



## Remittances and domestic investment nexus: Evidence from a PMG-ARDL approach

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### Abstract

This paper examines the nexus between domestic investment and remittances in developing economies, with a particular focus on countries in Africa. The panel Auto Regressive Distributed Lags and the Dumitrescu-Hurlin causality testing techniques covering the period from 2000-2021 for 30 African countries were employed to examine the remittance-domestic investment nexus. The findings of the study suggest that there are long-run relationships and a very strong joint causality between domestic investment and remittances for the panel of countries in this study. Furthermore, the findings of the causality test suggested a bi-directional causality between domestic investment and remittances. Remittances have been a key link between migration and development in low- and middle-income countries (LMICs), both at the household and country levels. Remittance receipts play an integral part in facilitating consumption smoothing and serving as a vital source of cash for domestic investment in LMICs. The United Nations Sustainable Development Goals acknowledge the importance of remittances, such that in some states, more than 10 percent of the respective countries gross domestic product is from remittance receipts. The results denote that policies aimed at increasing domestic investment through remittances need to be cautiously planned to ensure prolonged effects. Since there is a bi-directional causality between domestic investment and remittances, policymakers need to understand the macroeconomic implications of remittance inflows for domestic investment. In a nutshell, policies can be designed to harness and maximize the benefits that recipient countries can derive from remittance flows to drive domestic investment.

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## 1. Introduction

Remittances inflow to LMICs significantly increased over a decade, such that remittances remain a key source of external funding for LMICs (World Bank, 2021). Contrary to the World Bank's forecasts of a fall in remittances by 20 percent in 2020, remittances only fell by 1.7 percent (Ratha et al., 2020). It is acknowledged that remittances are a quick, easy, and cheaper method of transferring money globally (Imai, Gaiha, Ali, & Kaicker, 2014; World Bank, 2021). Remittances continue to play a vital role in the interconnection between migration and development in LMICs. The International Labour Organisation (ILO) (2021) opined that there are about 169 million labour migrants globally, of which 68 percent are hosted in high-income countries. In some African countries, such as (Lesotho, Liberia, and Gambia) remittances to the respective countries share a gross domestic product of more than 20 percent (World Bank, 2021).

Repatriation of workers' earnings is an important aspect of international development finance, as most households in poor countries depend on remittances for consumption smoothing and investment (Fang & Qamruzzaman, 2021; Gammeltuft, 2002; Ratha, 2007). The size of remittances on national and international level has attracted so much attention as remittances are regarded as essential for economic development (International Monetary Fund, 2020). Remittances to LMICs in 1990 were US\$29 billion, which surged to US\$491 billion in 2018, and they were estimated to be around \$565 billion in 2022 (World Bank, 2021). However, the actual amount of remittances flowing to LMICs can be greater than the World Bank's predictions, as the World Bank data is based on formal remittances.

Despite the increased interest in remittances, with a plethora of literature on the remittance effect on economic growth, poverty, and inequality in receiving countries (Chowdhury, 2016; Imai et al., 2014; Olayungbo & Quadri, 2019; Ratha, 2013), there is limited empirical literature on the impact of remittances on domestic investments in receiving states. In poorer families, remittances can fund the acquisition of children's education, housing, basic consumption goods, and health care (International Monetary Fund, 2020; Knomad, 2020; Rivera & Tullao, 2020). For richer households, remittances can offer capital for small businesses and entrepreneurial activities (Ratha, 2013). Sovereign states and international organisations motivate remittance services to be declared essential, and digital remittance channels should be scaled up to keep remittances flowing to the LMICs (Knomad, 2020). There is a limited amount of empirical research available on the relationship between domestic investment and remittances. Nwokolo, Ogbuagu, and Isola (2021) argued that remittance income is more constant than other forms of international flows such as foreign aid and Foreign Direct Investment (FDI). Additionally, for some low-income countries, remittances are the main source of foreign exchange (Ratha et al., 2020).

Effectively used remittances have the potential to generate multiplier effects, so making a significant contribution towards supporting local demand, and fostering economic growth and for LMICs (Ratha et al., 2020). Remittance flows to some Sub-Saharan countries as a share of gross domestic product (GDP) are more than ten percent in comparison to 2 percent of GDP in high-income countries (International Monetary Fund, 2020). Furthermore, it is argued that remittances are more stable than other forms of international capital, such as FDI Official Development Assistance (ODA), which tends to be countercyclical (International Monetary Fund, 2020). The remittances received in LMICs tend to be stable irrespective of a decline in the financial markets or economic downturns (Bui, Le, & Daly, 2015; Ratha, 2013). Thus, remittances are thought to promote domestic investment if these flows are transformed to enhance economic productivity.

