

# Remittance inflows in a digital economy: A Sub-Saharan African experience

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**Abstract:** The undeniable importance of migrants' remittances to the welfare of developing countries was again demonstrated during the COVID-19 pandemic. This has therefore led to a significant shift in attention to the relevance of remittances and has likewise spurred research interest in factors that motivate the inflows of remittances. However, in spite of the increasing recognition of the roles of digital technology in the macroeconomic performance of developed and developing economies alike, empirical analysis of its possible impacts on remittance inflows has not been well explored in the literature. Therefore, pooling the annual data of 35 sub-Saharan African (SSA) countries from 2011 to 2020, this study investigates the nexus between digital technology and remittance inflows within the generalized method of moments (GMM) framework. Using two measures of digital technology infrastructure—internet usage and mobile cellular subscription—the study finds a positive relationship between digital technology and remittances inflow. In addition, the findings indicate that the magnitude of the effect is relatively higher for internet usage. The study thus shows that the increased rate of remittance mobilization constitutes a significant pathway through which digital technology impacts the economies of the SSA region. Moreover, it offers further insight on the importance of digital technology in the socioeconomic development of developing countries. From a policy standpoint, governments and policymakers in SSA countries should intensify efforts to promote the diffusion and penetration of digital infrastructure.

**Keywords:** migrant remittances; digital technology; ICT; Sub-Saharan Africa, developing countries

## 1. Introduction

The indisputable significance of remittance inflows in the welfare of developing countries was again exemplified by the COVID-19 pandemic. In the words of Michal Rutkowski, the Global Director of World Bank's Social Protection and Jobs Global Practice, "As COVID-19 still devastates families around the world, remittances continue to provide a critical lifeline for the poor and vulnerable" (World Bank, 2021). The stability and sustainability of remittance as a source of foreign inflow was attested to by its resilience during the pandemic. According to a World Bank (2021) report, against predictions of significant decline due to the pandemic, remittances showed resilience with slight decline in 2020. In particular, remittances flow to low-and middle-income countries only fell by 1.6 percent against the projected 7 percent decline, falling from \$548 billion in 2019 to \$540 billion in 2020. This was remarkably lower than the decline in foreign direct investment (FDI), which fell by more than 30 percent (excluding China FDI inflows) in the same period. Hence, as external sources of financial resources, remittances surpassed both FDI and official development assistance (ODA) combined in 2020 (World Bank Development Indicator (WDI), 2021).

Prior to the pandemic, the bearing of remittance was particularly boosted by three recent notable events namely; the inclusion of remittance inflows as a target to achieving sustainable development goal (SDG) of reduced inequality (SDG 10), declaration of International Day of Family Remittances (IDFR) by the United Nations since 2015 and the outdistancing of global average FDI by remittance for the first time in 2019 (World Bank, 2020, 2021; United Nations, 2022). Owing to its enormous roles in achieving various macroeconomic development outcomes, remittance inflows is particularly important for developing countries. Aside from provision of lifeline for millions of households, remittance inflows spur inclusion and growth in the financial sector (Agarwal et al., 2011; Anzoategui et al., 2014; Jemiluyi and Jeke, 2023a), reduces inequality and poverty (Arapi-Gjini et al., 2020; Azizi et al., 2021), fuel domestic investment (Asongu and Odhiambo, 2020) thereby promoting industrialization with attendant improvement in the economic performance of developing countries (Dridi et al., 2019; Ekanayake et al., 2020; Francois et al., 2022).

Following the increasing awareness of the import of remittances in solving diverse socioeconomic challenges especially in developing countries, policy interest has continued to gear towards expanding remittance inflows. Thus, in both policy and empirical debates, factors that dictate the inflow of remittances has continued to be studied. Consequent on the increasing wave of information and communication technology (ICT) diffusion in developing countries in recent time and the growing awareness of its transformative roles evidenced in ICT-enabled socioeconomic transformations characterizing the globe in the last three decades, research attention has also shifted towards understanding the roles of ICT diffusion in remittance inflows (Kunze, 2017; Nicoli and Ahmed, 2019; Raithatha et al., 2021).

While the resilience in remittance flow during the pandemic was hinged on various factors including exchange rate and fiscal incentives in host countries, the significance of digital technology (Digital technology, ICT and digitalization are used interchangeably throughout this study) in the trend has also been noted (World Bank, 2021). Thus, there has been a renewed call for digitalization of remittances flow (Nicoli and Ahmad, 2019; Bersch et al., 2021; Raithatha et al., 2021). Digitalization of remittance spurred by development in ICT has not only led to substantial cut in cost of remittance, it also facilitates convenience, saves time, enhances trust thereby promoting development in the financial sector (Nicoli and Ahmed, 2019; Raithatha et al., 2021; Jemiluyi and Jeke, 2023a). Therefore, we are making contribution to the remittance literature by investigating the relationship between diffusion of digital technology and remittance inflows in sub-Saharan Africa (SSA).

