Migration and Human Capital Development in Africa: The Brain Drain to Brain Gain Philosophy

Uche Abamba Osakede
Bowen University, Nigeria
uche.osakede@bowen.edu.ng

Johnson Olaosebikan
Bowen University, Nigeria
johnson.olaosebikan@bowen.edu.ng

Joel Tobiloba Adeyemo
Bowen University, Nigeria
joel.adeyemo@bowen.edu.ng

Akanni Olayinka Lawanson
University of Ibadan, Nigeria
ao.lawanson@ui.edu.ng

Opeyemi Eunice Olagunju
Bowen University, Nigeria
opeyemi.olagunju@bowen.edu.ng

Olanrewaju Olaniyan
University of Ibadan, Nigeria
o.olaniyan@ui.edu.ng

Olayinka Omolara Adenikinju
Bowen University, Nigeria
olayinka.adenikinju@bowen.edu.ng

Evidence on the effect of remittances on human capital development in Africa remains mixed, with limited evidence on the educational attainment of most African migrants. Understanding these patterns is crucial to assessing whether migration leads to brain drain or brain gain. This study examines labour migration from Africa and the role of remittances in shaping school enrolment rates. Using the panel-corrected standard error (PCSE) and feasible generalized least squares (FGLS) methods, the analysis accounts for heteroscedasticity, autocorrelation, and cross-sectional dependence, providing reliable estimates. The results indicate that most African migrants have attained secondary level of education, while remittances significantly improve primary and secondary enrolment, with no significant effect on tertiary education. Findings also showed that real GDP, government expenditure, and access to electricity enhance enrolment outcomes. These findings suggest that while remittances build foundational human capital, policy interventions are needed to channel resources toward educational outcomes, particularly higher education, to ensure sustainable growth in Africa.

Keywords: migration, brain drain, brain gain, PCSE, FGLS
JEL *Classifications:* F22, F24, I25

Received 2025/12/18 · Revised 2026/03/25 · Accepted 2026/04/01

Published online 2026/06/30 © Author
CC BY-SA https://doi.org/10.26493/1854-6935.24.255-279

Introduction

Beyond theoretical assertions, empirical evidence has shown that human capital plays a pivotal role in driving sustained economic growth and development (Mankiw et al. 1992; Keji 2021; Adeyemi and Ogunsola 2016). In Africa, however, human capital remains notably underdeveloped, which is often cited as a significant factor contributing to the region's sluggish economic growth compared to other parts of the world (Blanco-Moreno 2024; World Bank 2024). Despite the low levels of human capital, there is a significant outflow of labour, worsening the economic development gap between Africa and other global regions (IOM, UN Migration 2021). This migration, particularly of skilled labour, is often perceived as a 'brain drain', which further deteriorates economic conditions in the region (Mjelva and Carling 2023).

The rationale behind labour migration is twofold: migrants are often motivated by the potential to send remittances back home, which can benefit their families, and these remittances may be used to invest in human capital, possibly turning the 'brain drain' into a 'brain gain'. However, whether this hypothesis holds true for Africa remains uncertain, especially given the region's persistent issue of low-skilled labour. This paper explores the relationship between migration and human capital development by addressing two key research questions: (i) How is the emigration of skilled labour (brain drain) affected by human capital development in Africa, and (ii) Can migrant remittances contribute to a 'brain gain' by enhancing human capital development in the region?

To address the research questions, the study applies the panel-corrected standard error (PCSE) and the feasible generalized least squares (FGLS) methodologies. These methods are employed to provide a comprehensive analysis of the impact of migration on human capital development. PCSE and FGLS are applied to control for heteroscedasticity and cross-sectional dependence common in panel data (Wooldridge 2013; Gujarati and Porter 2008; Prais and Winsten 1954). This study focuses on Africa, covering 54 countries over a time range from 1980 to 2022. The data is sourced from the World Bank database and provides a comprehensive picture of migration patterns and their impact on human capital development.

The significance of this study rests on several key gaps in the extant literature. While a growing body of empirical work has examined the migration–development nexus, much of the recent literature has focused either on the macroeconomic and growth effects of remittances or on

the welfare implications of migration, often treating human capital as a secondary or indirect outcome (Makwembere et al. 2024; Weeraratne 2024; Usman 2023; Gajurel and Chindengwike 2025; Oyadeyi et al. 2024; Al Mosharrafa et al. 2024). Furthermore, existing studies frequently rely on single-country analyses or short time horizons, which limit their ability to capture the long-run and cross-country dynamics that characterise migration and human capital development, particularly in Africa (Makwembere et al. 2024; Gajurel and Chindengwike 2025; Al Mosharrafa et al. 2024; Dharmadasa et al. 2019; Mawuena and Okey 2021; Cebotari 2020). Again, the theoretical debates on brain drain versus brain gain remain inconclusive, particularly in contexts such as African economies, where educational systems, labour markets, and institutional quality are weak. In addition, the extant literature provides a narrow conceptualisation of brain drain, which predominantly emphasises tertiary and postgraduate migrants (Docquier and Rapoport 2009). This focus overlooks the African context, where secondary education often enables international mobility and contributes to labour market value (Mastercard Foundation 2020). Consequently, limiting the analysis to highly educated migrants may understate the broader developmental implications of human capital outflows.

This underscores the need for a more inclusive approach that captures human capital formation across all educational levels. By explicitly modelling both the drivers of skilled labour emigration and the potential feedback effects of remittances on human capital accumulation across a large panel of African countries and over four decades, this study advances the literature in several ways. First, it provides a more recent and comprehensive regional perspective that captures the migration human capital nexus in Africa, across countries and over time. Second, it empirically evaluates the dual role of migration as both a potential constraint and a catalyst for human capital development, thereby moving beyond the simplistic dichotomy of brain drain versus brain gain. Third, the findings are shown for the brain-drain-to-gain philosophy across different levels of educational attainment to capture the pipeline of human capital outflow and formation in the African region. Fourth, the study employs advanced methodologies for panel data analysis, including PCSE and FGLS, which account for heterogeneity in cross-sectional data and autocorrelation that are common challenges in time series analysis. This robust approach ensures that the estimates are consistent and reliable. These contributions position the study as a timely and policy-relevant

addition to the literature on migration, human capital, and economic development in Africa.

The remainder of the paper is structured as follows: Section 2 presents the literature review, Section 3 outlines the methodology, Section 4 discusses the empirical results, and Section 5 provides the conclusion.

Literature Review

Many developing countries, particularly in Africa, seek alternative funding sources to support human capital development, specifically in education and healthcare. This effort is driven by the need to reduce poverty and enhance the well-being of their populations, given the low revenue base resulting from the highly informal economies in the region (International Labour Organization 2022). Over time, remittances have emerged as a significant tool for improving prosperity and as an alternative means to finance investments in Africa. In terms of the effect of migration on human capital, findings in the literature remain inconclusive. The results in the existing literature are summarised below.