While there are studies that examine the impact of remittances on growth, remittances and financial development, and remittances and inequality in beneficiary countries, there is a dearth of studies on the cointegration and causality of remittances and domestic investment Mallick (2012). Tung (2018) and Dash (2020) Despite these studies ascertaining the cointegration of remittances and domestic investment, there is scant empirical work on the cointegration and causality of remittances and domestic investment in LMICs with an African focus. It is imperative to comprehend the causal effects of remittances and domestic investments, as development institutions have been advocating remittances as a panacea for development in LMICs. Remittances inflows in Africa can, with hindsight, have the predictive power of domestic investment and vice versa. It is worth remarking that nations in Sub-Saharan Africa not only have an enormous migrant population but are also mostly poor, heavily indebted, and characterized by a lack of domestic resource mobilisation (Ratha et al., 2020). Thus, remittances contribute to the external financial positions of most LMICs (World Bank, 2021). Hence, the study contributes to the policy discussions on the role of remittances in the development of the recipient countries in Africa.

The present article is organized in the following manner: Section 2 provides a comprehensive examination of the existing theoretical and empirical literature. Section 3 of the paper provides discussion on the data and its description, as well as model specification and econometric method employed in the study. Section 4 presents an analysis of the results obtained, including an estimation and discussion. Section 5 encompasses the conclusion, policy implication, and recommendation for future research.

## **2. Literature Review**

Remittance inflows have the potential to impact domestic investment through various channels. Barajas, Chami, Fullenkamp, Gapen, and Montiel (2009) argued that families that receive remittances have additional income, which eases their financial constraints to take up investments in entrepreneurial activities or for consumption smoothing. Theoretically, there are limited theories that directly link migrant remittances and domestic investment. However, the neoclassical theory of investment (Bloom & Freeman, 1986; Stark & Bloom, 1985), where investment is a function of income (in this case, migrant remittances), is supported. This enhances both the altruistic motive and the portfolio approach of migration, where migrants send money back home for consumption and investment purposes (Barajas et al., 2009). Additionally, the decision to migrate is informed by households' decision to generate capital for consumption and investment, an assertion outlined in the New Economics of Labour Migration (NELM) (Jorgenson, 1963; Mannan & Fredericks, 2015; Stark & Bloom, 1985).

Taylor (1999) supported the NELM by arguing that in impact markets, remittances are an essential development dynamic as they reduce the financial constraints faced by households. According to the

hypothesis by McKinnon and Shaw, it is not mainly the cost of capital that hinders investments but rather the availability of funds to invest (McKinnon, 1973; Shaw, 1973). Hence, remittances, being important sources of income for LMICs, are essential to ascertaining how they affect domestic investments in these economies. The theories outline the channels through which remittances are essential for development in LMICs, which include consumption smoothing, domestic investments, financial sector development, human development through education and health, domestic savings, and the supply of foreign currency. This study therefore seeks to use the domestic investment channel of remittances by examining the remittances-domestic investment nexus.

Formal remittances enhance financial development, which in turn encourages domestic savings and access to credit (Naceur, Chami, & Trabelsi, 2020). High domestic savings and improved credit access stimulate domestic investment (Aggarwal, Demirgüç-Kunt, & Peria, 2011; Ratha, 2013). Furthermore, remittance inflows beef up the inflow of international capital with a likelihood of increasing money supply in the domestic economy and a multiplier effect of a reduced discount rates, which stimulates domestic investments (Dash, 2020; Ratha, 2013). By providing much-needed foreign exchange, remittances provide the foreign currency for domestic industries (Meyer & Shera, 2017). The drive between migration and development is augmented by the notion of the importance of remittances for economic development. Contingent on their use, remittances are said to promote education and consumption and reduce poverty in emerging markets (Aggarwal et al., 2011; Chowdhury, 2016; Fang & Qamruzzaman, 2021; Ratha, 2013). Furthermore, remittances are argued to stimulate economic growth and entrepreneurship in remittance-receiving countries (Rao & Hassan, 2012). Aid agencies advocated for the integration of migration into development mainly because of the remittances' economic contribution as a main foreign currency earner for LMICs (Gammeltoft, 2009; International Labour Organisation (ILO), 2021). The remittance received in LMICs is a vital source of income for many domestic families and a major foreign exchange source for the states in labour-exporting nations (International Monetary Fund, 2020).