In recent time, remittance inflows have been growing steadily in SSA, constituting the largest source of foreign income (International Monetary Fund, 2021). Exploring the nexus between ICT and remittance inflows is particularly important for SSA given the remarkable growth in ICT diffusion in recent time and the pile of development challenges that could be solved with increasing remittance inflows. In the period between 2010 and 2020, internet usage increased by 327 percent while fixed broadband and mobile cellular subscription grew by 162 percent and 73 percent respectively in the same period (WDI, 2021). Despite the significant improvement in ICT diffusion, remittance inflows in SSA are relatively lower to other developing regions (WDI, 2021). In particular, the regional breakdown of the World Bank (2021)

remittances report indicates that remittance inflows actually rose in the Middle East and North Africa, South Asia and Latin America and the Caribbean during the pandemic, while it fell in Europe and Central America, East Asia and the Pacific and sub-Saharan Africa. The fall was however highest in SSA with a decline of 12.5 percent, higher than the projected 8.8 percent regional decline (World Bank, 2021). An assessment of the possible relationship between digital technology and remittances inflow is therefore not only timely for SSA, but also of huge importance. The significance of digital technology in macroeconomic performance is gaining momentum in SSA (see Adeleye and Eboagu, 2019; Asongu and Odhiambo, 2020; Jemiluyi and Jeke, 2023b), but its role in remittance mobilization is sparsely studied. We are not denying the fact that the determinants of remittance have been empirically examined for the region, the evidences are few (Ezeoha, 2013; Singh et al., 2010), and we are not aware of any study that has examined the role of digital technology in mobilizing remittance inflows in the region. Given the established evidences of significance of remittances, filling this identified gap in the literature can serve as an impetus to solving diverse development problems in the region.

## **2. Literature review**

Although the issue of the determinants of remittance inflows has been extensively studied at both micro and macro levels, the consideration for the role of digitalization has only been recently studied. Hence, for the purpose of this study the empirical review focuses on studies which examined various motivators of remittance inflows. Moreover, to affirm the contemporaneity of the issue of remittance we focus more on recent studies. Emphasizing the role of migrant remittance in overcoming the challenge of middle-income trap in Asian region, Yoshino et al. (2019) studied the influencing factors of remittance in the region. Findings of the empirical analysis based on panel of twelve migrant sending Asian countries concluded that factors including output growth, trade openness, real exchange rate and level of education are motivators of remittance inflows to the region. In an earlier study on the Asian region. Mallick and Mahalik (2015) ascribed the inflow of remittance to output growth, difference in interest rate between the host and the home countries and financial development of the home country. In country-specific analyses of the Asian region, Rana and Hashmi (2015) found that foreign factors such as change in labour force size, inflation, exchange rate and size of the foreign sector in the host country are significant influencers of remittance inflows in Bangladesh. Jijin et al. (2022) similarly showed that output growth and exchange are important for remittance inflows in India and Ranathunga (2018) revealed that number of children in school and household consumption level are two major factors determining the size of remittance inflow in rural Sri Lanka.

In empirical explorations for SSA, Adenutsi and Ahorator (2021) documented difference in income and interest rate between the host and home countries, financial development and inflation rate as remittance motivating factors for the sub-region. Similar findings were reported in a previous study by Singh et al. (2010). The authors showed that the size of a country's diaspora and the income level in the host country are crucial for remittance inflows in SSA. In the same vein, import of financial

development for remittance inflows for the sub-region was argued by Ezeoha (2013). Focusing on the Western region of SSA, Omon (2021) corroborated the stance that the level of development in the host country, development of home country's financial sector and domestic currency exchange rate are the key macroeconomic determinants of remittance inflows. Arguments for the relevance of income, interest and exchange rates were also affirmed in country specific analyses including Laniran and Adeniyi (2015) for Nigeria, Molapo (2022) for Southern African countries; and Ahiawodzi (2012) for Ghana. In more general analyses, Simpson and Sparber (2020) found that remittance outflow from the US is strongly related to the level of household earning. Also, Tsurai and Maseko (2020) found that economic growth, level of financial development and inflation are fuelers of remittances in transition economies.

With increase in the rate of diffusion of technology particularly in the developing regions, empirical research on the potential role of technology in remittances inflow has begun to grow. Studying the role of technological development in remittances transfer of Somali migrants in Canada, Elmi and Ngwenyama (2020) found that progress in technology diffusion constitutes an important explanation for growth in migrant remittances from Canada. The contribution of digital technology to rising migrants' remittances is also attested to in a recent study by Ahmed and NaRanong (2023). Based on the outcomes of the empirical strategies, the study showed that improvement in ICT plays a key role in remittances inflow in Bangladesh. Emara and Zhang (2021) established a nonlinear relationship between remittances inflow and digital technology in BRICS. According to the study's GMM estimates, digitalization only increases the stock of remittances below the threshold level. In another recent study, Gascon et al. (2023) affirmed that digitalization increases the probability of receiving remittance in Salvador.