POSITIVE EFFECTS OF REMITTANCES ON HUMAN CAPITAL

A prominent strand of the literature highlights the potential positive role of migration in human capital development, particularly through return migration. Studies argue that skilled migrants who return to their home countries often bring enhanced knowledge, technical skills, and international exposure that improve the quality of human capital and production processes (Stark and Fan 2007; Docquier and Rapoport 2007; Delavande 2023). However, such gains depend on migrants' ability to acquire valuable skills abroad and their willingness to reintegrate into domestic labour markets. In practice, destination-country policies aimed at retaining skilled migrants may limit return migration while increasing remittance flows, potentially offsetting human capital losses through financial transfers but also contributing to depopulation and long-term growth constraints in sending countries (Docquier 2014; Mileris 2019).

Empirical evidence largely supports the view that remittances positively influence human capital development. Gyimah-Brempong and Asiedu (2015) and Azam and Raza (2016) show that remittance inflows enhance educational outcomes, and this in turn enhances economic growth. Using both symmetric and asymmetric frameworks, Xia et al. (2022) confirm these findings for major remittance-receiving countries

over the period 1980–2019. Shafiq et al. (2022), using dynamic panel GMM techniques, also find that remittances significantly raise education expenditure across developing countries. Similar results were reported by Amega (2018) for sub-Saharan Africa (SSA) and by Azizi (2018) for a broad set of developing countries, with remittances shown to improve both education and health outcomes.

Country-specific studies further corroborate these findings. For instance, findings by Dharmadasa et al. (2019) demonstrate that migration and remittances increase school enrolment among children left behind in rural Sri Lanka. Similar results are shown by Mawuena and Okey (2021) in Togo, and Cebotari (2020) in Ghana, indicating that remittance-receiving households are more likely to invest in education.

While the positive role of remittances is well-documented, several studies reveal that these effects vary across educational levels and demographic groups. Amakom and Iheoma (2014) find that remittances exert a stronger influence on secondary school enrolment than on primary enrolment in Nigeria. Similar conclusions are drawn by Zhunio et al. (2012) and Lu and Treiman (2007), who show higher probabilities of secondary education attainment in remittance-receiving households. Gyimah-Brempong and Asiedu (2015) also show that female-headed households are more likely to allocate remittances towards children's education, highlighting gender-based differences in investment behaviour.

Recent cross-country studies reinforce these heterogeneous effects. Aregbeshola (2022) provides evidence from 18 African countries that remittances improve access to education, while Feldmann (2025) shows that personal remittances significantly increase primary and secondary enrolments globally, with stronger effects for girls at the primary level. Williams (2025) further demonstrates that remittances improve secondary and tertiary education outcomes in developing countries, particularly for females, although negative effects are observed in some regions such as Latin America and the Caribbean.

INSIGNIFICANT AND NEGATIVE EFFECTS OF REMITTANCES ON HUMAN CAPITAL

In contrast to the predominantly positive narrative, a growing body of literature documents weak, insignificant, or even negative effects of remittances on educational attainment. Köllner (2013), using household-level data from Tajikistan, finds that remittances do not significantly promote human capital investment when education is voluntary,

underscoring the role of household preferences. Similarly, Oda (2023) identifies gender disparities in Pakistan, with remittances failing to improve educational outcomes for females due to entrenched social norms. Evidence from Moldova (Pilařová and Kandakov 2017) also points to insignificant effects of remittances on high school attendance.

McKenzie and Rapoport (2011) document negative impacts of migration and remittances on schooling in rural Albania, attributing this to low perceived returns to education and a preference for immediate consumption. However, they note that remittances may still relax credit constraints for poorer households, particularly benefitting younger girls from less-educated families. These findings challenge the assumption of a linear and uniformly positive remittance–education relationship and emphasise the importance of heterogeneity in household decision-making.

Existing studies also suggest that migrants are disproportionately drawn from higher educational groups due to the costs of migration and greater awareness of overseas opportunities (Organisation for Economic Co-operation and Development (OECD) 2017). Aydemir et al. (2022) confirm that higher education significantly increases migration likelihood, particularly among males. In a related study, Latukha et al. (2022) showed that industry and individual-level factors promote migration intentions among talented graduates in leading Russian Universities. The findings, however, indicate that strengthening talent development as a form of human capital, alongside policies that attract and retain talented graduates, can help reverse the adverse effects of brain drain and reduce migration intentions. The results highlight the risk of brain drain in emerging economies and demonstrate that strategic actions can be effective in mitigating it.

GAPS IN THE LITERATURE

Despite extensive evidence on remittances and education, the literature presents mixed and context-dependent findings on the impact of remittances on human capital development, alongside limited empirical evidence on the educational profile of African migrants. There is also a clear gap in understanding whether migration from Africa is predominantly characterised by skilled labour outflows and whether remittances can effectively generate a compensating brain gain across different levels of educational attainment. Addressing these gaps is particularly important given the scale of labour migration from Africa and its implications

for long-term human capital formation and sustainable development in the region.

Generally, the classical brain drain literature focuses on highly educated migrants, particularly those with tertiary and postgraduate qualifications (Docquier and Rapoport 2009). This approach underestimates the developmental implications of human capital outflows in low-income settings. This is because, in many African economies, completion of secondary education significantly increases international migration probabilities and often constitutes the minimum threshold for skilled emigration (Mastercard Foundation 2020). In labour markets characterised by structural skill shortages, even mid-level educated workers are internationally mobile and economically valuable. Therefore, restricting the concept of brain drain to postgraduate education may understate the implications of human capital outflows in low-income economies. From a development perspective, enrolment rates at primary, secondary, and tertiary levels capture the pipeline of human capital formation, which directly affects future migration potential. Hence, analysing migration–human capital dynamics using enrolment across educational tiers and in a region characterised by population growth is hypothetically appropriate and policy relevant.

This study hence incorporates primary, secondary, and tertiary enrolment as measures of human capital development. This does not constitute a redefinition of brain drain; rather, it reflects a broader analytical perspective on human capital formation and its interaction with migration dynamics in Africa. Exploring these linkages is crucial, particularly given the ongoing labour migration from the region to developed countries. This area of research is essential for making projections to improve human capital and achieve sustainable development in Africa.

Methodology

THEORETICAL FRAMEWORK

The theoretical framework for this study is based on the aspirations-capabilities framework, as articulated by De Haas (2021). This framework addresses the limitations of functionalist and historical-structural theories, which often conceptualise migration as a uniform response to external stimuli, predictable and consistent across different contexts (De Haas 2021). The aspirations-capabilities framework provides a more nuanced understanding of the concept of migration by considering how migrant aspirations are influenced by a variety of factors, including culture, edu-

cation, personal disposition, identity, information, and the images people encounter.

