

Impacts of remittances on financial development

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Remittances
and financial
development

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Abstract

Purpose – The purpose of this paper is to examine the impacts of international remittances on financial development in developing countries.

Design/methodology/approach – The focus is on a panel of 124 developing countries for the period 1990–2015. The empirical evidence is based on the instrumental variable-fixed effect model.

Findings – Results obtained in this study indicate that a 10 percent increase in the remittance to GDP ratio leads to 1.7 percent increase in domestic credit to private sector, 1.9 percent increase in bank credit, 1.2 percent increase in bank deposit, and 0.8 percent increase in liquid liabilities. The positive impact of remittances on financial development in developing countries is particularly important because financial development fosters long-run growth and reduces poverty.

Originality/value – To address the endogeneity of remittances, the study estimates bilateral remittances and use them to create weighted gross national income per capita and real interest rates of remittance-sending countries. To the best of the author's knowledge, this is the first study to assess the endogeneity of remittances in this way.

Keywords Migration, Remittances, Financial development, Developing countries

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1. Introduction

Between 1990 and 2015, the number of individuals living outside their countries of birth grew from 153 million people to 244 million people, which corresponds to 2.87 percent of the world population in the year 1990 and 3.32 percent of the world population in the year 2015 (United Nations). The total amount of remittances received has risen from \$68 billion in 1990 to \$553 billion in 2015. The average amount of money each migrant remitted (in 2011 constant dollars) has risen from \$688 in 1990 to \$2,128 in 2015. These amounts include only remittances that have been sent through official channels (the World Bank, United Nations, author's calculations).

This surge in the value of remittances has attracted the attention of many researchers. During recent years, different aspects of remittances have been under the scrutiny of researchers. One of the main aspects of remittances is its impact on remittance-receiving countries. The outflow of migrants and inflow of remittances can affect remittance-receiving countries in a variety of subjects such as brain drain (Faini (2007); Bollard *et al.* (2011)), poverty and inequality (Barham and Boucher (1998); Adams and Page (2005)), human capital and labor supply (Sasin and McKenzie (2007); Azizi (2018); Lopez *et al.* (2007)), and financial development, which is the subject of this paper. Also, incentive behind remittances (Yang and Choi (2007), Lucas and Stark (1985), Azizi (2017), Azizi (2019), remittances and information flows (Seshan and Zubrickas (2015); Batista and Narciso (2016)), cost of remittances (Beck and Martinez Peria (2011)), determinants of remittances (Castillo-Ponce *et al.* (2011); Mak Arvin and Lew (2012)), remittances and volatility (Jackman *et al.* (2009)), remittances and industrialization (Asongu and Odhiambo (2019); Efobi *et al.* (2019)), and other miscellaneous impact of remittances on remittance-receiving countries (Karpestam (2012); Asongu *et al.* (2019)) are among other interesting subjects to the researchers in this field.



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In this paper, I use data on 124 developing countries over the period from 1990 to 2015 to study the link between remittances and financial development as measured by the share of deposits to GDP, credit to GDP, liquid liabilities, and domestic credit to the private sector to GDP. As mentioned by [Aggarwal *et al.* \(2011\)](#), whether and how remittances might affect financial development is *a priori* unclear. On the one hand, remittances recipients might have a need for financial products that allow for the safe storage of these funds (i.e. bank deposits) even if most of these funds are not received through banks. In the case of households that receive their remittances through banks, the potential to learn about and demand other bank products is even larger. At the same time, providing remittance transfer services allows banks to find recipients with limited financial intermediation. On the other hand, because remittances can help relax individuals' financing constraints, they might lead to lower demand for credit and have a dampening effect on credit market development.