In sum, the empirical review shows that remittance inflows are motivated by macroeconomic factors including level of economic development in both the host and home countries, exchange and interest rates differential, inflation, size of a country diaspora, level of education and digitalization. The review further shows that the possible role of digitalization in remittance has not been considered for SSA.

### **3. Methodology**

#### **3.1. Data and measurement of variable**

For the empirical analysis of the study's objective, data were obtained from the World Development Indicator (WDI), an online database of the World Bank. Owing to data constraint, we were only able to compile data for thirty-five SSA countries, representing approximately 73 percent of the total study population. The data span over a period of ten years from 2011 to 2020. The period was selected based on data availability and consideration for the intended method of estimation. In addition, the chosen scope also coincides with the period of increased usage and penetration of ICT in the continent of Africa. This period is thus considered suitable for the measurement of the possible effect of digital technology on remittance inflow in SSA economies.

In measuring the variables, we used data on personal remittance received to proxy the dependent variable and the principal regressor digital technology is represented by two measures of ICT infrastructure namely percentage of the population using internet

(INTERUSER) and mobile cellular subscription (MOBSUB). Our choices were informed by notable research which have made seminal contributions in the literature (Aggarwal et al., 2006; Barajas et al., 2018; Adeleye and Eboagu, 2019; Asongu and Odhiambo, 2020). Furthermore, in order to avoid errors that may stem from misspecification of our model and to ensure the validity of our findings, we adopted as control variables macroeconomic indicators that have been identified as important predictors of remittance inflows. In particular, we employed level of economic development proxy by GDP per capita growth rate (GDPCG), level of financial development represented by broad money supply (FINDEV), changes in price level measured by inflation rate (INFL), interest rate (INTR) and exchange rate (EXCHR). All these macroeconomic indicators have been identified in extant studies as important predictors of remittance inflows (Jijin et al., 2022; Yoshino et al., 2020). The definitions of the variables and their respective units of measurement are presented in **Table 1**.

**Table 1.** Definitions of variables.

<b>Variables code</b>	<b>Definition</b>	<b>Unit of measurement</b>
REMIT	Personal remittance received (% of GDP)	Percentage
INTERUSER	Individuals using internet (% of population)	Percentage
MOBSUB	Mobile cellular subscription	Millions
FINDEV	Financial development proxy by money supply (% of GDP)	Percentage
GDPCG	Growth rate of gross domestic product per capita	Percentage
INFL	Inflation, consumer prices (annual %)	Percentage
INTR	Lending interest rate	Percentage
EXCHR	Official exchange rate	Local currency

Note: In order to reduce skewness in the original data, log transformation of remittances, mobile cellular subscription and exchange rate are used. Source: Authors' computation.

### **3.2. Empirical model and estimation technique**

To empirically investigate the effect of digital technology on remittance inflow, we employed a quantitative method of analysis. Being a study that focuses on a pool of countries, we specifically adopted dynamic panel-data estimation model. Generally, dynamic panel-data model makes the estimation of dynamic economic relationships in which the current level of the dependent variable does not only depend on the selected explanatory variables but also on the previous (lagged) values of the dependent variable, possible. The GMM estimators—Difference GMM (DGMM) and System GMM (SYGMM) are considered most suitable in the class of dynamic panel-data. In particular, they are more efficient in tackling the problem of endogeneity which arises from the inclusion of lagged value of the dependent variable.

However, we chose the Arellano-Bond (1991) DGMM over SYGMM of Arellano-Bover (1995) due to our not so large dataset. The SYGMM uses more instrument than DGMM, and in order to avoid the challenge of weak Sargan test due to excess number of instruments over the number of countries, we thus adopted DGMM (Roodman, 2009a, 2009b). By transforming the regressors, DGMM is also advantageous in taking care of the problem of fixed effect which may arise from the

correlation of the regressors with the time-invariant countries' geographic and demographic characteristics (Arellano and Bond, 1991). In addition, the first differencing process also set up instruments for inherently endogenous variables in the model.

The standard model for the study is presented as follows:

$$REM_{it} = \alpha REM_{it-1} + \phi ICT_{it} + \beta X_{it} + \varepsilon_{it} \quad (1)$$

where:  $REM_{it}$  is remittance inflows in country  $i$  at time  $t$ ;  $REM_{it-1}$  is the lagged of remittances in country  $i$  at time  $t - 1$ ;  $ICT_{it}$  is the measure ICT development in country  $i$  at time  $t$  while  $X_{it}$  is the vector of other regressors. Other omitted variables are captured in the error term  $\varepsilon_{it}$ .  $\alpha$ ,  $\phi$  and  $\beta$  are the parameters of interest which measure the causal effects of the lagged dependent variable, ICT development and other control variables respectively on remittance inflows.

As earlier indicated, digital technology is represented by two measures of ICT infrastructure percentage of the population using internet (INTERUSER) and mobile cellular subscription (MOBSUB). Hence, we estimated a separate model for each measure of ICT. Specifically, we estimated model I as the MOBSUB model while model II is the INTERNET model.