According to this framework, educated individuals are more likely to migrate due to their enhanced skills, knowledge, and awareness of alternative lifestyles. They are exposed to various images of a desirable life, which can heighten their aspirations to move abroad. This is because education not only provides the qualifications needed for migration but also broadens individuals' perspectives on life opportunities available in other regions.

This framework also considers the reverse aspect of migration, where individuals return to their home countries intending to enhance human capital. This return can be motivated by personal disposition and a desire to contribute to their homeland. Additionally, migrants may send remittances back home, driven by strong cultural ties or family bonds, to improve the well-being of their families left behind. The aspirations-capabilities framework thus encapsulates the dynamic interplay between individual aspirations and the broader socio-economic factors that influence migration and its impacts.

To further substantiate this conceptual foundation, the endogenous growth theory offers valuable insights. This theory posits that long-term economic growth is primarily driven by internal factors, notably the accumulation of knowledge, innovation, and human capital (Romer 1986; Mankiw et al. 1992). Unlike exogenous growth models that treat technological progress as external, endogenous growth theory internalises human capital as a production input, emphasising its self-reinforcing role in economic development. In this light, migration-induced changes in education and skills acquisition can directly feed into the growth process. Hence, when individuals migrate and send back remittances used to finance education, it initiates a virtuous cycle: improved educational outcomes strengthen the stock of human capital, which enhances productivity, fosters innovation, and supports sustained growth. This connection forms the foundation for exploring the 'brain gain' argument; that migration, while initially seen as a drain on domestic talent, can indirectly benefit origin countries by enhancing investment in education and skill formation.

Taken together, the aspirations-capabilities framework and the endogenous growth theory form a cohesive analytical lens for this study. The former helps to understand why migration occurs and how aspirations are shaped by educational exposure, while the latter explains how the

outcomes of migration, particularly remittances, can influence the development trajectory through investment in human capital. This dual framework underpins the study's twofold inquiry: first, to assess how differences in school enrolment at primary, secondary, and tertiary levels affect migration flows from Africa; and second, to evaluate the impact of migrant remittances on school enrolment and human capital accumulation in the region.

EMPIRICAL MODEL SPECIFICATION

The empirical model of this study is grounded in the aspirations-capabilities framework. We adapt the model for brain drain following the approach outlined by Aydemir et al. (2022). For brain gain, we modify the model based on the framework developed by Amega (2018). Both models are further refined by incorporating control variables that influence the respective outcome variables. The baseline model for brain drain is specified for the period 1980–2022.

The model specification for brain drain is stated as:

$$netmig_{i,t} = \alpha + \tau Schlenrol_{i,t} + \phi X_{i,t} + \mu_{it} \quad (1)$$

$$i = 1,2\ldots,N, \quad t = 1980,\ldots 2022,$$

where $netmig_{i,t}$ denotes net migration, and $Schlenrol_{i,t}$ represents school enrolment, which is captured separately for primary, secondary and tertiary school levels. $X_{i,t}$ is the vector of control variables, including per capita real GDP, labour force participation, control of corruption, and population growth.

The model for brain gain is specified as:

$$Schlenrol_{i,t} = \beta + \gamma Rem_{i,t} + \theta Y_{i,t} + \mu_{it} \quad (1)$$

$$i = 1,2\ldots,N, \quad t = 1980,\ldots 2022,$$

where $Rem_{i,t}$ denotes personal remittances, and $Y_{i,t}$ is the vector of control variables, including access to electricity, labour force participation, per capita real GDP, and government spending on education.

ESTIMATION TECHNIQUE

The empirical models adopted in this study are analysed using the panel-corrected standard error (PCSE) methodology, with the robustness of

the estimates further tested using the feasible generalized least squares (FGLS) technique. The PCSE method is preferred over other panel data methods due to its capacity to address heteroscedasticity and autocorrelation, which are prevalent in cross-sectional and time series data, respectively (Wooldridge 2013). The FGLS approach is employed for robustness checks, given its effectiveness in controlling for both heteroscedasticity and autocorrelation in the error term (Bai et al. 2009).

While techniques such as instrumental variable (IV) regression and dynamic panel estimators like the generalized method of moments (GMM) are widely recognised for addressing endogeneity, they often rely on strong instruments and strict assumptions about data properties that may not always hold. In contrast, the PCSE and FGLS estimators are more suitable for the structure of this study's dataset, particularly given the moderate time dimension and cross-sectional variation (Gujarati and Porter 2008). These methods are efficient in mitigating serial correlation and heteroscedasticity without introducing the biases that weak instruments or overfitting might cause in IV or GMM frameworks. The PCSE and FGLS are also preferred over the GMM techniques as they accommodate challenges with cross-sectional dependence (CSD) and panel-specific heteroscedasticity that are common in panel data, and hence provide more consistent and reliable estimates. Controlling for CSD is important to avoid biased estimates that may arise from high dependence across countries. This study's use of PCSE and FGLS offers an alternative yet complementary pathway to robust inference, particularly when the primary concern is correcting for CSD, contemporaneous correlation and heteroscedastic errors rather than dynamic endogeneity.

DATA SOURCE

The data for this study encompasses all countries in Africa and spans the period from 1980 to 2022. The data is sourced from the World Development Indicators (WDI) provided by the World Bank (2023).

Results and Discussion

SUMMARY STATISTICS

Table 1 presents the summary statistics for various variables related to net migration, remittances, and education metrics. The variable 'NetMig', which measures net migration, has a mean of 10,356.6, indicating a general trend of emigration across the sample. The large standard devi-

ation (105,984.4) and extreme minimum and maximum values suggest significant variability in migration patterns among the observed countries.

Personal remittances (PsRem) have a mean of $751 million, reflecting substantial remittance inflows. The wide range, from $0 to over $32 billion, and the high standard deviation (2.85 billion) highlight considerable disparities in remittance receipts among countries. Access to electricity (Elec), with a mean of 42.28% and a standard deviation of 29.78%, shows considerable variation in infrastructure development, ranging from minimal access to full coverage.

