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Do remittances improve access to safe drinking water and sanitation in developing countries?

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Abstract

This study examines the effect of migrant remittances on access to safe drinking water and sanitation in 116 developing countries over the period 2000-2017. Using the two-steps Generalized Method of Moments (GMM), this study attest the existence of a positive and statistically significant effect of remittances on access to safe drinking water and sanitation for the total, urban and rural populations, respectively. Furthermore, the results show that remittances reduce the urban-rural gap in access to these services. These results remain robust to the use of additional control variables and the use of an alternative measure of remittances.

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1. Introduction

There exist an abundant literature which shows the importance of access to safe drinking water and sanitation in reducing poverty, improving education and maternal and child health (Larson et al., 2006; Rheingans et al., 2006; Cameron et al., 2021). It was therefore not surprising that one of the Millennium Development Goals (MDG 7) was dedicated to access to safe drinking water and sanitation[1] and later renewed as a Sustainable Development Goals (SDG 6). The Millennium Development Goals era has been successful in that the rate of access to safe drinking water increased averagely worldwide from 61% to 71% between 2000 and 2015. During the same period, the percentage of the total population with access to sanitation increased from 28% to 43% (United Nations, 2019). Despite this progress, in 2017, 29% and 55% of the population lacked access to safe drinking water and sanitation, respectively (WHO and UNICEF, 2019). Rheingans et al. (2006) state that more than 1 billion people lack access to safe drinking water sources and approximately 2.6 billion lack access to adequate sanitation. Poor quality and/or inadequate safe drinking water supply and sanitation for populations can affect maternal and child health outcomes through several pathways, including the quality of drinking water consumed by the pregnant woman and exposure to dangerous pathogens in the environment due to poor water and sanitation quality (Rheingans et al., 2006; Cameron et al., 2021). Governments can provide public services to households either directly through public infrastructure or indirectly because households themselves compensate for the lack of public infrastructure. Moreover, some authors reveal that these public services are not "public goods," as the literature tends to claim (Habyarimana et al., 2007; Adida and Girod, 2011). By definition, public goods are non-exclusive and non-rivalrous. Access to water would represent a public good, for example, if the government could not exclude anyone from obtaining water and if one citizen's access did not limit another's. However, if access to water depends on household access technology, water is an excludable good and therefore not a public good (Adida and Girod, 2011).

These findings have led researchers to examine the determinants of access to safe water and sanitation. Several factors such as external aid (Gopalan and Rajan, 2016; Ndikumana and Pickbourn, 2017), institutional quality (Anand, 2006; Francois et al., 2021), public expenditure (Fry et al., 2008), the Heavily Indebted Poor Countries Initiative (Atangana, 2017), and natural resource rents (Mazaheri, 2017; Tadadjeu et al., 2020) have been highlighted. However, one important factor that has not been sufficiently analyzed in the literature is migrant remittances.

Remittances refer to financial or in-kind transfers made by migrants to their friends or family members in their home communities (IMF, 2009). These flows have increased significantly over the past decades. In 2008, remittances received by developing countries reached $335.8 billion. Remittances to developing countries amounted to $404 billion in 2013, and $436 billion in 2014 to reach $443 billion in 2017. In 2020, 646 billion US dollars flowed to the countries of the world in the form of remittances[2] (World Bank, 2021). These funds have surpassed the most traditionally important international financial flows, such as official development assistance and foreign direct investment. The stability, large volume, and permanence of international remittances have made them one of the most important sources of foreign currency and household income for many developing and emerging economies. Several studies have investigate the effects of migrant remittances along various economic dimensions, including economic growth (Amuedo-Dorantes and Pozo, 2004; Adams and Page, 2005), education and health (Azizi, 2018; Kapri and Jha 2020), financial development (Aggarwal et al., 2011; Donou-Adonsou et al., 2020), shadow economy (Njangang et al., 2018), institutional quality (Deonanan and Williams 2017; Williams, 2017), and recently

[1] Millennium Development Goal (MDG) number 7 and Sustainable Development Goal (SDG) number 6 is to ensure the availability and sustainable management of water and sanitation for all by 2030.

[2] Moreover, despite this improvement, data on migrant remittances are inherently underreported; much of the flow does not go through the banking system. Among the various informal methods of transferring money are personal transportation of funds and money sent through a third party (Avom et al., 2021).

economic complexity (Saadi, 2020). Despite this extensive literature on the effects of remittances, the only study to the best our knowledge that has examined the effect of migrant remittances on access to safe water and sanitation is that of Adida and Girod (2011). These authors conduct an analysis on 2,438 municipalities in Mexico and show that remittances help citizens improve their own access to basic social services, including access to clean water and sanitation. They go further to highlight that the state does not have a monopoly on the provision on basic services. Non-state providers, including non-governmental organizations (NGOs), for-profit organizations, and even revolutionary movements, are providing access to water and sanitation in the developing world, in places as diverse as Bangladesh, India, South Africa, Kenya, and Ethiopia (Adida and Girod, 2011). Based on the above development, we can hypothesize that remittances improve access to water and sanitation and reduce the urban-rural gap in access to these services in developing countries.