Taking the first difference of Equation (1) above and explicitly stating the control variables, our estimated model is stated thus;

$$\Delta REM_{it} = \alpha \Delta REM_{it-1} + \phi \Delta ICT_{it} + \Delta \beta_1 \Delta GDPCG_{it} + \Delta \beta_2 \Delta FINDEV_{it} + \beta_3 \Delta INFL_{it} + \beta_4 \Delta INTR_{it} + \beta_5 \Delta EXCH_{it} + \varepsilon_{it} \quad (2)$$

#### 4. Findings and discussion

Prior to estimation of our models, we attempted to summarize and describe our data using descriptive statistics. This is particularly important, our data being panel involving large amount of data. The summary statistics for the variables are presented in **Table 2**.

**Table 2.** Summary statistics of variables.

Variable	Observation	Mean	Std. Dev.	Min.	Max.
REMIT	338	19.3	1.8	12.2	23.9
INTERUSER	289	20.8	17.1	0.9	77.8
MOBSUB	335	15.9	1.5	11.5	19.1
FINDEV	335	35.6	21.8	10.1	163.8
GDPCG	350	1	3.8	-15.7	14.7
INFL	336	7.4	33.5	-4.3	557.2
INTR	278	8	12.9	-79.8	52.4
EXCHR	341	5.3	2.0	0.5	9.2

The reported mean values show that financial development proxied by money supply as share of GDP has the highest average among the variables over the study period while the least average value is reported for per capita GDP growth rate. The low mean value of GDPCG shows the low level of economic growth in the region. However, the mean values of the two measures of digital technology – INTERUSER (20.8%) and MOBSUB (15.9%) show the rising level of diffusion of digital

technology in the region. In terms of variability of the data as measured by the standard deviation values, except for remittance inflows, mobile cellular subscription and exchange rate, the data exhibit wide variability.

The minimum and maximum values indicate the lower and upper limit values for each variable in the dataset. Considering the minimum and maximum values for all the variables, high range value (maximum value less minimum value) is recorded for inflation, followed by the measure of financial development, interest rate and internet usage. The high range values for these variables are likewise signaled by their relatively higher standard deviation, indicating wide variability in the variables.

Having summarized and described our data, the two-steps DGMM results are presented in **Table 3**. Importantly, the coefficients of the lag of the dependent variable, principal regressors and other control variables are reported alongside their standard error and statistical significance indicated by the probability values. As earlier mentioned, to avoid the problem of multicollinearity, we estimated two remittance determination models, interchanging the two measures of ICT infrastructure.

**Table 3.** Results of the difference GMM (DGMM) model of remittance determination.

Regressors	MODEL I: Mobile cellular subscription (MOBSUB)			Model II: Internet usage (INTERUSER)		
	Coefficients	Std. error	Prob. Value	Coefficients	Std error	Prob. Value
REMIT <sub>t-1</sub>	-0.147	0.058	0.012	-0.199	0.007	0.000
ICT	0.291	0.092	0.002	0.014	0.004	0.002
FINDEV	0.016	0.002	0.000	0.012	0.002	0.000
GDPCG	0.012	0.003	0.000	0.020	0.004	0.000
INFL	-0.033	0.004	0.000	-0.032	0.004	0.000
INTR	0.008	0.004	0.000	0.011	0.003	0.000
EXCHR	0.233	0.048	0.000	-0.095	0.115	0.000
Number of obs.	178			152		
Number of Groups/Instruments	28/22			27/22		
Wald ( <i>p</i> -value)	Chi2(7) = 530.3 (0.000)			Chi2(7) = 441.9 (0.000)		
Post-Estimation Tests						
Sargan Test ( <i>p</i> -value)	0.144			0.271		
AR (-2) Test ( <i>p</i> -value)	0.334			0.627		

Note: log transformation of remittance received, mobile cellular transaction and exchange rate are used estimated regressors coefficient are interpreted accordingly. Source: Authors' calculation.

Based on the results output as presented in **Table 3** remittance inflows in the previous period has a decreasing effect on the current level of remittance inflows in both models. This is quite surprising in that remittance in immediate past period is expected to be positively correlated to remittance in the current period. Similar finding was however documented by Okon (2022). For both models, our proxies of digital technology are positively related to remittance inflows implying that digital technology has an increasing effect on remittance inflows. Based on the associated probability values, the relationships are statistically distinguishable from zero even at 1 percent level of significance. These findings lend support to the assertion of Global System for Mobile Communication Association (GSMA) report on the potential of

mobile technology to raise remittance inflow in the Pacific. The report authored by Raithatha et al. (2021) opined that based on several researches carried out by the organization, digital technology could substantially raise the size of remittance inflows by increasing access and reducing cost. Similar stance was corroborated by a World Bank report authored by Kunze (2017) and Nicoli and Ahmed (2019).