However, Hassan and Holmes (2013) found that remittances' impact on domestic investment is time-variable. Remittances negatively affect domestic investment in the short run, while the negative relationship is offset in the long run, such that remittances enhance capital accumulation. International migrants create international knowledge networks that can be reinvested in their home country (Rapoport, 2019). In a nutshell, the marginal propensity to consume remittance earnings determines the overall relationship between remittances and domestic investment (Abbas, 2019). Increased investments by households can lead to more migration, which in turn increases remittances (investment-led remittances) for the home country (Dash, 2020). This is contrary to the remittances-led investments, where an increase in remittances causes investment by snowballing domestic savings and investment in human and physical capital (Ratha, 2013; Salas, 2014).

While there is literature on the remittance-growth and the remittance-poverty nexus, the empirical literature is limited to domestic investment-remittances cointegration and causal effects. From a macroeconomic perspective, the link between remittances and domestic investment remains inconclusive. Dash (2020) found that domestic investment increases with an increase in remittances for a sample of countries in Southeast Asia. This contrasted with Adolfo Barajas, Chami, Ebeke, and Oeking (2018) finding that remittances are private funds that are interest- (policy rate) insensitive. Although they can increase liquidity in banks' loanable funds, they are likely not to increase investment. On the other hand, Ratha (2013) opined that investments made by remittance-receiving households have a positive accrual effect on economic investment in the domestic economy. Gani (2016) suggested that remittance transfers surge domestic savings, which in turn increases the level of domestic investment. This argument hypothesises an indirect remittance-domestic investment nexus. However, the empirical inferences on remittances on domestic investment are inconclusive, rendering the inquiry on whether remittances thwart or improve domestic investment an open empirical topic.

Additionally, the critical provision of foreign currency necessary for the import of essential capital and intermediate goods contributes to domestic investment in LMICs (Chami et al., 2008). Issifu (2018) opined that the remittances-domestic investment nexus is conditional on institutional quality and financial sector development. Dash (2020) found that an increase in remittances in Southeast Asia increases households' capital investment. This contradicted the findings of Ahamada and Coulibaly (2013), whose findings for Sub-Saharan Africa were that remittances increase investments only in social and human capital but not physical capital. Mallick (2012) finding for India suggested that remittances result in dependence syndrome, such that they increase private consumption with little or no effect on domestic investment. Despite the effect on private consumption and investment, remittances are also opined to crowd out public investments while increasing private investments (Mallick, 2012; Tung, 2018). Despite the scant literature on remittances and domestic investment in LMICs, the few studies that have empirically studied this relationship are inconclusive. This article, therefore, contributes to the literature on the cointegration and causality between domestic investments remittances.

### **3. Methodology, Data and Model Specifications**

The data and the research design are presented and discussed in this section. The data and description of variables are explained in section 3.1. The research design is discussed in Section 3.3.

### 3.1. Data

The cointegration and causality relationship between domestic investment and remittances were determined using annual panel data from 2000-2021. The data was sourced from the World Development Indicators database. The ultimate number of countries in the study was determined by data availability, with the automatic exclusion of countries that had missing data on the domestic investment variable as it is the dependent variable of the study. A three-year moving average was employed to complete the gaps in the data. Table 1 presents the description, definitions, and data sources for the variables used in the study.

**Table 1.** Description of variables and data sources.

Variable	Definition/Measurement	Source	Expected sign
Domestic investment (DINV)	Gross capital formation (% of GDP)	World development indicators (WDI)	
Remittances (REM)	Remittance inflows, in percent of GDP	WDI	Positive/ Negative (+/-)
Lagged economic growth (LECOGR)	GDP growth	WDI	Positive (+)
Trade	Imports plus exports, in percent of GDP	WDI	Positive (+)
Macroeconomic stability (MACROST)	Percent change in consumption price index proxies by inflation	WDI	Negative (-)
Savings rate (SAVRT)	Gross savings (% of GDP)	WDI	Positive (+ve)

