggregate private investment.	WDI 2022
5.	Sustainable Development (SDGI)	The Sustainable Development Goal Index (SDGI) serves as the proxy for sustainable development.	WDI 2022; *SDG Report 2023* (Sachs *et al*., 2023)
6.	Foreign Direct Investment (FDI)	Foreign direct investment, net inflows (% of GDP).	WDI 2022
7.	Gross Domestic Product (GDP)	The log of GDP in constant 2015 US$. This measures the size of the economy.	WDI 2022
8.	GDP Per Capita	GDP per capita (in 2015 dollars constant). This proxied the degree of economic progress.	WDI 2022
9.	Trade Openness (OPEN)	The ratio of Export plus import as percentage of GDP	WDI 2022

Table 1. *Measurement of Variables and Source of Data Source: Author's compilation*

Empirical Results, Analysis and Discussion

Panel Unit Root Tests

Before proceeding with the empirical analysis, we carry out some statistical tests in order to investigate the time series properties of the variables. More precisely, we first apply unit root tests to ascertain the order of integration of the variables. The results of the IPS test and the ADF-Fisher test by are presented in Table 5. We also report the Breitung test proposed by Breitung (2000) which controls for heterogeneous panels and cross-sectional dependence in the data. The results show that remittances (InREM), financial development (InFD) and foreign direct investment (InFDI) are stationary at levels from at least two unit-root tests. Inflation (InINF) and trade openness (InOPEN) are stationary at levels from IPS unit root test alone. However, all the variables are stationary at first differences. Hence, InREM, InFD and InFDI are I(0) variables while all the others are I(1) variables.

Series	**Level**			**First Differences**
	IPS	ADF-Fisher	Breitung	IPS
lnSD	-1.2867	6.7528	5.1322	-3.9896***
12.9350***	-6.5023***			
lnREM	-2.7099***	-4.0107***	-11.1386***	-4.5219***
16.3830***	-11.6649***			
lnFD	-1.6876*	3.8031	-2.6698***	-9.5931***
41.5138***	-1.4960*			
lnGDP	-2.4031***	-0.3848	0.6814	-5.5432***
32.8679***	-14.5600***			
lnFDI	-1.9042**	2.1471	-4.4027***	-7.3305***
32.0276***	-12.5284***			
lnGDPPC	-1.6209	3.2405	5.4151	-4.4833***
15.8645***	-8.0043***			
lnINV	-1.0036	8.6866	8.2950	-4.7767***
17.9792***	-9.0375***			
lnINF	-2.2276***	-0.3524	4.9061	-5.9882***
25.0852***	-10.0158***			
lnOPEN	-2.0078***	1.3476	-0.9419	-4.2917***
14.9108***	-5.8586***			

Table 2. *Panel Unit Root test Result*

Note: *lnSD* denotes Sustainable Development, *lnREM* is remittances as a share of GDP, *lnFD* is financial development, *lnGDP* is real gross domestic product, *lnFDI* is foreign direct investment as a share of GDP, *lnGDPPC* is GDP per capita, *lnINV* is gross investment, and *lnOPEN* is trade openness.

Panel Cointegration Tests

The panel Kao and Pedroni cointegration tests were conducted for potential long-term cointegration among the variables of interest. Table 3 displays the Kao panel cointegration test which demonstrates the existence of cointegration. The null hypothesis that there is no cointegration is actually rejected at the 5% level of significance for the five statistical tests (Modified Dickey-Fuller, Dickey-Fuller, Augmented Dickey-Fuller, Unadjusted Modified Dickey-Fuller and Unadjusted Dickey-Fuller). This implies that the relevant variables have long-term cointegration.

Statistical Test	Statistic	P-value
Modified Dickey Fuller	-24.7088***	0.0000
Dickey-Fuller	-16.1579***	0.0000
Augmented Dickey-Fuller	-11.2981***	0.0000
Unadjusted Modified Dickey-Fuller	-24.7322***	0.0000
Unadjusted Dickey-Fuller	-16.1597***	0.0000

Table 3: *Kao Panel Cointegration Test*
**** indicates statistical significance at 5% level.*
Source: Author's computation

Likewise, Table 4 displays the Pedroni panel cointegration test which demonstrates the existence of cointegration. The null hypothesis that there is no cointegration is actually rejected at the 5% level of significance for the three statistical tests (Modified Philips-Perron, Philips-Perron, Augmented Dickey-Fuller). This implies that the relevant variables have long-term cointegration.