The measures of educational attainment, specifically primary (EnrPrim), secondary (EnrSec), and tertiary (EnrTer) school enrolments, have means of 0.87, 0.79, and 0.62, respectively, showing a progressively smaller number of persons with higher educational attainment. The high standard deviations across these indices indicate significant differences

TABLE 1 Summary Statistics

Variable symbol and description	Obs	Mean	Std. dev.	Min	Max
NetMig: Net migration	2,322	−10,356.6	105,984.4	−2,162,873	1,372,202
PsRem: Personal remittances received in current US$	2,322	7.51E+08	2.85E+09	0	3.23E+10
Elec: Access to electricity (% of population)	2,322	42.2789	29.7816	0.5339	100
EnrPrim: School enrolment primary (gross), Gender Parity Index (GPI)	2,322	0.8728	0.1522	0.3796	1.4115
EnrSec: School enrolment secondary (gross), Gender Parity Index (GPI)	2,322	0.7889	0.2534	0.1799	1.5265
EnrTer: School enrolment tertiary (gross), Gender Parity Index (GPI)	2,322	0.6201	0.36978	0.0617	1.7289
CC: Estimate of the Control of corruption	2,322	−0.6268	0.6295	−1.9165	1.6334
Geduc: Government expenditure on education, total (% of government expenditure)	2,322	16.1852	5.7549	0.8334	37.5210
Pgrowth: Population growth (annual %)	2,322	2.4754	1.4006	−16.8806	16.6255
LFP: Labour force participation rate, total (% of total population, ages 15+) (modelled)	2,322	62.7060	13.1056	30.751	90.122
RGDP: GDP per capita (constant 2015 US$)	2,322	2048.12	2537.761	165.9344	17117.03

in educational access among countries. Control of corruption (CC) has a mean of –0.63, indicating weak governance quality. The substantial range in the minimum and maximum values suggests variability in the quality of governance over the study period and across countries. Government expenditure on education (Geduc) averages 16.19% of total expenditure, with a notable range, indicating differing national priorities in educational investment. Finally, 'Pgrowth' and 'LFP' reflect population growth and labour force participation with means of 2.48% and 62.71%, respectively, showing a rise in population size in the region and more than half of the population in economic employment activities.

PRE-ESTIMATION TEST

Before conducting panel data estimation, we first present some diagnostic tests for CSD, unit roots, and cointegration. The CSD test is essential in panel data; otherwise, the results may be inconsistent and biased. The CSD test evaluates the null hypothesis of either weak or strict CSD (Pesaran 2004; De Hoyos and Sarafidis 2006). The results presented in table 2 indicate significant CSD among the selected countries, as evidenced by the rejection of the null hypothesis at the 1% significance level. This implies that shocks in one country can easily be transmitted to others. To address this, the study employs the Pesaran cross-sectionally augmented Dickey-Fuller test for panel unit roots on variables exhibiting CSD. The second-generation unit root test results show that most variables are stationary at level, except for personal remittances, the labour force participation rate, and real GDP, which were stationary at the first difference. Additionally, the Westerlund cointegration test confirms that the selected variables are cointegrated, as the null hypothesis of no cointegration is rejected at the 5% significance level.

PCSE AND FGLS REGRESSION RESULTS

This section provides a comprehensive analysis of the regression results examining the relationship between human capital and migration using the PCSE and FGLS methodologies. These methods address issues of heterogeneity and autocorrelation in the panel data under study.

Table 3 presents the results of the brain drain model, focusing on the relationship between net migration and its determinants: school enrolment (separately categorised into primary, secondary, and tertiary), per capita real GDP, labour force participation, control of corruption, and population growth. The regression results are reported for both the main and robust-

TABLE 2 Cross-Sectional Dependence (CD)

Variable	CSD Statistics	PESCADF		Westerlund
		Level	1st Diff.	Statistics
NetMig	0.798	−17.488***	−33.798***	−26.768 ***
PsRem	25.014***	14.9412	−27.5900***	
Elec	45.878***	−2.2591***	−24.3026***	
EnrPrim	56.105***	−6.6807***	−32.2219***	
EnrSec	56.914***	−14.1272***	−33.1436***	
EnrTer	31.441***	−16.3560***	−33.3509***	
CC	−1.157	−12.6068***	−36.6348***	
Geduc	1.107	−13.9729***	−33.0760***	
Pgrowth	13.111***	−7.9575***	−25.0068***	
LFP	8.1***	0.5185	−27.1054***	
RGDP	43.495***	4.6372	−26.1071***	

NOTES *** indicates statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

ness checks. Columns 1 through 3 display the main regression results using PCSE, while columns 4 through 6 provide robustness checks using FGLS.

In the main regression results, column 1 shows a significant negative relationship between primary school enrolment and net migration. Column 2, however, indicates a negative but insignificant effect. This suggests that populations with higher primary school attendance are less likely to migrate, supporting the notion that emigrants often have higher educational attainment (OECD 2017; Aydemir et al. 2022). Secondary

TABLE 2 Cross-Sectional Dependence (CD)

Variable	CSD Statistics	PESCADF		Westerlund
		Level	1st Diff.	Statistics
NetMig	0.798	−17.488***	−33.798***	−26.768 ***
PsRem	25.014***	14.9412	−27.5900***	
Elec	45.878***	−2.2591***	−24.3026***	
EnrPrim	56.105***	−6.6807***	−32.2219***	
EnrSec	56.914***	−14.1272***	−33.1436***	
EnrTer	31.441***	−16.3560***	−33.3509***	
CC	−1.157	−12.6068***	−36.6348***	
Geduc	1.107	−13.9729***	−33.0760***	
Pgrowth	13.111***	−7.9575***	−25.0068***	
LFP	8.1***	0.5185	−27.1054***	
RGDP	43.495***	4.6372	−26.1071***	

NOTES *** indicates statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

TABLE 3 PCSE and FGLS Regression Estimates: Brain Drain

Variables	PCSE Main Regression			FGLS Robustness Check		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
EnrPrim	−66,117***	−38,471	−54,148*	−66,117***	−3,238	−4,124
	(17,807)	(30,057)	(29,848)	(19,873)	(6,600)	(5,291)
EnrSec	56,740***	15,174	29,228	56,740***	9,461**	2,206
	(14,738)	(18,526)	(18,221)	(14,969)	(4,570)	(2,908)
EnrTer	3,535	12,617	9,935	3,535	9,071***	1,947
	(8,649)	(11,275)	(9,923)	(8,608)	(2,567)	(1,751)
RGDP	11,146***	15,069**	14,557**	11,146***	9,654***	8,814***
	(2,315)	(6,039)	(5,823)	(2,569)	(1,136)	(1,495)
LFP	−4.101	79.20	146.8	−4.101	174.2**	−53.79
	(243.5)	(340.1)	(365.0)	(185.3)	(74.28)	(88.70)
CC	25,911***	15,895**	15,521**	25,911***	1,214	2,005*
	(6,254)	(7,327)	(7,526)	(4,438)	(1,647)	(1,131)
Pgrowth	39,059***	40,290***	42,669***	39,059***	20,734***	26,465***
	(3,038)	(4,633)	(3,377)	(1,411)	(1,059)	(1,118)
Constant	−159,451***	−199,813***	−193,015***	−159,451***	−149,530***	−132,140***
	(28,942)	(55,367)	(54,535)	(26,649)	(11,768)	(13,675)
Observations	2,322	2,322	2,322	2,322	2,322	2,322
R-squared	0.253	0.183	0.286			
Number of ID	54	54	54	54	54	54