Domestic investment is hypothesised to be a function of remittances, economic growth, trade, macroeconomic stability, and the savings rate in this study. In the migration and development literature, remittances are the panacea for mobilising the inclusion of migration in the development agenda of the Sustainable Development Goals (SDGs). Existing literature is scant on remittances as a determinant of domestic investment, yet there is consensus that remittance receipts are the most constant source of foreign exchange in LMICs (Nwokolo et al., 2021; Ratha et al., 2020). In the theory of NELM, the assertion is that the decision to migrate by households is for consumption and investment purposes. Furthermore, in the Neoclassical Investment Theory investment is hypothesised to be a function of income. In LMICs, migrant remittances are a source of income for their families back home. The second important traditional determinant of domestic investment (DINV) is economic growth, in which an economic boom creates an increase in demand for capital, which leads to greater investment (Meyer & Shera, 2017; Peprah, Kwesi Ofori, & Asomani, 2019).

Macroeconomic stability is essential for domestic investment. For this study, inflation was used as a proxy for macroeconomic stability. A positive outlook on the macroeconomic stability of a country improves investor sentiments towards investing in the domestic economy (Nwokolo et al., 2021). The stability of migrants' home economies also affects their economic confidence, such that they take up investment opportunities in their home countries (Basnet, Donou-Adonsou, & Upadhyaya, 2022). Additionally, macroeconomic instability erodes the purchasing power of remittance recipients such that it affects the amount of money invested (Rivera & Tullao, 2020).

Trade is another variable considered a control variable for investment in this study. The Agenda 2063 advocates for the African Continental Free Trade Area (AfCFTA). An increase in the volume of trade results in the exponential growth of domestic investments (Nwokolo et al., 2021; Rivera & Tullao, 2020). Lastly, the savings rate was included as a determinant of domestic investments, as the literature argues that higher domestic savings are associated with the quality and quantity of domestic investments (Osili, 2007; Rivera & Tullao, 2020). Remittance recipients may save the money received as precautionary savings (Benhamou & Cassin, 2021).

### 3.2. Model Specification

In this study, the domestic investment proxied by gross capital formation is hypothesised to be a function of remittances, economic growth, savings rate, and macroeconomic stability.

$$DINV_{i,t} = f(REM_{i,t}, ECOGR_{i,t}, MACROST_{i,t}, SAVRT_{i,t}, TRADE_{i,t}) \quad 1$$

Where DINV is the gross capital formation representing domestic investment, REM is remittances, ECOGR is economic growth, MACROST is macroeconomic stability, which is proxied by the inflation rate, SAVRT is the savings rate, and trade is the total import and export as a percentage of the gross domestic product, respectively; and the cross-section and time-period are captured by *i* and *t*, respectively.

### 3.3. Estimation Techniques

Section 3.3.1-3.3.3 discusses the unit root, panel cointegration, and the panel causality, respectively.

3.3.1. Cross-Sectional Dependence and Panel Unit Root Analysis

Cross-sectional dependence (CD) is a key concern in panel data studies. It is necessary to recognize the properties of the data and test for CD. Hence, the Pesaran (2021) (CD) and Frees (1995) tests were performed, and the results are presented in Table 3.

After determining the CD, the order of integration of the variables was determined using the panel unit root test. The examination of cointegration between the variables using the ARDL methodology does not strictly entail the pre-testing of variables for a unit root. However, the ARDL method entails that the variables should not be of second-order integration I(2) or higher (Pesaran, Shin, & Smith, 1999). The unit root test was employed to guarantee that there are no variables of I(2) or higher used in the analysis. The cross-sectionally augmented Im, Pesaran, and Shin (IPS) was used to determine the variable order of integration (see Pesaran (2007)). The cross-sectionally augmented IPS test has the advantage that it accounts for issues of CD in the panels. Table 4 presents the results of the cross-sectionally augmented IPS test.