The obtained results signaled that ICT fuels the inflow of remittances in the region. Following the momentous rise in ICT diffusion over the last decade, distance barrier between migrants and their relatives back home has been significantly reduced and completely removed in some instances. With increasing usage of mobile telephones and internet data, migrants are able to have unhindered instant communication with their relatives and associates back home using diverse ICT-enabled social media platform such as WhatsApp, Skype, Zoom and Teams (UNESCO, 2021). Hence, migrants now have quicker and better access to information regarding altruistic purpose or investment opportunities and thus remit more funds. The effect of digital technology is particularly significant for investment remittances. The investment and industrialization effect of remittance has been documented (Efobi et al., 2019; Asongu and Odhiambo, 2020) and improvement in digital technology could enhance these effects in a number of ways. In addition to portfolio investment, migrants also invest in other ventures including small and medium scale enterprise (SMEs) and real estate (World Bank, 2011; Asongu and Odhiambo, 2020; Asquith and Opoku-Owusu, 2020). Aside ensuring timely access to information on investment opportunities, improvement in digital technology also makes monitoring and coordination of such investments in home countries possible and easy. Migrants are thus encouraged to invest more, with resultant increase in remittance inflows for investment purpose.

Moreover, ICT-enabled development in the financial sector serves as a motivator for migrants to remit more fund. Financial technology has not only led to quicker process of fund transfers, it also ensures safe keeping of remitted fund as beneficiaries are able to receive fund directly into their bank accounts. (Pandikasala et al., 2020; Bolarinwa and Akinbobola, 2021). This is particularly important for rural dwellers in remote places without bank branch operation. With financial development fueled by digital technology, such categories of beneficiaries tend to have unhindered access to fund in their bank accounts which serves as a strong motivation for migrants to remit fund. In the same vein, development of banking application such as mobile banking, offers migrants access to seamless banking transaction thereby encouraging them to operate bank accounts in their home countries (Acosta et al., 2009; Pandikasal et al., 2020; Bolarinwa and Akinbobola, 2021). Moreover, bank competition due to increased penetration of digital technology has led to significant cut in cost of remittance thereby boosting remittance inflows (World Bank, 2015; Nicoli and Ahmed, 2019; Bersch et al., 2021).

Furthermore, a comparison of the obtained results indicates that the magnitude of the positive effect of ICT diffusion on remittance is relatively higher for internet usage. In particular, a percentage increase in proportion of the population using internet causes remittance inflows to rise by 1.4 percent while a percentage increase in mobile cellular subscription causes an increase of 0.3 percent in remittance inflow. This finding is plausible in that internet usage will serve as a better stimulant of remittance



inflows than mobile cellular subscription owing to the former's role in access and usage of various tech-enabled platforms for remittance transmission. While voice communication which account for a significant proportion of mobile cellular subscription aids communication and faster exchange of information, internet usage tends to be more efficient for communication with the diaspora and aids in faster dissemination of information via various internet-enabled social media platforms. More importantly internet usage plays crucial roles in the automation of service delivery in the financial sector which has been identified as a significant motivator of remittance inflow. In fact, internet has been identified as a key enabler of financial technology (fintech) which has brought about massive transformation in financial services delivery including remittance processing (Lewan, 2018; Mamonov, 2020). In all, the findings corroborate the conclusions of prior related studies including Elmi and Ngwenyama (2020), Gascon et al. (2023), Ahmed and NaRanong (2023) for Somalia, Bangladeshi and El Salvador respectively.

As regards other correlates of remittance inflow adopted in our model, the measures of financial development and economic development have increasing effect on remittance inflow. For the two models. the findings are in consonance and the associated probability values indicate statistical significance even at 1 percent level of significance. These findings are in line with the large documented evidence of positive nexus between financial development and remittance inflows on one hand (Adenutsi and Ahorator, 2015; Mallick and Mahalik, 2021; Omon, 2021) and economic development and remittance on the other hand (Adenutsi and Ahorator, 2015; Tsaurai and Maseko, 2020). In the same vein, the results affirmed the fueling effect of interest rate and exchange rate on remittance inflow as documented by earlier studies (Yoshino et al., 2019; Jijin et al., 2022; Molapo, 2022). In both models, interest rate and exchange rate exhibit statistically significant positive effects on remittance inflow in SSA. This is in support of the assertion that diasporan are more inclined to remit money home in the period of high exchange and interest rates in order to take advantage of domestic currency depreciation and high return on investment (Yoshino et al., 2019; Molapo, 2022).

Inflation on the other hand has a deterring effect on remittance inflow. The result is consistent for both models. This is in contrast to documented evidence in favor of the altruistic motive of remittance inflows which assert that migrants remit more fund in the period of high inflation to cushion the adverse impact of rising prices on household welfare (Rana and Hashmi 2015; Rivera and Tiullao, 2020; Tsaurai and Maseko, 2020).