This study contributes to the literature in several ways. First, to the best of our knowledge, this paper is the first macroeconomic study to analyze the effect of migrant remittances on access to safe drinking water and sanitation in developing countries. This study therefore fills the knowledge gap on the issue in a region characterized by abundant inflows of migrant remittances, but which, paradoxically, lags behind in the provision of basic social services, particularly safe drinking water and sanitation. Second, because of the large inequalities in access to safe drinking water and sanitation between urban and rural areas, and following Ndikumana and Pickbourn (2017) and Tadadjeu et al. (2020), this study also examines the effect of remittances on the urban-rural gap in access to these services. No previous study has examined the effect of remittances on the urban-rural gap in access to these services. Third, from a methodological point of view, we use the two-step system GMM estimator that allows us to correct for the endogeneity of variables that are assumed to be endogenous. In addition, by performing the two-step system GMM estimator, we incorporate the finite-sample correction for standard deviations of Windmeijer (2005) which produces more efficient estimators. Our results show the positive effect of migrant remittances on access to safe drinking water and sanitation for the total, urban, and rural populations, respectively. Also, remittances reduce the urban-rural gap in access to these services.

The rest of the paper is structured as follows. Section 2 presents the theoretical framework while section 3 describes the data and empirical strategy. Sections 4 presents the empirical results and Section 5 concludes.

2. Theoretical framework

The effect of remittances on access to safe drinking water and sanitation flows through several mechanisms among which we can identify: the socio-economic channels (income and education), and the political channel (democracy).

2.1 *Social channel*

An abundant economic literature shows that migrant remittances are an important source of income for education financing for recipient households (Zhunio et al., 2012; Azizi, 2018; Askarov and Doucouliagos, 2020). These authors argue that, in general, households receiving remittances tend to spend more on education than households not receiving remittances. One of the main constraints faced by the poorest households is the lack of credit. Credit constraints make it difficult for households to borrow to finance education (Galor and Zeira, 1993). As a result, credit constraints lead to suboptimal investment in human capital, especially among low-income households. Given credit constraints, many expect remittances to reduce a household's need for and increase spending on education and health. At the same time, some studies agree that education level is positively related to access to safe drinking water and sanitation (Adams et al., 2016). It has been shown that, all else being equal, educated people are aware of the negative consequences of poor sanitation[3] and therefore

[3] Such as the transmission of cholera, plague, intestinal worms, skin diseases and many other infectious diseases.

make appropriate decisions aimed at improving sanitation (Adams et al., 2016). Along these lines, migrant remittances improve access to safe drinking water and sanitation in developing countries by flowing through education.

2.2 *Economic channel*

Economic literature teaches that remittances increase income (Giuliano and Ruiz-Arranz, 2009; De and Ratha, 2012) and at the same time, income is positively related to access to safe drinking water and sanitation. Among the determinants of household income levels, migrant remittances occupy an important place. Several empirical studies show that an increase in remittances improves the gross domestic product of the recipient economy (Giuliano and Ruiz-Arranz, 2009; De and Ratha, 2012; Avom et al., 2021). Remittances are therefore an additional source of income available to households (Gupta et al., 2007). This additional income can be invested in improving housing and living conditions through the construction of toilets, septic tanks, boreholes, and other devices to improve drinking water supplies.

2.3 *Political channel*

Several theoretical and empirical works highlight the role of migrant remittances in improving democracy (Escriàb-Folch et al., 2015; Deonanan and Williams, 2017; Williams, 2017). For example, Deonanan and Williams (2017) argue that remittances improve the quality of democratic institutions in recipient countries, and progressively strengthen democratic institutions regardless of the previous level of democracy. This result can be explained by the fact that remittances directly increase household income and thus reduce poverty (Adams and Page, 2005; Adams, 2006; Gupta et al., 2007). A large and sufficiently wealthy middle class is more supportive of democratic institutions because democratic institutions offer better protection of their property rights (Acemoglu and Robinson, 2006). In a similar vein, Williams (2017) finds that while remittances reduce poverty in developing countries, poverty can mediate because remittances can improve the well-being of poor households, allowing them to refuse handouts from political elites and demand greater accountability from governments. At the same time, several theoretical and empirical studies argue that institutional quality and democracy are critical conditions for the provision of public goods (Deacon, 2009; Ahlborg et al., 2015; Arora and Chong, 2018). For example, Ahlborg et al. (2015) find that institutional quality has a positive and significant effect on access to public services, specifically in the case of household access to electricity in Africa. Deacon (2009), using cross-country data on the provision of public goods and empirical indicators of political regime, examines the assumption about the provision of a public good by the distribution of political power. He arrives at the result that the relatively equal distribution of political power among groups in a democracy favors spending on non-excludable public goods. The more concentrated pattern of political power in a dictatorship favors spending on transfers targeted at powerful groups. Deacon (2009) goes on to argue that dictatorial governments are found to provide public education, roads, clean water, public sanitation, and pollution control at much lower levels than democracies. In this logic, because of its contribution to improving institutional quality and democracy, migrant remittances are very important for the provision of public goods, including clean water and improved sanitation.