3.3.2. Panel Autoregressive Distributed Lag (ARDL)

Domestic investment-remittances nexus was determined using the panel autoregressive distributed lag (ARDL) (1,0,0,1,0,0). The panel ARDL model see (Pesaran et al., 1999) was applied in the study to examine the domestic investment-remittances nexus. The ARDL in this study has the advantage that it allows for differentiating between the short- and long-run properties of remittances inflows on domestic investment through the use of three estimators (pooled mean group, mean group, and the dynamic fixed effects) (Pesaran et al., 1999; Samargandi, Fidrmuc, & Ghosh, 2015). M Hashem Pesaran et al. (1999) introduced a dynamic heterogeneous panel regression in an error correction form with  $p$  and  $q$  lags of the dependent and independent variables, respectively. According to other empirical studies (Apergis & Payne, 2009; Pedroni, 2004; Pesaran et al., 1999), the ARDL and the error correction model (ECM) were run concomitantly to capture the speed of adjustment after disequilibrium. In this study, the model is therefore parameterized as:

$$\Delta DINV_{it} = \phi_i(DINV_{i,t-1} - \gamma_{1i}REM_{i,t} - \gamma_{2i}X_{i,t}) + \sum_{j=1}^{p-1} \delta_{ij}\Delta DINV_{i,t-j} + \sum_{j=0}^{q-1} \beta_{1i}\Delta REM_{i,t-j} + \sum_{j=0}^{q-1} \beta_{2i}\Delta X_{i,t-j} + \mu_i + \varepsilon_{it} \tag{2}$$

Equation 2 is the ARDL model that tests the long run and short run dynamics between domestic investment, remittances, and other control variables.

$$\Delta REM_{it} = \phi_i(REM_{i,t-1} - \gamma_{1i}DINV_{i,t} - \gamma_{2i}X_{i,t}) + \sum_{j=1}^{p-1} \delta_{ij}\Delta REM_{i,t-j} + \sum_{j=0}^{q-1} \beta_{1i}\Delta DINV_{i,t-j} + \sum_{j=0}^{q-1} \beta_{2i}\Delta X_{i,t-j} + \mu_i + \varepsilon_{it} \tag{3}$$

Equation 3 represents the ARDL model, which tests the long run and short run dynamics between remittances, domestic investment, and other control variables.

$$\Delta X_{it} = \phi_i(X_{i,t-1} - \gamma_{1i}DINV_{i,t} - \gamma_{2i}REM_{i,t}) + \sum_{j=1}^{p-1} \delta_{ij}\Delta X_{i,t-j} + \sum_{j=0}^{q-1} \beta_{1i}\Delta DINV_{i,t-j} + \sum_{j=0}^{q-1} \beta_{2i}\Delta REM_{i,t-j} + \mu_i + \varepsilon_{it} \tag{4}$$

In Equation 4, X is a vector of control variables representing the long run and short run dynamics of each of the control variables: domestic investment, and remittances.

$DINV_{it}$  represents the level of domestic investment for country i for year t measured by the GCF as a percentage of gross domestic product;  $REM_{it}$  represents remittance inflows as a share of GDP in country i for year t; X is a vector of control variables, which included macroeconomic stability (macrost), and savings rate (savrt), trade (trade)  $\varepsilon_{i,t}$  is the error term.  $\beta_0$  is the intercept and  $\beta_{1...N}$  are the long-run coefficients  $\delta$ ,  $\lambda$  and  $\lambda$  are the short-run coefficients; the long-run coefficient in our model are  $\gamma_{1i}$  and  $\gamma_{2i}$  and the  $\phi_i$  represent the speed of adjustment.

According to Pesaran, Shin, and Smith (1997), the pooled mean group (PMG) estimation model takes into account that the slope parameters across countries are same in the long term, with different short-run coefficients across countries. However, the Mean Group (MG) estimation affords country characteristics in both the short and long term. The Hausman test was employed to differentiate between PMG and MG. Pesaran et al. (1999) argue that despite the fact that both PMG and MG are consistent, under the premise of long-term homogeneity, the PMG estimation is more efficient.

### 3.3.3. Causality Test

The causal relationship between DINV and remittances is empirically tested using a panel causality test. The Dumitrescu and Hurlin (2012) test, designed to detect causality in panel data, was employed. The Akaike Information Criteria (AIC) was used to determine the appropriate lag length with the application of bootstrapping to deal with the empirical issue of cross-sectional dependence (Dumitrescu & Hurlin, 2012; Lopez & Weber, 2017). According to Lopez and Weber (2017), the lag order (k) in the panel is assumed to be identical for individuals, and the panel must be balanced. In the Dumitrescu & Hurlin (DH) test, the coefficients are assumed to be time-invariant but allowed to differ across individuals (Dumitrescu & Hurlin, 2012). Similar studies that have used the DH model in testing the causality hypothesis include (Dash, 2020). The null hypothesis, of no Granger causality in any cross-section is tested against the alternative hypothesis of Granger causality for at least one panel. The empirical model in the DH tests is parameterized in Equations 5 and 6.