NOTES Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ ID denotes the unique identifier for countries in the study.

school enrolment exhibits a significant positive relationship with net migration in column 1, indicating that a 1% increase in secondary school enrolment leads to a 56,740 increase in net migration of individuals from African countries. This finding aligns with the expectation that increased education correlates with higher migration rates. Tertiary education enrolment shows a non-significant positive relationship with net migration in the main results. This weak linkage may reflect indirect or delayed migration responses to higher education, consistent with the notion of a backdoor brain drain, whereby human capital accumulation does not immediately translate into outward migration but still generates long-term skill losses (Stark and Byra 2012).

The results show an interesting mix of relationships between education and migration in Africa. For primary school enrolment, the negative

relationship (–66,117; $p < 0.01$) indicates that areas with higher primary school attendance tend to have lower migration rates, possibly because emigrants typically have higher levels of education. On the other hand, the positive relationship with secondary school enrolment is notable (56,740; $p < 0.01$); this means that as more people enrol in secondary education, migration tends to increase, possibly because better education expands opportunities for migration. However, for tertiary education, the effect on migration is not significant, suggesting that higher education may not play as big a role in driving migration as secondary education. In sum, the findings indicate that levels of educational attainment influence migration differently across the region.

Per capita real GDP demonstrates a positive and significant relationship with net migration (estimates ranging from 11,146 to 15,069) across columns 1 to 3, suggesting that economic growth enhances human capital, leading to increased migration. Conversely, the labour force participation rate shows both negative (column 1) and positive (columns 2 and 3) effects on net migration but remains insignificant throughout the main estimates. The control of corruption exhibits a consistently positive effect on net migration in all main estimates, indicating that effective corruption controls may attract migrants seeking reputable environments. Additionally, population growth shows a positive and significant relationship with net migration across all main estimates, suggesting that a growing population contributes directly to migration.

The robustness check using FGLS confirms the main regression results, with primary school enrolment maintaining its significant negative relationship with net migration. Secondary school enrolment also remains positively significant, consistent with the main results. Population growth, control of corruption, and economic growth similarly show consistency with the main findings. However, tertiary school enrolment, initially showing a positive but insignificant relationship with net migration in the main results, becomes significant in column 5 of the robustness check. Finally, the labour force participation rate shows mixed effects in the robustness test, with negative insignificant and positive significant effects in columns 4 and 5.

To illustrate the brain gain model, table 4 presents estimates of the relationship between remittances and primary school enrolment. The main results indicate that remittances have a positive and statistically significant effect on primary school enrolment in Africa. This finding is consistent with expectations, as remittances directly enhance house-

hold income and living standards, making education more affordable (Stark and Wang 2002). Specifically, a 1% increase in remittances leads to a 3.50e−12 increase in the number of persons with primary school enrolment. Although the magnitude of the effect is quite small, the positive impact of remittances on primary school enrolment is corroborated by Amakom and Iheoma (2014) and Feldmann (2025). The estimated coefficients indicate that while remittances exert a statistically significant effect on primary school enrolment, the economic magnitude is negligible, implying that remittance inflows translate into only marginal enrolment gains at the aggregate level.

Access to electricity, as anticipated, shows a positive relationship with primary school enrolment in column 1, although columns 2 and 3 display a positive but insignificant effect. The results reveal that a 1% increase in access to electricity corresponds to a 0.0001% rise in primary school enrolment in Africa. This small effect suggests that infrastructure improvements enhance learning conditions but are insufficient on their own to substantially raise enrolment. The labour force participation rate shows a positive relationship with primary school enrolment in the main estimates, but it is insignificant across columns 1 to 3.

Furthermore, real GDP and government spending on education are positively and significantly related to primary school enrolment across columns 1 to 3. This outcome aligns with the *a priori* expectation that economic growth and increased investment in education improve educational attainment.

For the robustness check, the results for remittances remain consistent with the main regression, showing a positive and significant relationship with primary school enrolment in columns 4 and 5. Similarly, the effect of access to electricity remains positive and significant.

Table 5 presents findings for the brain gain model in terms of the effect of remittances on secondary school enrolment using both the PCSE and FGLS methods. The results reveal a significant positive impact of remittances on secondary school enrolment, as shown in column 1 of the main regression. Specifically, remittances have a statistically significant positive effect on secondary school enrolment, indicating that households receiving remittances experience improved educational outcomes. The results demonstrate that a 1% increase in remittances induces a $2.87e^{12}$ increase in the number of persons with secondary school enrolment. The estimated coefficient implies that a 1% increase in remittances translates into only a marginal rise in enrolment, suggesting that while remittances

TABLE 4 PCSE and FGLS Regression Estimates: Brain Gain (Primary School Enrolment)

Variables	PCSE Main Regression			FGLS Robustness Check		
	(1)	(2)	(3)	(4)	(5)	(6)
PsRem	3.50e−12***	2.07e−12 *	1.70e−12	3.50e−12***	1.79e−12 *	1.70e−12
	(8.80e−13)	(1.21e−12)	(1.33e−12)	(1.04e−12)	(1.08e−12)	(1.16e−12)
Elec	0.0001***	0.0001	0.0001	0.0006***	0.0003***	0.0003***
	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(8.54e−05)
LFP	0.0004	0.0002	0.0001	0.0004	0.0005*	0.0001
	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0002)
RGDP	0.0600***	0.0382***	0.0356***	0.0600***	0.0343***	0.0330***
	(0.0071)	(0.0054)	(0.0046)	(0.0037)	(0.0045)	(0.0038)
Geduc	0.0039***	0.0008*	0.0007*	0.0039***	0.0004	0.0003
	(0.0006)	(0.0004)	(0.0004)	(0.0007)	(0.0003)	(0.0003)
Constant	0.380***	0.562***	0.592***	0.380***	0.581***	0.610***
	(0.0777)	(0.0538)	(0.0480)	(0.0345)	(0.0419)	(0.0354)
Observations	2,322	2,322	2,322	2,322	2,322	2,322
R-squared	0.137	0.434	0.922			
Number of ID	54	54	54	54	54	54

NOTES Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. ID denotes the unique identifier for countries in the study

help ease household constraints and support schooling decisions, their standalone capacity to substantially expand secondary enrolment is limited. Findings for positive effects of remittances on secondary enrolments align with those of Zhunio et al. (2012), Lu and Treiman (2007), Feldmann (2025) and Williams (2025).