In the past few years, many researchers have examined the impact of remittances on financial development and reached different and even contradictory results. One important barrier in evaluating the impact of remittances on growth is the endogeneity of remittances. Reverse causality, common factors affecting both remittances and financial development, and measurement error are among the sources of endogeneity. Correcting for the endogeneity of remittances remains an important challenge for researchers who investigate the effects of remittances on growth. Although some scholars have tried to mitigate this problem by choosing a set of conditioning variables or by choosing the estimation technique, yet the main technique is to use instrumental variables.

To address the endogeneity of remittances, this research uses a novel instrumental variable (IV) approach by incorporating two economic indicators of the remittance-sending countries as instruments: per capita gross national income (GNI) and real interest rate. Since each remittance-receiving country has many countries as the sources of remittances, building the instruments requires knowing the bilateral remittances to calculate the weighted average indicators of the remittance-sending countries. Because bilateral remittances are not generally available, I estimate them and use them as weights to build the instruments. This estimation strategy allows me to utilize two valid and strong instruments to investigate the impacts of remittances on financial development in remittance-receiving countries. After addressing the endogeneity of remittances, I analyze the impact of remittances on financial development using a sample of 124 developing countries and find that remittances have a positive and significant impact on financial development. A 10 percent increase in remittances leads to 1.7 percent increase in domestic credit to private sector, 1.9 percent increase in bank credit, 1.2 percent increase in bank deposit, and 0.8 percent increase in liquid liabilities.

The rest of the paper is arranged as follows. Background and literature review is provided in [Section 2](#). [Section 3](#) discusses the data used in this paper. [Section 4](#) is devoted to the econometric model. [Section 5](#) presents empirical results, and [Section 6](#) some conclusions.

2. Literature review

[Aggarwal *et al.* \(2011\)](#) use data on remittance flows to 109 developing countries from 1975 to 2007 to study the link between remittances and financial sector development as measured by the share of deposits and credit to GDP. They conclude there is a positive, significant, and robust link between remittances and financial development in developing countries. The authors believe an important complication in empirically studying the impact of remittances on financial development is the potential for endogeneity biases because of measurement error, reverse causation, and omitted variables. Officially recorded remittances are known to be measured with error. In particular, the balance of payments data on remittances tends to record more accurately remittances sent via banks. Reverse causality is also a concern when examining the link between remittances and financial development since greater

financial development might lead to larger measured remittances, either because financial development enables remittance flows or because a larger percentage of remittances is measured when those remittances are channeled through formal financial institutions. In addition, financial development might lower the cost of transmitting remittances, leading to an increase in such flows. Finally, omitted factors can explain both the evolution of remittances and of financial development, also leading to biases in the estimated impact of remittances on financial development. The authors use four instrumental variables to address the endogeneity of remittances: GDP per capita in remittance-sending countries, unemployment in remittance-sending countries, views on immigration in remittance-sending countries, and policies on immigration in remittance-sending countries. However, they only use the top five remittance-sending countries for each country in our sample, using an estimated bilateral remittances data of the year 2005.

[Bettin *et al.* \(2012\)](#) investigate how financial development might affect the decision to remit and how much to remit. The authors analyze remitting decisions for a sample of immigrants to Australia from 125 different countries. They argue the development of financial institutions is likely to positively affect the level of immigrant's investment in their country of origin. In addition, a more developed financial system in the home country should entail lower costs of transferring money ([Freund and Spatafora, 2008](#)). On the other hand, a substitution mechanism could also be at work: where credit markets do not function properly and borrowers are constrained in their access to credit, remittances might allow recipient households to bridge financial constraints ([Giuliano and Ruiz-Arranz, 2009](#)). They conclude that although the propensity to remit seems unaffected by the level of financial development, the higher the level of financial development in the country of origin, the higher the transfer. To measure financial development, they use the three standard ratios introduced in the literature by [King and Levine \(1993\)](#): the share of bank deposits, the share of bank credit to the private sector, and the share of liquid liabilities of the financial system, all expressed as a percentage of GDP.