$$\Delta \text{DINV}_{i,t} = \alpha_i + \sum_{k=1}^K \beta_{ik} \Delta \text{DINV}_{i,t-k} + \sum_{k=1}^K \delta_{ik} \Delta \text{REM}_{i,t-k} + \varepsilon_{i,t} \quad (5)$$

$$\Delta \text{REM}_{i,t} = \alpha_i + \sum_{k=1}^K \beta_{ik} \Delta \text{REM}_{i,t-k} + \sum_{k=1}^K \lambda_{ik} \Delta \text{REM}_{i,t-k} + \varepsilon_{i,t} \quad (6)$$

With  $i = 1, \dots, N$  and  $t = 1, \dots, T$   $\Delta$  is the difference operator, DINV is domestic investment and X is a vector of control variables which include remittances, economic growth, macroeconomic stability, savings rate and trade.

## 4. Empirical Results and Discussion

Table 2 presents the descriptive statistics of the study<sup>1</sup>

Table 2. Descriptive statistics.

Variable	Mean	Median	Maximum	Minimum	Std. dev.	Jarque-Bera	Observations
DINV	24.266	22.633	79.401	1.097	9.278	481.869	660
LECOGR	3.648	3.917	33.629	-20.599	4.166	2323.848	660
MACROST	5.893	4.151	150.323	-9.616	9.212	303137.6	660
REM	3.816	1.813	53.826	0.000	6.247	77.433	660
SAVRT	20.525	17.797	57.850	-13.791	11.228	76.871	660
TRADE	72.570	61.793	225.023	0.785	37.365	232.123	660

### 4.1. Cross-Sectional Dependence and the Unit Root Tests

The initial phase empirical analysis in this study was conducting tests to access the presence of cross-sectional dependence and unit root test. Tables 3 and 4 present the results of the CD test, unit root tests respectively.

Table 3. Cross sectional dependence test.

Test	Statistic	Prob.
Frees	2.296	0.01
Pesaran CD	9.411	0.0000

The results from the cross-sectional dependence test confirmed the presence of CD in the panel. Time series econometrics requires that the data be stationary before testing the variables' long-run relationships. Thus, the cross-sectional augmented Im, Pesaran, and Shin (IPS) unit root test was performed because it accounts for CD (Pesaran, 2007). Table 4 presents the summary of the results.

Table 4. Panel unit root test: cross-sectionally augmented (IPS).

Variable	Constant	Constant and trend	None	Decision
dinv	-2.630***	-2.894***	-1.907***	I(0)
Rem	-2.499***	-3.056***	-2.342***	I(0)
L.Ecogr	-3.854***	-4.067***	-3.419***	I(0)
Savrt	-2.251**	-3.095***	-2.039***	I(0)
Macrost	-3.217***	-3.929***	-3.171***	I(0)
Trade	-2.309**	-3.009***	-1.954***	I(0)

Note: \*\*p<.05; \*\*\*p<.01.

<sup>1</sup>For space consideration the correlation matrix is not reported but it is available on request.

The unit root test rejects the null that the panel has a unit root at level. The results of the unit root confirm stationarity in the series. The advantage of the unit root test is to circumvent the problem of spurious regression in the analysis. Thus, the notion of stationarity in the series allows for cointegration and causality tests to be performed in examining the cointegration and causal effects between DINV and remittances. Section 4.1 discusses the cointegration results.

*4.2. Panel ARDL Test and PMG Estimation Results*

Table 5 presents the panel ARDL results.