H_0: No cointegration
H_a: All panels are cointegrated

Statistical Test	Statistic	P-value
Modified Philips-Perron	3.6131***	0.0002
Philips-Perron	-8.9796***	0.0000
Augmented Dickey-Fuller	-8.3753***	0.0000

Table 4. *Pedroni Panel Cointegration Test*
**** indicates statistical significance at 5% level.*
Source: Author's computation

SYS-GMM & Two-Step Dynamic GMM Results and Analysis

As seen from Table 5, for the system GMM result shows that the estimated coefficient of the lagged sustainable development variable is positive and statistically significant at the 1% level indicating that sustainable development in in the current year is heavily influenced by sustainable development in the previous year. The estimated coefficient of the interactive term of remittances and financial development is positive and statistically significant in accordance with theoretical *a priori* expectation. These results are important in establishing that there is a strong interactive relationship between remittances and financial development in relation to sustainable development in Sub-Saharan Africa.

Dependent Variable: InSDGI		
Variable	**SYS-GMM**	**TWO-STEP DYNAMIC GMM**
InSDGI (-1)	0.8120*** (0.000)	
InREM	0.0009 (0.810)	0.0641*** (0.000)
InFD	0.0227*** (0.000)	-0.1601*** (0.000)
InFD (-1)		0.0716*** (0.000)
InFD (-2)		0.0520*** (0.000)
InREM*InFD	0.0033** (0.038)	
InREM*InFD (-1)		-0.0082*** (0.000)
InREM*InFD (-2)		-0.0061*** (0.000)
InGDP	-0.0026* (0.050)	-0.0000 (0.994)
InGDP (-1)		-0.0000 (0.997)
InGDP (-2)		-0.0000 (0.994)
InFDI	-0.0035***(0.000)	-0.0072*** (0.000)
InFDI (-1)		
InFDI (-2)		0.0579*** (0.000)
$InGDP^2$	0.0002(0.126)	0.0000 (0.994)
$InGDP^2$ (-1)		0.0000 (0.995)
$InGDP^2$ (-2)		0.0000 (0.995)
InINV	-0.0036 (0.224)	
InINV (-1)		-0.0083*** (0.000)
InINV (-2)		-0.0664*** (0.000)
InINF	-0.0015*** (0.000)	0.0240*** (0.000)
InINF (-1)		-0.0070*** (0.000)
InINF (-2)		-0.0022*** (0.000)
InGDPPC	0.0125*** (0.000)	0.0000 (0.995)
InGDPPC (-1)		0.0000 (0.997)
InGDPPC (-2)		0.0000 (0.992)
InOPEN	-0.0097*** (0.000)	0.0339*** (0.000)
InOPEN (-1)		0.0753*** (0.000)
InOPEN (-2)		0.0475*** (0.000)
Constant	0.6652*** (0.000)	
Hansen	0.00 (1.000)	227.38 (1.000)
Sargan	29.9995 (0.6671)	362.81 (1.000)
AR(1)	0.600 (0.5485)	0.06 (0.961)
AR(2)	-1.5602 (0.1187)	0.00 (0.997)
No. of Instruments	46	499
Obs.	660	600

Table 5. *Sys-Gmm And Two-Step Dynamic Gmm Estimation Results*

Note: SYS-GMM stands for system generalised method of moments while 2S-D-GMM denotes 2-step dynamic generalised method of moments. Robust t-statistics reported beside estimated coefficients. The regression coefficients are estimated using Arellano & Bover (1995) and Blundell & Bond (1998) system GMM estimation approach. Following the suggestions of Roodman (2009), estimation uses the xtrabond2 command in Stata 15. AR(1) and AR(2) are Arellano & Bond (1991) tests for autocorrelation in differences. Sargan is a test (Sargan, 1958) for overidentifications. Hansen is a test (Hansen, 1982) for overidentification restrictions. P-values for these tests are shown in square parentheses. ***p<0.01, **p<0.05, *p<0.10.