Access to electricity also shows a significant positive influence on secondary school education, suggesting that improved access to electricity enhances secondary school enrolment and, consequently, educational attainment. Additionally, both the labour force participation rate and government spending on education exhibit a significantly positive relationship with secondary school enrolment in the main regression estimates. Real GDP consistently demonstrates a positive and significant relationship with primary school enrolment across columns 1 through 3, aligning with expectations that educational attainment improves with economic growth.

In the robustness checks, the outcomes for remittances and the labour force participation rate remain consistent with the main regression

TABLE 5 PCSE and FGLS Regression Estimates: Brain Gain (Secondary School Enrolment)

Variables	PCSE			FGLS		
	Main Regression			Robustness Check		
	(1)	(2)	(3)	(4)	(5)	(6)
PsRem	2.87e−12**	6.81e−13	1.05e−12	2.87e−12**	4.68e−13	7.24e−13
	(1.17e−12)	(1.81e−12)	(1.74e−12)	(1.46e−12)	(1.65e−12)	(1.61e−12)
Elec	0.0005*	0.0007***	0.0008***	0.0005**	0.0007***	0.0009***
	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
LFP	0.0001***	0.0003	6.90e−05	0.0001***	0.0002	−2.83e−05
	(0.0003)	(0.0005)	(0.0005)	(0.0004)	(0.0004)	(0.0004)
RGDP	0.0673***	0.0542***	0.0618***	0.0673***	0.0454***	0.0456***
	(0.0078)	(0.0086)	(0.0080)	(0.0053)	(0.0072)	(0.0068)
Geduc	0.0052***	0.0005	−0.0002	0.0052***	0.0013**	0.0008
	(0.0010)	(0.0009)	(0.0007)	(0.0001)	(0.0006)	(0.0005)
Constant	0.144*	0.339***	0.295***	0.144***	0.400***	0.408***
	(0.0803)	(0.0790)	(0.0733)	(0.0484)	(0.0652)	(0.0609)
Observations	2,322	2,322	2,322	2,322	2,322	2,322
R-squared	0.136	0.115	0.661			
Number of ID	54	54	54	54	54	54

NOTES Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. ID denotes the unique identifier for countries in the study

results, showing a positive and significant relationship with secondary school enrolment in column 4. Similarly, access to electricity maintains a positive and significant effect across all columns. The results for real GDP also continue to show a positive and significant impact, consistent with the main findings. Finally, government spending on education shows consistent positive significance in column 4 of the robustness check and is significant in column 5 as well.

Findings for the brain gain model in terms of the effect of remittances on tertiary enrolment are presented in table 6. In the main regression results, personal remittances exhibit a positive but statistically insignificant coefficient. This suggests that while remittances have the potential to enhance tertiary education, they are primarily allocated to basic education, as supported by findings in tables 4 and 5. Given earlier results, the differential effects of remittances on school enrolments appear mixed. The findings indicate that remittances have a positive and statistically significant effect on primary and secondary school enrolment in Africa, supporting the idea that increased household income from remittanc-

es makes education more affordable and accessible. As remittances enhance the living standards of recipient households, they enable families to invest in education, particularly at the primary and secondary levels. The improvement in educational outcomes is a direct consequence of the financial support provided, which helps cover school fees, purchase learning materials, and even support transportation costs. These benefits underscore the role of remittances in reducing barriers to education for many households, providing a vital resource for children to continue their schooling in regions where access to education can be limited by financial constraints.

However, in terms of tertiary education, the coefficient of personal remittances is positive but statistically insignificant, suggesting that remittances have a limited or negligible impact on tertiary school enrolment. One reason for this could be the high costs associated with tertiary education, which often exceed what can be provided by remittances alone. Additionally, migrants' altruistic motives may play a role in how remittances are allocated (Azam and Gubert 2006; Clemens and McKenzie 2018; Adda et al. 2022), as they often prioritise the immediate welfare of their families, such as providing for daily living expenses, healthcare, and housing, over longer-term investments like tertiary education. While migrants often maintain emotional and cultural ties to their home country, their financial contributions might prioritise family welfare and community development over investing in higher education, especially given the limited job opportunities available for graduates. The lack of return on investment in tertiary education, coupled with the high costs, may discourage migrants from directing remittances toward higher education, leading to a preference for more immediate needs, such as primary and secondary schooling, which have more direct benefits. Findings for the insignificant effect of remittances on tertiary education contrast with those of Williams (2025), showing that remittances improve tertiary educational outcomes in developing economies.

The availability of electricity is associated with an increased likelihood of enrolling students in tertiary institutions. Additionally, real GDP and government expenditures on education positively and significantly impact tertiary education attainment. Our results also indicate that an increased labour force participation rate contributes to improved tertiary education, suggesting that greater workforce engagement motivates higher education.

TABLE 6 PCSE and FGLS Regression Estimates: Brain Gain (Tertiary School Enrolment)

Variables	PCSE Main Regression			FGLS Robustness Check		
	(1)	(2)	(3)	(4)	(5)	(6)
PsRem	1.63e−12	1.37e−12	2.35e−12	1.63e−12	−1.21e−12	1.46e−13
	(1.44e−12)	(1.83e−12)	(2.62e−12)	(1.98e−12)	(1.69e−12)	(2.26e−12)
Elec	0.0017***	0.0017***	0.0001***	0.0017***	0.0018***	0.0012***
	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0003)	(0.0003)
LFP	0.0009**	−0.0011	−0.0019***	−0.0009*	−0.0006	0.0013***
	(0.0004)	(0.0008)	(0.0006)	(0.0005)	(0.0006)	(0.0005)
RGDP	0.0880***	0.0787***	0.0746***	0.0880***	0.0628***	0.0621***
	(0.0069)	(0.0118)	(0.0103)	(0.0071)	(0.0099)	(0.0088)
Geduc	0.0037***	0.0037***	0.0025**	0.0037***	0.0006	0.0006
	(0.0013)	(0.0014)	(0.0012)	(0.0013)	(0.0011)	(0.0009)
Constant	0.0071	0.0867	0.206**	0.0071	0.246***	0.312***
	(0.0594)	(0.106)	(0.0866)	(0.0657)	(0.0872)	(0.0728)
Observations	2,322	2,322	2,322	2,322	2,322	2,322
R-squared	0.198	0.085	0.510			
Number of ID	54	54	54	54	54	54

NOTES Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ ID denotes the unique identifier for countries in the study.

The robustness check results in table 6, obtained using the FGLS test, generally confirm the main regression findings. However, there are notable differences: the coefficient for remittances turns negative in column 5, and the labour force participation rate turns negative in column 4, indicating variability in the effects depending on the estimation method used.