**Table 5.** Panel ARDL (PMG) estimation results.

Independent variables	PMG	PMG	PMG	PMG	PMG	PMG
Variables	D.dinv	D.rem	D.(L.ecogr)	D.macrost	D.savrt	D.trade
Long-run						
L.ecogr	0.0649 (0.103)	0.00507* (0.00241)		0.103** (0.0397)	0.401*** (0.0975)	1.144*** (0.229)
rem	0.677* (0.312)		-0.196*** (0.0389)	0.352*** (0.0472)	0.205 (0.142)	4.592*** (0.885)
macrost	0.264** (0.101)	0.0000498 (0.00352)	-0.0318 (0.0343)		-0.317*** (0.0865)	-0.0315 (0.107)
savrt	0.454*** (0.0783)	0.00584*** (0.00171)	0.198*** (0.0383)	0.0303 (0.0224)		-1.259*** (0.181)
trade	0.252*** (0.0343)	0.00140 (0.00102)	0.114*** (0.0169)	0.0171* (0.00804)	-0.0989*** (0.0259)	
dinv		-0.00205* (0.000863)	-0.0695* (0.0312)	-0.0225 (0.0226)	0.376*** (0.0587)	0.242 (0.140)
ECT	-0.259*** (0.0390)	-0.320*** (0.0523)	-0.688*** (0.0813)	-0.688*** (0.0702)	-0.356*** (0.0569)	-0.224*** (0.0513)
Short-run						
D. L.ecogr	-0.0390 (0.0349)	-0.0295** (0.0109)		0.000735 (0.0597)	-0.0994* (0.0471)	0.000781 (0.0820)
D.rem	9.891 (11.12)		-16.16 (18.51)	4.165 (2.876)	1.651 (1.537)	23.12 (20.07)
D.macrost	-0.0343 (0.0845)	0.0310 (0.0358)	-0.0148 (0.0451)		-0.0480 (0.0924)	0.269* (0.121)
D.savrt	11.13 (11.09)	0.0100 (0.0182)	5.344 (5.468)	-1.454 (1.206)		10.33 (10.28)
D.trade	0.0725* (0.0366)	0.0209 (0.0136)	-0.0587 (0.0314)	0.0430 (0.0565)	0.0455 (0.0448)	
D.dinv		0.00619 (0.0261)	-0.0985 (0.0556)	-0.0241 (0.0764)	0.186* (0.0845)	0.852*** (0.232)
_cons	-1.935** (0.588)	0.923*** (0.189)	-4.318*** (0.917)	1.264 (0.693)	5.417*** (0.854)	17.83** (5.727)
Diagnostic statistics						
N	600	600	600	600	600	600
Groups	30	30	30	30	30	30
Hausman test	1.48	1.75	1.41	0.66	0.98	0.80
p-value	0.9157	0.8826	0.9230	0.9850	0.9643	0.9773

Note: t statistics in parentheses, \*p<.10; \*\*p<.05; \*\*\*p<.01., p-value is the is the probability value of the Hausman test.

The results show that the error correction term (ECT) is negative and significant at 1 percent, confirming a long-run relationship between the variables and strong joint causality. The error correction term shows the speed of adjustment to long-run equilibrium after short run disequilibrium. Additionally if the coefficient of the error correction term is negative and significant it shows that there is a long-run causal relationship between the variables (Mishra, 2011). All the panel ARDL estimators generate similar results on the effect of remittances on DINV, both in the short and long-run. Based on the Hausman test results, the discussion of the results focused on the findings of the PMG estimator only. This is in line with Pesaran et al. (1999) argument that even though both PMG and MG are consistent, under the assumption of long-term homogeneity, the PMG estimation is more efficient. The ARDL cointegration analysis reveals a positive and significant association between remittances and DINV in the long-run. These findings support previous empirical research that has established a significant and positive association between remittance and DINV (Chowdhury,

2016; Dash, 2020). Nevertheless, the results are contrary to Tung (2018), whose study found a significant negative relationship between remittances and DINV for the Asia-Pacific region. A neutral relationship between remittances and DINV was also empirically suggested by Adolfo Barajas et al. (2018).

The long-run relationship between DINV and savings is positive and statistically significant. An increase in DINV increases with an increase in savings rate in the long-run, a result that was different for the short-run. The findings of increased DINV due to an increase in savings coincide with Gani's (2016) findings. High domestic savings stimulate investment activities in the local economy (Aggarwal et al., 2011; Ratha, 2013). However, in the short-run, DINV increases with a decline in the savings rate. Dash (2020) argued that remittances increase the total supply of savings to fund DINV. In the remittances-led hypothesis, increase in remittances increases domestic savings, which in turn are used to support investment. In the short-run the association between investment and savings is also positive but not significant.