In essence, these results show that financial development played a positive moderating role in the nexus between remittances and sustainable development by incentivizing sustainability in SSA countries based on the SYS-GMM regression model. Moreover, the SYS-GMM result implied that financial development enhances the transmission of remittances into investment or productive activities which undoubtedly promote sustainable development in the 30 SSA countries. This finding supported the two-gap theory and financial intermediation theory by showing the moderating role played by financial development in the nexus between remittances and sustainable development in the 30 SSA countries. The result of the two-step dynamic GMM regression model indicates that the first and second lagged interactive term variable of remittances and financial development on sustainable development were negative and statistically significant at the 1% level indicating that the interactive term of remittances and financial development in in the first and second years are heavily influenced by the interactive term of remittances and financial development in the previous year.

The SYS-GMM result shows that positive significant relationships were established between financial development and GDP per capita in relation to sustainable development in the SSA region. Negative significant relationships were however established foreign direct investment, inflation and trade openness in relation to sustainable development in SSA. The two-step dynamic GMM result indicates that positive significant relationships were found between remittances (as expected, *a priori*), inflation and trade openness in relation to sustainable development in the sub-continent. Nonetheless, negative significant correlations were established between financial development and foreign direct investment in relation to sustainable development. Interestingly, in accordance with theoretical *a priori* expectation, both the SYS-GMM and two-step dynamic GMM results show a negative significant relationship between foreign direct investment and sustainable development. This implies that foreign direct investment (foreign capital, technology and ideas) is a disincentive to sustainable development in the SSA region. It is expedient to note that though both SYS-GMM and two-step dynamic GMM are Arellano-Bond/Blundell-Bond type estimators, they handle moment conditions and weighting matrix differently and that may account for some of the differences in the results of both methodologies. Moreover, the differences in the results of the two approaches could be due to either: estimation technique differences, model specification or instrument choice.

There are some post estimation tests in the lower part of Table 5. AR (1) and AR (2) are Arellano & Bond (1991) tests for first order and second-order autocorrelation in the first differenced errors. When the regression errors are independent and identically distributed, the first differenced errors are by construction autocorrelated. Results of AR (1) and AR (2) tests support the validity of the model specification for SSA countries. Sargan/Hansen statistics can also be used to test the validity of subsets of overidentifying restrictions (instruments). A rejection from this test indicates that model or instruments maybe miss-specified. These tests confirm the validity of instruments in both SYS-GMM and two-step dynamic GMM regression models. These post estimation results indicate that the dynamic panel model is a reasonably good specification for the moderating role of financial development in the nexus between remittances and sustainable development in SSA countries.

The choice of system GMM estimator over other approaches is very instructive. SYS-GMM is preferred over fixed effects, random effects and Difference GMM estimators because of several reasons: (i) Efficiency: System GMM is more efficient than Difference GMM because it uses additional moment conditions which leads to more precise estimates. (ii) Handling endogeneity: System GMM tackles endogeneity issues better, especially when instruments are weak. It uses lagged differences as instruments for levels, and vice versa, making it more robust (Li *et al*., 2021). (iii) Dealing with persistence: System GM is suitable for panels with persistent series, as it accounts for the dynamics.

Some issues need clarifications is regard to the use of system GMM and two-step dynamic GMM in this paper. Endogeneity: this is when the explanatory variables are correlated with the error term, leading to biased estimates. System GMM and two-step dynamic GMM tackle this using instrumental variables (lags of the variables (Li *et al*., 2021). Dynamic panel bias: this occurs in short panels (small T, large N) with lagged dependent variables. The fixed effects estimator becomes inconsistent. System GMM helps by using lagged differences and levels as instruments to address this bias. Unobserved heterogeneity: this refers to time-invariant factors affecting the outcome variable. System GMM accounts for this by including fixed effects in the level equation. Two-step dynamic GMM is also an efficient estimator. It uses a two-step procedure to estimate the variance-covariance matrix, making it more efficient than one-step GMM.

Variable	Coefficient	Std. Error	t-statistic	Prob.
InREM	0.1091	0.0080	13.5747	0.0000
InFD	0.1442	0.0057	25.2147	0.0000

InREM*InFD	-0.0279	0.0035	-7.9665	0.0000
InGDP	-0.0054	0.0039	-1.3846	0.1667
InFDI	-0.0144	0.0029	-4.9611	0.0000
$InGDP^2$	0.0005	0.0004	1.2561	0.2095
InGDPPC	0.0035	0.0021	1.6677	0.0959
InINV	0.0477	0.0076	6.2662	0.0000
InINF	0.0204	0.0016	12.6819	0.0000
InOPEN	-0.2597	0.0062	-41.9192	0.0000
Constant	4.4731	0.0162	275.912	0.0000
R^2	0.9584			
Instruments Rank	40			
F-statistic	785.97***			