To confirm the validity of our findings, the goodness of fit for our model specifications are reported in the lower panel of **Table 3** alongside the post-estimation tests results. Based on the reported chi-square statistics and the associated probability values of the Sargan test, the null of hypothesis of over identifying restrictions are valid could not be rejected for both model specifications at 5 percent level of significance. The Sargan test in particular confirms the validity of the instruments used in the models and ascertains the absence of over-identification due to instruments proliferation. Also, both models are void of any evidence of serial correlation given the probability values of the Arellano-Bond correlation tests AR(2). Moreover, the Wald test results for both models reject the null hypothesis that the joint effects of all

the explanatory variables on the dependent variable is zero. In addition, the number of instruments is fewer than the number of groups in both models (Roodman, 2009a).

## 5. Conclusion

Although the issue of digital technology has garnered much attention in recent time, its role in remittance inflows has not been well explored, thus there exists few empirical evidences on ICT diffusion-remittance inflows nexus. This study therefore contributes to the growing strand of the ICT literature by investigating the nexus for SSA region using a decade data of thirty-five SSA countries spanning the periods of 2011 through 2020.

The empirical analysis estimated within the two step DGMM shows that improvement in digital technology spurs remittance inflows in the sub-region. Specifically, the measures of digital technology internet usage and mobile cellular subscription have statistically significant increasing effect on remittance inflows during the study period. In addition, the results indicate that the magnitude of the effect is higher for internet usage.

Based on the outcomes of this study, it is recommended that the SSA economies should continue to prioritize policies aimed at fostering diffusion and penetration of digital technology. Specifically, in line with target 10c of SDG 10, remittances transaction costs should be downwardly reviewed. In addition, the affordability aspect of digital technology should be prioritized in order to promote access and usage of digital infrastructure which are important for wider diffusion.

Although this study has made a laudable contribution to the remittance literature, further examination of the relationship can be explored by investigating the nexus in other developing and emerging economies. Further studies can in particular evaluate the nexus within a comparative framework involving multiple developing regions. In addition, substitute panel data methods may be adopted for possible different but robust outcomes. The suggestions for further studies will of certainty enrich the extant literature.

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## References

- Acosta, P. A, Baerg, N. R., Mandelman, F. S. (2009). Financial development, remittances, and real exchange rate appreciation. *Economic Review* 94. Federal Reserve Bank of Atlanta, Atlanta, GA.
- Adeleye, N., & Eboagu, C. (2019). Evaluation of ICT development and economic growth in Africa. *NETNOMICS: Economic Research and Electronic Networking*, 20(1), 31–53. <https://doi.org/10.1007/s11066-019-09131-6>
- Adenutsi, D., Ahortor, C. (2021). Macroeconomic determinants of remittance flows to sub-Saharan Africa. Working Papers 415, African Economic Research Consortium (AERC).