[Efobi *et al.* \(2019\)](#) assess how remittances, directly and indirectly, affect industrialization, using a panel of 49 African countries for the period from 1980 to 2014. The indirect impact is assessed through financial development channels. The authors conclude that for certain initial levels of industrialization, remittances can drive industrialization through the financial development mechanism. Also, [Asongu and Odhiambo \(2019\)](#) examine the role of information and communication technology (ICT) on remittances for industrialization. The authors implement three estimation techniques: (1) instrumental fixed effects (FE), which is also adopted in this paper, (2) generalized method of moments (GMM), and (3) instrumental quantile regressions (QR). The authors conclude that the role of ICT in remittances for industrialization is much more apparent when existing levels of industrialization are accounted for.

Some researchers have investigated the impact of remittances on financial development in a specific country or a number of countries. For example, [Coulibaly \(2015\)](#) investigates the causality between remittances and financial sector development in sub-Saharan African (SSA) countries. The author uses panel Granger causality testing approach and employs annual data from 1980 to 2010 for 19 countries and concludes remittances positively influence financial development only in four countries (Niger, Senegal, Sierra Leone, and Sudan). [Chowdhury \(2011\)](#) investigates the impacts of remittances on financial development in Bangladesh by using annual data from 1971 to 2008, and concludes that remittances have a significant positive effect on financial development. By applying the Granger causality test, the author concludes that remittances causally impact financial development, but not vice versa. [Gupta *et al.* \(2009\)](#) investigate the effect of remittances on poverty and financial development in sub-Saharan Africa and conclude that remittances have a direct poverty-mitigating effect and promote financial development. To address the endogeneity of remittances, authors use unemployment, GDP growth, and per capita GDP in the source country as instruments. [Demircug-Kunt *et al.*](#)

(2011) examine the impact of remittances on the breadth and depth of the banking sector. By using municipality-level data on the fraction of households receiving remittances and on measures of banking breadth and depth for Mexico, the authors conclude that remittances are strongly associated with greater banking breadth and depth, increasing the number of branches and accounts per capita and the amount of deposits to GDP. Brown *et al.* (2013), by using macro-level data, find that remittances do not increase domestic credit to the private sector, and, if anything, the effect seems to be negative. Fromentin (2018) finds a positive, significant, and robust bidirectional link between remittances and financial development for the panel of 32 Latin American and the Caribbean countries.

One important source of endogeneity of remittances is measurement errors. As mentioned by Aggarwal *et al.* (2011), officially recorded remittances are measured with error. In particular, the balance of payments data on remittances tends to record more accurately remittances sent via banks, and, in some cases, ignore those sent via non-bank institutions (e.g. money transfer operators) and informal channels (e.g. family and friends). Estimates of unrecorded remittances range from 50 to 250 percent of official statistics on remittances. Finding valid and strong instruments to address the endogeneity of remittances due to measurement errors has remained one of the biggest challenges to the researches of the field. Many researchers have addressed the endogeneity of remittances by using lagged values of remittances as instruments. Although using lagged values as an instrument is very convenient, however, they do not address the endogeneity that is caused by measurement error. As pointed by Aggarwal *et al.* (2011), while using lagged values of the regressors as instruments can help to deal with the problem of reverse causality, it does not address biases arising from measurement error, since lagged values of the remittances are likely to suffer from measurement error as well.

3. Data

This study examines 124 developing (poor and middle-income) countries to investigate the impact of remittances on financial development in remittance-receiving countries. The income classification in this paper follows the conventions of the World Bank. The annual data have a time span from 1990 to 2015. Data on remittances come from the World Bank, which has defined remittances as the sum of two components: personal transfers (workers' remittances) and compensation of employees.

This study uses two instruments to address the endogeneity of remittances: weighted average per capita GNI and real interest rate of remittance-sending countries. Data on GNI and populations are from the United Nations. The real interest rate is defined as the lending interest rate adjusted for inflation as measured by the GDP deflator. Real interest rates are from the World Bank. Bank deposits to GDP ratio are defined as demand, time and saving deposits in deposit money banks as a share of GDP. Table I reports descriptive statistics for all variables.