Table 6. *Panel Two Stage Least Squares Methodolog. Dependent Variable: Insdgi Source: Authors' Computation*

Robustness Checks

The Panel TSLS technique was used in this study as robustness check because it focuses on examining the moderating role played by financial development in the nexus between remittances and sustainable development with the lag of each explanatory variable used as instruments. The result is presented in Table 6. The panel two-stage least squares (Panel TSLS) technique offers several merits in econometric analysis especially as robustness check in this study. Firstly, panel TSLS effectively handles endogeneity issues arising from omitted variable bias, measurement errors, or reverse causality, providing more accurate estimates. Secondly, by utilizing instrumental variables, panel TSLS helps identify causal relationships between variables, especially in simultaneous equation models. Thirdly, this approach provides consistent estimates of parameters, even explanatory variables are correlated with the error terms. Lastly, panel 2SLS is robust to various issues, including heteroscedasticity, and offers a reliable method for evaluating policy impacts and trends.

The instruments used in the panel TSLS methodology are valid haven satisfied two main conditions: relevance and exogeneity. Firstly, the instruments (lags of the explanatory variables) correlate with the endogenous explanatory variables since they are good predictors of the latter. This is evident from the F-statistic and R-squared. Secondly, the instruments are not correlated with the error term given that exogeneity was established from the Sargan/Hansen tests as reported in the SYS-GMM and two-step dynamic GMM results in Table 8.

The outcomes showed that there is a negative significant relationship between the interactive term (of remittances and financial development) and sustainable development. Also, positive significant relationships were demonstrated between remittances, financial development, aggregate private investment and inflation in relation to sustainable development while a negative

significant correlation was found between foreign direct investment, and trade openness in relation to sustainable development in Sub-Saharan Africa.

Discussion

The results on inclusion of an interactive term between remittances and financial development provided an interesting outcome on concerning the role played by financial development in moderating the nexus between remittances and sustainable development in Sub-Saharan Africa. There is a positive significant relationship between the interactive term of remittances and financial development in relation to sustainable development in the 30 SSA nations. This finding supported the financial intermediation theoretical postulate and the two-gap theory by showing that financial sector development is a strong transmission channel through which remittances positively affect sustainable development in SSA countries. Furthermore, this result is in contrast to the finding from studies such as Rehman and Hysa (2021), who demonstrated that the interaction between remittances and financial development had a significant negative effect on output growth. Furthermore, the result demonstrated that remittances and financial development are complements for sustainable development in the region, which aligns with the findings of Dada & Akinlo (2023) in the case of Nigeria and Nyamongo *et al*. (2012) in the case of 36 African economies, who found that over time, remittances and financial development are complementary to output growth.

Nevertheless, when the two step dynamic GMM approach was used, in contrast to the system GMM results, a negative significant relationship was demonstrated between the first and second lagged interactive terms of remittances and financial development in relation to sustainable development. This outcome aligns with that of Rehman & Hysa (2021), who showed that the interactive term between remittances and financial development had a negative effect on output growth. Furthermore, the two-step dynamic GMM result indicated that remittances and financial development are substitutes to sustainable development in the 30 SSA economies.

CONCLUSION

The study examines the moderating effect that financial development played in the nexus between remittances and sustainable development in 30 Sub-Sahara African countries using system GMM and two-step dynamic GMM methodologies. The study made theoretical contributions by establishing that the complementarity postulate holds in respect of the moderating

role played by financial development in the nexus between remittances and sustainable development in the sub-continent. Theoretically, the study also established the fact that the Two-Gap Theory and the Financial Intermediation Theory can jointly be used in anchoring this relationship in economic literature in the absence of explicit theories for the research of this study.

Given the findings of the study, the following policy implications are expedient for policymakers in the SSAA region. Firstly, the financial sector infrastructure should be strengthened for optimal development outcomes especially in the attainment of SDGs. Secondly, there should be reforms aimed at reducing remittance transfer costs. This is because a sound financial system reduces the cost of sending remittances which aligned with SDG 10.c that seeks to reduce transaction costs in sending remittances. Thirdly, the reforms should also strive at promoting financial inclusion for remittance recipients in the region which will undoubtedly incentivised sustainability.

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