- Aggarwal, R., Demirgüç-Kunt, A., & Pería, M. S. M. (2011). Do remittances promote financial development? *Journal of Development Economics*, 96(2), 255–264. <https://doi.org/10.1016/j.jdeveco.2010.10.005>
- Ahiawodzi, A. K. (2012). Macroeconomic determinants of private inward remittances in Ghana: An empirical study. *Journal of Business Research*, 6(1).
- Ahmed, Z., & NaRanong, A. (2023). The Effects of ICT/e-Government on Migrant Workers' Remittance Inflows in Bangladesh: An Empirical Study. *Journal of Sustainable Development*, 16(1), 53. <https://doi.org/10.5539/jsd.v16n1p53>
- Anzoategui, D., Demirgüç-Kunt, A., & Martínez Pería, M. S. (2014). Remittances and Financial Inclusion: Evidence from El Salvador. *World Development*, 54, 338–349. <https://doi.org/10.1016/j.worlddev.2013.10.006>
- Arapı-Gjini, A., Möllers, J., & Herzfeld, T. (2020). Measuring Dynamic Effects of Remittances on Poverty and Inequality with Evidence from Kosovo. *Eastern European Economics*, 58(4), 283–308. <https://doi.org/10.1080/00128775.2020.1720517>
- Arellano, M., & Bond, S. (1991). Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations. *The Review of Economic Studies*, 58(2), 277. <https://doi.org/10.2307/2297968>
- Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, 68(1), 29–51. [https://doi.org/10.1016/0304-4076\(94\)01642-d](https://doi.org/10.1016/0304-4076(94)01642-d)
- Asongu, S. A., & Odhiambo, N. M. (2020). Remittances, the diffusion of information and industrialisation in Africa. *Contemporary Social Science*, 15(1), 98–117. <https://doi.org/10.1080/21582041.2019.1618898>
- Asquith, P., & Opoku-Owusu, S. (2020). Diaspora Investment to Help Achieve the SDGs in Africa: Prospects and Trends. *Foreign Direct Investment Perspective through Foreign Direct Divestment*. <https://doi.org/10.5772/intechopen.93129>
- Azizi, S. (2021). The impacts of workers' remittances on poverty and inequality in developing countries. *Empirical Economics*, 60(2), 969–991. <https://doi.org/10.1007/s00181-019-01764-8>
- Barajas, A., Chami, R., Ebeke, C., & Oeking, A. (2018). What's different about monetary policy transmission in remittance-dependent countries? *Journal of Development Economics*, 134, 272–288. <https://doi.org/10.1016/j.jdeveco.2018.05.013>
- Bersch, J., Perez Ruiz, E., Yakhshilikov, Y., François Clevy, J., & Muhammad, N. (2021). Fintech Potential for Remittance Transfers: A Central America Perspective. *IMF Working Papers*, 2021(175), 1. <https://doi.org/10.5089/9781513585420.001>
- Bolarinwa, T. S., Akinbobola, T. O. (2021). Remittances-financial development nexus: Causal evidence from four African countries. *Ilorin Journal of Economic Policy*, 8(1), 1-17.
- Drid, J., Gursøy, T., Perez-Saiz, H., Bari, M. (2019). The impact of remittances on economic activity: The importance of sectoral linkages. Working Paper 19/175 International Monetary Fund.
- Efobi, U., Asongu, S., Okafor, C., Tchamyu, V., & Tanankem, B. (2019). Remittances, finance and industrialisation in Africa. *Journal of Multinational Financial Management*, 49, 54–66. <https://doi.org/10.1016/j.mulfin.2019.02.002>
- Ekanayake, E. M., & Moslares, C. (2020). Do Remittances Promote Economic Growth and Reduce Poverty? Evidence from Latin American Countries. *Economies*, 8(2), 35. <https://doi.org/10.3390/economies8020035>
- Elmi, M. A., & Ngwenyama, O. (2020). Examining the use of electronic money and technology by the diaspora in international remittance system: A case of Somali remittances from Canada. *The Electronic Journal of Information Systems in Developing Countries*, 86(5). <https://doi.org/10.1002/isd2.12138>
- Emara, N., & Zhang, Y. (2021). The non-linear impact of digitization on remittances inflow: Evidence from the BRICS. *Telecommunications Policy*, 45(4), 102112. <https://doi.org/10.1016/j.telpol.2021.102112>
- Ezeoha, A. E. (2013). Financial Determinants of International Remittance Flows to the Sub-Saharan African Region. *International Migration*, 51(s1). Portico. <https://doi.org/10.1111/imig.12061>
- Francois, J. N., Ahmad, N., Keinsley, A., Nti-Addae, A. (2022). Remittances increase GDP with potential differential impacts across countries. Available online: <https://blogs.worldbank.org/peoplemove/remittances-increase-gdp-potential-differential-impacts-across-countries> (accessed on 2 June 2023).
- Gascón, P., Larramona, G., & Salvador, M. (2023). The impact of digitalisation on remittances. Evidence from El Salvador. *Telecommunications Policy*, 47(4), 102500. <https://doi.org/10.1016/j.telpol.2023.102500>
- International Monetary Fund. (2021). Special series on COVID-19. Remittances in sub-Saharan Africa: An update. Available online: [https://www.imf.org/en-special-series-on-covid-19-remittances-in-sub-saharan-africa-an-update%20\(2\).pdf](https://www.imf.org/en-special-series-on-covid-19-remittances-in-sub-saharan-africa-an-update%20(2).pdf) (accessed on 2 June 2023).
- Jemiluyi, O. O., & Jeke, L. (2023a). How Catalytic Is Digital Technology in the Nexus between Migrants' Remittance and Financial Development in Sub-Saharan African Countries? *Economies*, 11(3), 74. <https://doi.org/10.3390/economies11030074>