Conclusion

This study explored the relationship between migration and human capital development through the lens of brain drain and brain gain. The findings indicate that individuals with secondary education are more likely to migrate, underscoring the risk of losing semi-skilled labour. At the same time, remittances were shown to significantly improve primary and secondary school enrolments, suggesting that migration indirectly supports foundational education at home. However, the absence of significant effects on tertiary education highlights a gap that could limit long-term human capital growth. To mitigate brain drain, governments must improve domestic conditions that push skilled individuals

to migrate. Increased investment in tertiary education, better job opportunities for graduates, and stronger links between higher education and labour markets are essential to retain talent and ensure productive outcomes. While remittances support basic education, policy actions should ensure that the flows are also channelled into higher education, scholarships, and research initiatives. This is to ensure that the region strengthens its human capital base and promotes inclusive development in the face of continued labour migration.

The results of the study are presented using the FGLS and PCSE techniques to verify the consistency of the estimated relationships across different econometric specifications and to strengthen the robustness of the empirical findings. However, potential endogeneity between migration, remittances, and human capital development may not be fully addressed in this study. Future research could address this limitation by employing instrumental variable approaches. In addition, the study focuses on a regional assessment by examining the full sample of countries in Africa, with robustness checks conducted using alternative estimation techniques. Future studies could extend this analysis through sub-sample examinations, such as by country income groups, to provide further insights into heterogeneity across countries in the region. Migration and remittance data may not fully capture informal flows, which could influence the measured effects on human capital development. However, due to the difficulty of tracking informal transfers, such flows could not be accounted for in the analysis. Again, enrolment rates reflect access to education and do not reflect its quality. While obtaining comprehensive data on education quality remains a challenge, enrolment rates are widely regarded as a reliable proxy for the overall level of educational attainment.

Acknowledgements:

1. Funding: This study received no external funding.
2. Competing interests: Authors declare no competing interest of any form.
3. Availability of data: Data is publicly available on the World Bank site.
4. Acknowledgement regarding the use of AI: The authors acknowledge the use of ChatGPT, developed by OpenAI, to assist with language editing and improve the readability of the manuscript. The authors take full responsibility for the conceptualisation, writing the original draft, analysis, interpretation of the results, and the conclusions of the study.

References

Adda, J., C. Dustmann, and J. S. Görlach. 2022. 'The Dynamics of Return Migration, Human Capital Accumulation, and Wage Assimilation.' *The Review of Economic Studies* 89 (6): 2841–71.

Adeyemi, P. A., and A. J. Ogunsola. 2016. 'The Impact of Human Capital Development on Economic Growth in Nigeria: ARDL Approach.' *IOSR Journal of Humanities and Social Science* 21 (3): 1–7.

Al Mosharrafa, R., M. Sahabuddin, and N. Saha. 2024. 'Migrant Workforces, Foreign Remittance, and Economic Growth Nexus in an Emerging Country.' *Journal of International Migration and Integration* 25 (4): 2321–37.

Amakom, U., and C. G. Iheoma. 2014. 'Impact of Migrant Remittances on Health and Education Outcomes in Sub-Saharan Africa.' *IOSR Journal of Humanities and Social Science* 19 (8): 33–44.

Amega, K. 2018. 'Remittances, Education and Health in Sub-Saharan Africa.' *Cogent Economics & Finance* 6 (1): 1516488.

Aregbeshola, R. A. 2022. 'Interplay of Poverty, Remittances and Human Capital Development: Panel Evidence from Selected Sub-Saharan African Countries.' *International Migration* 60 (6): 250–71.

Aydemir, A. B., M. G. Kırdar, and H. Torun. 2022. 'The Effect of Education on Internal Migration of Young Men and Women: Incidence, Timing, and Type of Migration.' *Labour Economics* 74:102098.

Azam, J.-P., and F. Gubert. 2006. 'Migrants' Remittances and the Household in Africa: A Review of Evidence.' *Journal of African Economies* 15 (2): 426–62.

Azam, M., and S. A. Raza. 2016. 'Do Workers' Remittances Boost Human Capital Development?' *The Pakistan Development Review* 55 (2): 123–49.

Azizi, S. 2018. 'The Impacts of Workers' Remittances on Human Capital and Labor Supply in Developing Countries.' *Economic Modelling* 75:377–96.

Bai, J., C. Kao, and S. Ng. 2009. 'Panel Cointegration with Global Stochastic Trends.' *Journal of Econometrics* 149 (1): 82–99.

Blanco-Moreno, A. C. 2024. 'Inter-Regional Graduate Migration, Subjective Expectations, and Human Capital Mobility.' *Regional Science Policy & Practice* 16 (10): 100110.

Cebotari, V. 2020. 'Migration, Remittances, and Child Education in Ghana: Evidence from a Longitudinal Study.' In Migration, Remittances, and Sustainable Development in Africa, edited by M. Konte and L. M. Mbaye. Routledge.

Clemens, M. A., and D. McKenzie. 2018. 'Why Don't Remittances Appear to Affect Growth?' *The Economic Journal* 128 (612): F179–F209.

De Haas, H. 2021. 'A Theory of Migration: The Aspirations-Capabilities Framework.' *Comparative Migration Studies* 9 (1): 8.

De Hoyos, R. E., and V. Sarafidis. 2006. 'Testing for Cross-Sectional Dependence in Panel-Data Models.' *The Stata Journal* 6 (4): 482–96.

Delavande, A. 2023. 'Expectations in Development Economics.' In *Handbook of Economic Expectations,* edited by R. Bachmann, G. Topa and W. van der Klaauw. Academic Press.

Dharmadasa, R. A. P. I. S., H. M. T. R. Herath, J. I. U. Jayalath, and K. K. H. M. Rathnayake. 2019. 'The Impact of Migration and Remittances on Education of Children Left-Behind: Evidence from the Rural Sector of Sri Lanka.' In *Proceeding of International Conference on Contemporary Management (ICCM): Reshaping Human Capital Towards Better Future*. University of Jaffna.

Docquier, F. 2014. 'The Brain Drain from Developing Countries.' *IZA World of Labor* 31. http://dx.doi.org/10.15185/izawol.31.

Docquier, F., and H. Rapoport. 2007. 'Skilled Migration: The Perspective of Developing Countries.' IZA Discussion Paper No. 2873, The Institute for the Study of Labor.

Docquier, F., and H. Rapoport. 2009. 'Documenting the Brain Drain of "la crème de la crème": Three Case-Studies on International Migration at the Upper Tail of the Education Distribution.' Working Paper, No. 25, Bar-Ilan University, Department of Economics.