Table I.
Descriptive statistics

Variable	<i>N</i>	Mean	SD	Min	Max
Domestic credit to private sector to GDP (%)	2,495	31.29	26.56	0.001	166.5
Bank deposits to GDP (%)	2,495	33.66	34.49	0.05	763.78
Credit to GDP (%)	2,495	27.57	24.67	0.04	378.79
Liquid liability	2,495	39.81	37.17	0.12	981.91
Remittance to GDP (%)	2,495	5.04	6.79	0.0002	49.29
Per capita GDP	2,495	6530.8	5058.47	354.28	27,319
Inflation	2,495	20.34	165.64	−36.52	6261.24
Trade openness	2,495	77.72	37.61	0.17	504.88

4. Econometric model

I use the panel data method to analyze how remittances impact financial development in the developing world. The econometric model can be written as

$$FD_{i,t} = \beta_0 + \beta_1 R_{i,t-1} + \beta_2' X_{i,t-1} + \mu_t + \delta_i + e_{it} \quad (1)$$

for $i = 1, \dots, N$ and $t = 1990, \dots, 2015$, where $FD_{i,t}$ is a measurement of financial development in country i at time t , β_0 is the intercept, $R_{i,t-1}$ is log of the remittance received by country i at year $t - 1$ (expressed as percentage of GDP), $X_{i,t-1}$ is a vector of other variables that potentially affect financial development, μ_t is year dummy, δ_i is country dummy, and e_{it} is the error term.

An econometric issue that arises here is that the error terms are autocorrelated and they do not have constant variance, which shows the existence of heteroskedasticity. To overcome autocorrelation and heteroskedasticity, Newey–West Heteroskedasticity and autocorrelation consistent (HAC) standard errors are used.

The main challenge in investigating the impact of remittances on financial development is that remittances are endogenous to financial development. Reverse causality, common factors affecting both remittances and financial development, and measurement error are among the sources of endogeneity. Reverse causality between remittances and financial development can be one source of endogeneity of remittances. Financial development in the remittance-receiving economy can potentially drive remittance inflows. This can occur because of the negative relationship between financial development and the cost of remittances. Also, omitted variable bias can be another source of endogeneity. Financial development and remittance flows may both be affected by independent causes. One such variable could be poor domestic governance, which both motivates higher migration (leading to higher remittances) and curbs financial development. Third, measurement error is another source of endogeneity. Officially recorded remittances do not include remittance in kind, unofficial transfers through kinship or through informal means such as hawala operators, friends, and family members. The negative impact of transaction costs on remittances encourages migrants to remit through informal channels when costs are high. Transfer costs are higher when financial systems are less developed. Evidence from household surveys also shows a sizable informal sector (Freund and Spatafora, 2008). Since poor countries usually are less financially developed, migrants from poor countries are more likely to remit through informal channels. Hence, measurement error is also one of the sources of endogeneity.

Therefore, least square estimates of the impact of remittances on financial development may be biased. The traditional way, which is followed in this paper, is to resolve the endogeneity problem by using instrumental variables. Three kinds of instruments are proposed by scholars. The first category of instruments is related to remittance-receiving countries. The main problem with using these instruments is that they can easily be correlated with the financial development of the same country in a way other than through remittances or covariates. Therefore, they can be invalid instruments. The second category of instruments is related to the cost of remittances. These instruments are usually strong and valid, but data on the cost of remittances are mainly unavailable for most developing countries. The third category of instruments is related to remittance-sending countries. Since these variables are not related to remittance-receiving countries, after controlling for some covariates, they are valid. However, the main problem is that each remittance-receiving country receives remittances from many remittance-sending countries, and due to lack of information on bilateral remittances (how much each remittance-receiving country receives from each remittance-sending country), the weights of remittance-sending countries are unknown.