- Jemiluyi, O. O., & Jeke, L. (2023b). Tax revenue mobilization effort in Southern African Development Community (SADC) bloc: Does ICT matter? *Cogent Economics & Finance*, 11(1). <https://doi.org/10.1080/23322039.2023.2172810>
- Jijin, P., Mishra, A. K., & Nithin, M. (2022). Macroeconomic determinants of remittances to India. *Economic Change and Restructuring*, 55(2), 1229–1248. <https://doi.org/10.1007/s10644-021-09347-3>
- Kunze, J. (2017). Digital remittances and global financial health. World Bank.
- Laniran, T., & Adeniyi, D. (2015). An Evaluation of the Determinants of Remittances: Evidence from Nigeria. *African Human Mobility Review*, 1(2). <https://doi.org/10.14426/ahmr.v1i2.739>
- Lewan, M. (2018). The Internet as an enabler of FinTech. *The Rise and Development of FinTech*, 190–204. <https://doi.org/10.4324/9781351183628-11>
- Mallick, H, Mahalik, M. (2015). Motivating factors of remittances inflows into developing Asian economies. *The Singapore Economic Review*, 61(04), 1550063. <https://doi.org/10.1142/s0217590815500630>
- Mamonov, S. (2020). The Role of Information Technology in Fintech Innovation: Insights from the New York City Ecosystem. *Responsible Design, Implementation and Use of Information and Communication Technology*, 313–324. [https://doi.org/10.1007/978-3-030-44999-5\\_26](https://doi.org/10.1007/978-3-030-44999-5_26)
- Molapo, S. (2022). Determinants Of remittances in selected Southern African Countries. *Macroeconomic and Financial Management Institute of Eastern and Southern Africa. Zimbabwe*. Available online: <https://policycommons.net/artifacts/2620685/determinants-of-remittances-in-selected-southern-african-countries/3643357/> (accessed on 2 June 2023).
- Nicoli, M, Ahmed, U. (2019). How digital remittances can help drive sustainable development. World Bank. Available online: <https://blogs.worldbank.org/psd/how-digital-remittances-can-help-drive-sustainable-development> (accessed on 2 June 2023).
- Okon, E. O. (2022). Interactive effect of exchange rates with remittance on informal remittance channel: A dynamic analysis. *Journal of Business, Economics and Finance*, 11(3), 110-12. <https://doi.org/10.17261/pressacademia.2022.1631>
- Omon, I. J. (2021). Determinants of Migrants Remittances in the West Africa Monetary Zones (WAMZ): An Econometric Evaluation. *Kardan Journal of Economics and Manangement Sciences*, 4(1), 39–56. <https://doi.org/10.31841/kjems.2021.10>
- Pandikasala, J., Vyas, I., & Mani, N. (2020). Do financial development drive remittances? Empirical evidence from India. *Journal of Public Affairs*, 22(1). Portico. <https://doi.org/10.1002/pa.2269>
- Raithatha, R., Farooq, S., Sharma, A. (2021). Using mobile technology to improve remittances to the Pacific. *Global System for Mobile Communication Association. (GSMA)*. Available online: [https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2021/07/CIU\\_PacificRemittances\\_R\\_WebSingles1.pdf](https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2021/07/CIU_PacificRemittances_R_WebSingles1.pdf) (accessed on 2 June 2023).
- Rana, R. H., & Hashmi, R. (2015). The Determinants of Worker Remittance in Terms of Foreign Factors: The Case of Bangladesh. *Studies in Business and Economics*, 10(3), 81–93. <https://doi.org/10.1515/sbe-2015-0038>
- Ranathunga, P. B. (2018). The determinants of remittance inflows and its usage in the rural communities: Special reference to rural-to-urban labour migration in Sri Lanka. *International Journal of Development and Sustainability*, 7(3), 1238-1249.
- Rivera, J. P. R., & Tullao, T. S. (2020). Investigating the link between remittances and inflation: evidence from the Philippines. *South East Asia Research*, 28(3), 301–326. <https://doi.org/10.1080/0967828x.2020.1793685>
- Roodman, D. (2009a). How to xtabond2: An introduction to difference and system GMM in Stata. *Stata Journal*, 9(1), 86–136.
- Roodman, D. (2009b). A note on the theme of too many instruments. *Oxford Bulletin of Economics & Statistics*, 71(1), 135-158.
- Singh, R., Haackerb, M., Lee, K., Le Goff, M. (2010). Determinants and macroeconomic impact of remittances in sub-Saharan Africa. *Journal of African Economies*.
- Simpson, N. B., Sparber, C. (2020). Estimating the determinants of remittances originating from US households using CPS data. *Eastern Economic Journal*, 46, 161–189.
- Tsaurai, K., Maseko, C. M. (2020). An empirical study of the determinants of remittances in transitional economies. *Oeconomica*, 16(3), 181-199.
- UNESCO Courier. (2021). Mobile phones: An indispensable tool for migrant. Available online: <https://en.unesco.org/courier/2021-4/mobile-phones-indispensable-tool-migrants> (accessed on 2 January 2024).
- United Nations. (2022). International Day of Family remittance June 16. Available online: <https://www.un.org/en/observances/remittances-day> (accessed on 2 January 2024).
- World Bank. (2011). *Diaspora for development in Africa*. Available online: <https://documents1.worldbank.org/curated/en/389011468191676942/pdf/616380PUB0Dias1351B0Extop0ID0182580.pdf> (accessed on 2 January 2024).

- World Bank. (2020). Atlas for sustainable development goals. Remittances: A lifeline for many economies. Available online: <https://datatopics.worldbank.org/sdgatlas/archive/2020/> (accessed on 2 January 2024).
- World Bank. (2021). Defying predictions, remittance flows remain strong during COVID-19 crisis. Available online: <https://www.worldbank.org/en/news/press-release/2021/05/12/defying-predictions-remittance-flows-remain-strong-during-covid-19-crisis> (accessed on 2 January 2024).
- Yoshino, N., Taghizadeh-Hesary, F., & Otsuka, M. (2020). Determinants of international remittance inflow in Asia-Pacific middle-income countries. *Economic Analysis and Policy*, 68, 29–43. <https://doi.org/10.1016/j.eap.2020.08.003>