Feldmann, H. 2025. 'The Effects of Remittances on School Enrolment Rates: A Global Perspective.' *International Review of Economics and Finance* 101:104175.

Gajurel, R. P., and J. D. Chindengwike. 2025. 'Remittance-Growth Nexus: Does Financial Development Mediate? Evidence from Nepal and Tanzania.' *African Development Finance Journal* 8 (9): 213–38.

Gujarati, D. N., and D. C. Porter. 2008. *Basic Econometrics*. McGraw-Hill.

Gyimah-Brempong, K., and Asiedu, E. 2015. 'Remittances and Investment in Education: Evidence from Ghana.' *The Journal of International Trade and Economic Development* 24 (2): 173–200.

International Labour Organization. 2022. *Informal Economy in Africa: Which Way Forward? Making Policy Responsive, Inclusive and Sustainable.* International Labour Organization.

IOM, UN Migration. 2021. 'Steady Increase in Labour Migration in Africa, New Report Reveals.' 22 November. https://ehsa.iom.int/news/steady-increase-labour-migration-africa-new-report-reveals

Keji, S. A. 2021. 'Human Capital and Economic Growth in Nigeria.' *Future Business Journal* 7 (1): 49.

Köllner, S. 2013. 'Remittances and Educational Attainment: Evidence from Tajikistan.' Wirtschaftswissenschaftliche Beiträge, No. 124. Bayerische Julius-Maximilians Universität Würzburg.

Latukha, M., M. Shagalkina, E. Mitskevich, and E. Strogetskaya. 2022. 'From Brain Drain to Brain Gain: The Agenda for Talent Management in Overcoming Talent Migration from Emerging Markets.' *The International Journal of Human Resource Management* 33 (11): 2226–55.

Lu, Y., and D. J. Treiman. 2007. 'The Effect of Labor Migration and Remittances on Children's Education Among Blacks in South Africa.' On-Line Working Paper 1, California Center for Population Research.

Makwembere, S., P. Acha-Anyi, A. J. Asaleye, and R. Garidzirai. 2024. 'Can Remittance Promote Tourism Income and Inclusive Gender Employment? Function of Migration in the South African Economy.' *Economies* 12 (7): 162.

Mankiw, N. G., D. Romer, and D. Weil. 1992. 'A Contribution to the Empirics of Economic Growth.' *The Quarterly Journal of Economics* 107 (2): 407–37.

Mastercard Foundation. 2020. *Secondary Education in Africa: Preparing Youth for the Future of Work*. Mastercard Foundation.

Mawuena, K. K., and M. K. N. Okey. 2021. 'The Effect of Remittances on Education in Togo.' *Theoretical Economics Letters* 11 (6): 1293–311.

McKenzie, D., and H. Rapoport. 2011. 'Can Migration Reduce Educational Attainment? Evidence from Mexico.' *Journal of Population Economics* 24 (4): 1331–58.

Mileris, R. 2019. 'Population Migration Flows in European Union: Economic Factors and Perspective Statistical Trends.' *Managing Global Transitions* 17 (2): 163–88.

Mjelva, M. B., and J. Carling. 2023. 'Surveys on Migration Aspirations, Plans and Intentions: A Comprehensive Overview.' *Open Research Europe* 3:145.

Oda, H. 2023. 'An Analysis of the Impact of International Remittances on Child Education: Evidence from Pakistan.' In *Migration in South Asia: IMISCOE Regional Reader,* edited by S. I. Rajan. Springer.

Organisation for Economic Co-operation and Development. 2017. *Interrelations Between Public Policies, Migration and Development.* OECD Publishing.

Oyadeyi, O. O., I. A. Adediran, and B. A. Kabir. 2024. 'Remittance and Macroeconomic Performance in Top Migrating Countries.' *Social Sciences* 13 (5): 239.

Pesaran, M. H. 2004. 'General Diagnostic Tests for Cross Section Dependence in Panels.' IZA Discussion Paper, No. 1240, The Institute for the Study of Labor.

Pilařová, T., and A. Kandakov. 2017. 'The Impact of Remittances on School Attendance: The Evidence from the Republic of Moldova.' *International Journal of Educational Development* 55:11–16.

Prais, S. J., and C. B. Winsten. 1954. 'Trend Estimators and Serial Correlation.' Cowles Commission Discussion Paper No. 383, Cowles Commission.

Romer, P. M. 1986. 'Increasing Returns and Long-Run Growth.' *Journal of Political Economy* 94 (5): 1002–37.

Shafiq, M. N., X. Yang, and M. A. Nawaz. 2022. 'Do Remittances Promote Education? Empirical Evidence from Developing Countries.' *Pakistan Journal of Humanities and Social Sciences* 10 (2): 830–41.

Stark, O., and L. Byra. 2012. 'A Backdoor Brain Drain', *Economics Letters* 116 (3): 273–76.

Stark, O., and C. S. Fan. 2007. 'Losses and Gains to Developing Countries from the Migration of Educated Workers: An Overview of Recent Research, and new Reflections'. ZEF Discussion Papers on Development Policy No. 116, University of Bonn.

Stark, O., and Y. Wang. 2002. 'Inducing Human Capital Formation: Migration as a Substitute for Subsidies.' *Journal of Public Economics* 86 (1): 29–46.

Usman, K. 2023. 'The Nexus Between Remittance, Exchange Rate and Economic Growth of E7 Economies: Frequency Domain Analysis.' *Heliyon* 9 (11): e21554.

Weeraratne, B. B. 2024. 'Migration and Development: The Role of Remittances.' In *Handbook of Migration and Globalisation*, edited by A. Triandafyllidou. Elgar.

Williams, K. 2025. 'Do Migrants' Remittances Improve Educational Attainment in Developing Countries?' In *Economic Challenges in Early 21st Century Guyana: Post-Independence Growth and Development,* edited by D. DaSilva-Glasgow, T. Khemraja and D. Thomas. Palgrave Macmillan.

Wooldridge, J. M. 2013. *Introductory Econometrics: A Modern Approach*. 5th ed. South-Western Cengage Learning.

World Bank. 2023. *World Development Indicators.* World Bank Group.

World Bank. 2024. *Migration and Remittances Overview: Development News, Research, Data*. World Bank Group.

Xia, C., M. Qamruzzaman, and A. H. Adow. 2022. 'An Asymmetric Nexus: Remittance-Led Human Capital Development in the top 10 Remittance-Receiving Countries: Are FDI and Gross Capital Formation Critical for a Road to Sustainability?' *Sustainability* 14 (6): 3703.

Zhunio, M. C., S. Vishwasrao, and E. P. Chiang. 2012. 'The Influence of Remittances on Education and Health Outcomes: A Cross-Country Study.' *Applied Economics* 44 (35): 4605–16.