There is a contrast between the effect of macroeconomic stability on investment in the short-run and the long-run. In the short-run, the relationship is negative and statistically insignificant. However, in the long-run, the relationship between macroeconomic stability and DINV is positive, and the effect is statistically significant. These results are contrary to Rivera and Tullao (2020), who argued that macroeconomic stability measured by inflation signals uncertainty in the economy and hence should negatively affect DINV. However, if the nominal interest rates account for inflation premiums, this implies positive real interest rates and consequently attracts investments.

The effect of trade on DINV is positive, as expected, similar to the findings of Dash (2020) for South Asia. The relationship is positive and statistically significant both in the short-run and in the long-run. Trade surges DINV by increasing physical and human capital accumulation through higher savings and enhanced technological transfer (Fatima, Chen, Ramzan, & Abbas, 2020; Lehmann, 2003). Under the ARDL estimation, the system is expected to return to long-run equilibrium after short-run disequilibrium, and in this study the speed of adjustment to the long-run equilibrium is 25.9 percent.

In a nutshell, the significance of the ECT for all the models suggests a causal relationship between the variables. Therefore, for robustness, a causality test for the variables of interest, namely DINV and remittance was only performed, and the discussion is presented in Section 4.2.

#### 4.3. Causality Test Results

Table 6 presents the results of the Dumitrescu and Hurlin (2012) Granger non-causality test. The results show a bi-directional causality between remittances and DINV for some of the panels in the study.

**Table 6.** Panel granger non-causality test between remittances and domestic investment

Direction of causality	Statistics	Test value
REM→DINV	W-bar	1.5826
	Z-bar	2.2564**
DINV→REM	W-bar	2.1868
	Z-bar	4.5966***

Note: \*\*p<.05; \*\*\*p<.01.

The null hypothesis that remittances do not Granger-cause DINV for the sample of our study is rejected at 5 percent. Thus, the remittances received in LMICs promote DINV, a finding that confirms the findings of Dash (2020) for the South Asian countries. For this study, remittance inflows increased with an increase in DINV. The results suggest a bi-directional relationship between remittances and DINV for this study. The bi-directional findings contrast the findings of Dash (2020) for the South Asian countries, which reported a unidirectional relationship running from remittances to DINV. Mallick (2012) and Tung (2018) findings supported a neutral relationship between remittances and DINV, which is contradictory to the bi-directional relationship reported for this study. However, the findings of this article confirm both the argument postulated by the proponents of remittance-led investments (Rao & Hassan, 2012; Ratha, 2013; Salas, 2014) and the investments-led remittances (Dash, 2020). Therefore, the findings of this study conclude that in the LMICs under this study, the causal relationship between DINV and remittances is bi-directional.

## 5. Conclusion

This study's objective was to examine the cointegration and causal relationship between domestic investment and remittance inflows in LMICs over the period 2000–2021, with a particular focus on African countries. Remittance inflows in LMIC are becoming a lifeline, providing key resources for domestic investment. Remittances have been a key link between migration and development in LMICs, both at household and country level. The coefficient of the relationship between remittances and domestic investment was positive, as expected; however, it was insignificant for the countries in the sample of the study. Empirical literature that investigates the causal relationship between remittances and domestic investment is very scant and inconclusive.



It is thought that remittances are supportive of investments in the domestic economy; however, for this study, the relationship was insignificant. Furthermore, the study provides a message for policymakers to consider both short and long-run dynamics when instituting policies. Although it is believed that remittances are mainly used for consumption, bi-directional relationship findings on remittances and domestic investments support the assertion that remittances are used for other purposes than consumption. Thus, governments in LMICs should put measures in place to harness the flow of remittances.

Furthermore, the policymakers should institute policies that support the business climate, as domestic investment leads to more remittance inflows. Despite the intuitions added by this study on the domestic investment-remittances nexus, the major limitation of the study was a lack of data in some of the countries. Hence, this study could be extended to cover more countries as more data becomes available and include the labour market, bank lending, and pandemics such as COVID-19 as variables. Moreover, it is advisable to conduct research on global value chain and domestic investment, with a particular focus on studying the relationship between trade and domestic investment. The available information in the form of anecdotes suggests that a significant portion of remittance to LMICs is facilitated through informal routes. Additionally, it is necessary to explore strategies for increasing the volume of remittances; they have been extensively utilised as a mean of facilitating consumption smoothing. However, there is scant research on the remittance-food security nexus.

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