Aggarwal *et al.* (2011) use economic conditions in the top remittance-source countries as instruments for the remittance flows. They argue economic conditions in the remittance-source

countries are likely to affect the volume of remittance flows that migrants are able to send, but are not expected to affect the dependent variables in the remittance-receiving countries in ways other than through its impact on remittances or covariates. In this research, I introduce two instruments that are correlated with remittances and uncorrelated with the dependent variables, unless through explanatory variables. Remittances, by definition, are money sent by migrants from host countries (remittance-sending countries) to their home countries (remittance-receiving countries). The value of remittances hinges on both remittance-sending and remittance-receiving countries' economic variables. Since the dependent variables belong to remittance-receiving countries, in order to ensure the instruments are valid, we should select a number of economic variables from remittance-sending countries. Two variables used in this research as instruments are per capita GNI and real interest rate. If the remittance-sending country's per capita GNI increases, it means migrants' income has increased, which means they have more money available to spend and remit. Therefore, it can be expected that remittances increase in response to a rise in the remittance-sending country's per capita GNI. If the real interest rates rise in the remittance-sending country, migrants have more incentive to invest in the host country rather than the home country, and they will remit less.

The IMF and the World Bank provide remittance data annually. Data are available in the aggregate level for each country. Unfortunately, bilateral remittance data are not available. Bilateral remittance means how much money a remittance-receiving country receives from each specific remittance-sending country. Therefore, although we know how much remittance each remittance-receiving country receives in any year in total, we do not know how much of the received remittances come from a specific remittance-sending country.

The main challenge in constructing instruments based on the economic conditions of remittance-sending countries is that each remittance-receiving country has more than one remittance-sending country. Therefore, rather than per capita GNI and real interest rate in the remittance-sending country, the weighted average of the remittance-sending countries' per capita GNI and real interest rate should be used as instruments. For remittance-receiving country i , in year t , the weights of each remittance-sending country j is

$$W_{jit} = \frac{\text{Remittances from country } j \text{ to country } i \text{ in year } t}{\text{Total remittances received by country } i \text{ in year } t} \quad (2)$$

Calculating these weights entails knowing bilateral remittances (i.e. how much remittances each remittance-receiving country receives from each remittance-sending country). Although the value of remittances each country receives is known, unfortunately, there is no comprehensive bilateral remittance data, and we do not know the amount of remittances received from each individual remittance-sending country. To overcome this problem, a specific method developed by [Ratha and Shaw \(2007\)](#) [1], and used in [Azizi \(2017\)](#) and [Azizi \(2018\)](#) and [Azizi \(2019\)](#), is used in this paper to estimate bilateral remittances for all countries from 1990 to 2015.

Fortunately, the UN has provided comprehensive bilateral migration data from 1990 to 2015. This means, we know how many immigrants live in each host-country, and we also know how many of them are from each specific home-country. I used this bilateral migration data set [2], per capita GNI of remittance-sending countries, and per capita GNI of remittance-receiving countries, to estimate bilateral remittances. I then use estimated bilateral remittance data to construct weighted averages of per capita GNI and real interest rate of remittance-sending countries. These weighted average indicators are used as instruments to address the endogeneity of remittances.

For remittance-receiving country i at time t , we define

$$\bar{Y}_{it} = \sum_{j=1}^{214} w_{jit} Y_{jt}$$

where \bar{Y}_{it} is one of the following variables: weighted average per capita GNI and real interest rate of the remittance-sending countries. w_{jit} is the weight as defined by equation (2), and Y_{jt} is one of the following: per capita GNI or real interest rate of the remittance-sending country j at year t . The total number of host countries is 214.

Two main concerns of using instrumental variables method, to address the problem of endogeneity, are the validity and strength of the instruments. The reason that economic variables (per capita GNI and real interest rates) related to remittance-sending countries are used is to guarantee the validity of the instruments. More specifically, selecting economic variables from remittance-sending countries, rather than from remittance-receiving countries, as instruments is to ensure the validity of instruments. My identifying assumption is that per capita GNI and real interest rate in remittance-sending countries do not affect financial development in remittance-receiving countries other than through remittances or other covariates including the regressions. The other concern about the instruments is whether or not they are strong. The whole process of estimating bilateral remittances and using them as the weights of remittance-sending countries is to ensure that instruments are strong. To investigate the strength of the instruments, first-stage regressions are examined. The results of the first-stage regressions are provided in Table II. Note that F-statistics for instruments is 71, which indicates the instruments are strong.

5. Results

The estimates for the impacts of remittances on financial development are presented in Table III.

Based on both fixed effect model and instrumental variables model, remittances have a positive and significant impact on financial development. After instrumenting for the possible endogeneity of remittances and after controlling for country and year fixed effects, a 10 percent increase in the ratio of remittances to GDP, on average, will lead to a 1.7 percent increase in domestic credit to private sector to GDP ratio, 1.9 percent increase in credit to GDP ratio, 1.2 percent increase in deposit to GDP ratio, and 0.8 percent increase in liquid liability.

Dependent variable		Per capita remittance		
Column number		(1)	(2)	(3)
Instrumental variables	Per capita GNI in remittance-sending countries	0.77*** (0.1)	0.79*** (0.1)	
	Real interest rate in remittance-sending countries	-0.008*** (0.0026)		-0.01*** (0.0026)
	Per capita GDP in remittance-receiving countries	-0.89*** (0.13)	-0.86*** (0.13)	-0.82*** (0.13)
Exogenous variables	Inflation in remittance-receiving countries	-3.7*** (1.2)	-3.8*** (1.2)	-3.5*** (1.2)
	Trade openness in remittance-receiving countries	0.43*** (0.073)	0.43*** (0.073)	0.43*** (0.073)
	Number of countries	120	120	120
Number of obs		2,543	2,543	2,543
R-squared		0.79	0.78	0.78
F-statistic for weak instruments		71	62	13

Note(s): Results are first-stage estimates of the equation $FD_{i,t} = \beta_0 + \beta_1 R_{i,t-1} + \beta_2' X_{i,t-1} + \mu_t + \delta_i + e_{it}$. First-stage estimates are obtained by running $\log(R_{it}) = \beta_0 + d_1(Z_{it}) + d_2 \log(X_{it}) + \mu_t + \delta_i + u_{it}$, where Z is a matrix of instrumental variables including weighted GNI per capita and real interest rate in remittance-sending countries where weights are from estimated bilateral remittances and X is a matrix of exogenous variables in remittance-receiving countries (***) significant at 1 percent level, ** significant at 5 percent level, * significant at 10 percent level)

Table II.
First stage regressions

Table III.
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Dependent Model	Column number	Credit to private		Credit to GDP		Deposit to GDP		Liquid liability	
		(1a) FE	(1b) IV-FE	(2a) FE	(2b) IV-FE	(3a) FE	(3b) IV-FE	(4a) FE	(4b) IV-FE
Rem/GDP		0.022** (0.0103)	0.17** (0.068)	0.07*** (0.008)	0.19** (0.09)	0.07*** (0.007)	0.123** (0.061)	0.06*** (0.006)	0.084** (0.037)
GDP per capita		1.2*** (0.069)	1.23*** (0.114)	0.89*** (0.057)	1.04*** (0.128)	0.3*** (0.049)	0.45*** (0.124)	0.14*** (0.039)	0.19*** (0.065)
Inflation		-0.086 (0.57)	-0.4 (0.74)	-1.3*** (0.48)	-1* (0.63)	-1.1*** (0.41)	-1** (0.48)	-1.4*** (0.35)	-2*** (0.48)
Trade openness		0.15*** (0.036)	0.11** (0.0536)	0.17*** (0.03)	0.13** (0.057)	0.19*** (0.026)	0.15*** (0.043)	0.14*** (0.022)	0.12*** (0.03)
Countries		120	120	122	121	122	122	124	123
Observations		2505	2505	2520	2511	2521	2512	2545	2536
R-squared		0.79	0.76	0.85	0.83	0.86	0.85	0.86	0.85

Note(s): HAC standard errors are in parentheses. All variables, except inflation, are in logarithm. All columns include country-specific fixed effects and time-specific fixed effects. *** significant at 1% level, ** significant at 5% level, * significant at 10% level

Financial development can be a source of economic growth and poverty reduction. Also, for some countries, financial development can facilitate industrialization. For example, [Efobi et al. \(2019\)](#) show that for certain initial levels of industrialization, remittances can drive industrialization through the financial development mechanism. Because of the indirect impacts of remittances on growth, poverty, and industrialization, we should examine the impacts of remittances on financial development more carefully. The result of this paper, the positive impact of remittances on financial development, is in line with studies like [Efobi et al. \(2019\)](#) which suggest the positive impact of remittances on industrialization through financial development.

6. Conclusion

By using data of 124 developing countries for the period 1990–2015, I investigate the link between remittances and financial development, focusing on domestic credit to the private sector to GDP ratio, the ratio of bank deposits to GDP, credit to GDP, and liquid liabilities to GDP. Two empirical models used in this paper are FE and IV-FE. To address autocorrelation and heteroskedasticity, HAC standard errors are used. To address the problem of endogeneity of remittances, weighted average GNI per capita and real interest rate of remittance-sending countries are used as instruments where weights are extracted from estimated bilateral remittances. I find a positive and significant association between remittances and financial sector development. This result is robust to using different estimation techniques (FE and IV-FE) and accounting for endogeneity biases.

The positive impact of remittances on financial development in developing countries is particularly important because financial development fosters long-run growth and reduces poverty. Reducing poverty and promoting economic growth have been two goals of policy-makers in developing countries for a long time. Results obtained in this paper suggest that when policy-makers in developing countries consider poverty-alleviating impacts of remittances, they should also take into account indirect impacts of remittances on poverty, especially through the positive impact of remittances on financial development. Policy-makers can promote remittances and financial development by encouraging commercial banks and financial institutions to lower the cost of remittances or by not levying any tax on remittances.

Notes

1. [Ratha and Shaw \(2007\)](#) propose a method of “Calculating Weights Based on Migrant Stocks, Per Capita Income in the Destination Countries, and Per Capita Income in the Source Countries.” The average remittance sent by a migrant from host country j to home country i (r_{ij}) is modeled as a function of the per capita income of the home country and the host country.

$$r_{ij} = f(\bar{Y}_i Y_j) = \begin{cases} \bar{Y}_i & \text{if } Y_j < \bar{Y}_i \\ \bar{Y}_i + (Y_j - \bar{Y}_i)^\beta & \text{otherwise} \end{cases}$$

where Y_j is the average per capita GNI of host country j , \bar{Y}_i is the per capita GNI of the migrant's home country, and β is a parameter between 0 and 1. The amount sent by an average migrant is assumed to be at least as much as the per capita income of the home country, even when the individual migrates to a lower-income country. The rationale is that the migration occurs in the expectation of earning a higher level of income for the dependent household than what the migrant would earn in his or her home country. To estimate bilateral remittances for all countries, they use the average β (equal to 0.75) for the top 20 remittance-receiving countries. Then, for each home country i , r_{ij} is used to build weights for each host country j as

$$W_{ij} = \frac{r_{ij} M_{ij}}{\sum_{j=1}^{214} r_{ij} M_{ij}}$$

2. The UN bilateral migration data include just the following years: 1990, 1995, 2000, 2005, 2010, 2013, and 2015. I used linear interpolation to estimate bilateral migration for the remaining years.

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