3. Data and methodology

3.1 Data

This study uses data from 116 developing countries over the period 2000-2017 with data from the World Development Indicators (WDI), and the World Governance Indicators (WGI). The time period and sample size are conditioned by data availability. Table 1 below presents the descriptive statistics.

Dependent variable

Following Ndikumana and Pickbourn (2017) and Tadadjeu et al. (2020), the dependent variable is measured by three indicators. The percentage of the population (total, rural and urban) with access to an improved water source. The second indicator is the percentage of the population (total, urban and rural) with access to improved sanitation facilities. The third indicator is the gap between the urban and rural population in terms of access to these services. The urban-rural gap is measured by the ratio of the percentage of the urban population with access to safe water and sanitation to the percentage of the rural population.

Independent variable

Our main explanatory variable is migrant remittances as a percentage of GDP defined as personal transfers and compensation of employees. Personal transfers include all current transfers in cash or in kind made or received by resident households to or from nonresident households (World Bank, 2021). This measure has been widely used in the literature by authors such as Njangang et al. (2018); Donou-Adonsou et al. (2020). For robustness purposes we use remittances in US dollars.

Control variables

Consistent with the literature (Gopalan and Rajan, 2016; Ndikumana and Pickbourn, 2017), we use a set of four macroeconomic variables considered to be determinants of access to safe drinking water and sanitation. These variables include: per capita income, Foreign Direct Investment (FDI), trade openness, and natural resources. We expect a positive effect of per capita income, FDI, trade openness on access to safe water, and a negative effect of natural resources on access to safe water and sanitation in line with the work of Mazaheri (2017) and Tadadjeu et al. (2020).

Table 1: Descriptive statistics

Variables	Observations	Mean	Std. Dev.	Min	Max
Water total	2077	77.898	18.826	18.695	99.931
Water rural	2077	68.879	23.19	4.083	100
Water urban	2078	90.431	9.294	49.487	100
Gap Water	2077	1.513	0.75	0.675	14.312
Sanitation urban	2078	69.015	25.645	9.432	100
Sanitation total	2077	59.51	29.719	3.404	100
Sanitation rural	2077	51.335	31.472	1.19	100
Gap Sanitation	2077	2.06	1.855	0.746	28.137
Remittances (%GDP)	1995	5.744	7.377	0	53.826
LnRemittances[4] in USD	1996	19.303	3.485	0	24.977
FDI	2060	4.2	6.351	-37.155	103.337
Trade	1907	77.39	37.281	0.167	347.997
Total rents	2069	9.075	11.42	0	86.252
Foreign aid	2022	6.467	8.958	-2.313	92.141
GDP Per Cap.	2068	3143.63	2709.135	194.873	14975.087
Corruption control	1971	-0.557	0.542	-1.722	1.568

3.2 Empirical strategy

The objective of this study is to analyze the effect of remittances on access to safe water and sanitation in developing countries, the empirical model builds on the dynamic framework that was used by Ndikumana and Pickbourn (2017) and Tadadjeu et al. (2020) using two versions of a baseline

[4] Ln stands for logarithms

model. The first version of the model relates migrant remittances to the percentage of the population (total, rural and urban, alternatively) with access to improved water sources or improved sanitation facilities, and can be expressed as follows:

$$Access_{it} = \alpha + \beta\, Access_{it-1} + \varphi\, TFM_{it} + \gamma\, X_{it} + \mu_i + V_t + \varepsilon_{it} \quad (1)$$

Where $Access_{it}$ is the share of the population (total, rural, and urban, alternatively) for country i in year t that has access to safe water or improved sanitation. Migrant remittance (TFM) is the main explanatory variable, X is the vector of control variables, μ_i is an unobserved country-specific effect, v_t is the time-specific effect, and ε_{it} is the error term.

The second version of the model is specified to study the effect of remittances on the urban-rural gap in access to water and sanitation, respectively. The model is specified as follows:

$$GapRatio_{it} = \alpha + \beta\, GapRatio_{it-1} + \varphi\, TFM_{it} + \gamma\, X_{it} + \mu_i + V_t + \varepsilon_{it} \quad (2)$$

Where $GapRatio_{it}$ represents the ratio of the percentage of the urban population to the percentage of the rural population with access to safe water or sanitation in country i in year t. The other terms in equation (2) have the same meanings as in equation (1). It is important to note that the use of the dynamic panel, in which the lagged dependent variable is used as an explanatory variable, allows for the analysis of the effect of migrant remittances on access to safe water and sanitation in a parsimonious model (Tiberto et al., 2020). This is possible due to the fact that delayed access to clean water and sanitation has a large part of the explanation in itself (de Moraes et al., 2021). Despite this advantage, the use of the lagged dependent variable in the models generates dynamic panel bias and inconsistency in the least squares estimators (Baltagi, 2005). In order to overcome this problem, the literature uses generalized methods of moments (GMM), as suggested by Arellano and Bond (1991). The GMM method is able to handle lagged dependent variables, unobserved fixed effects, independent endogenous regressors, and heteroskedasticity and autocorrelation between and within countries.

We estimate the empirical models using a two-step system GMM proposed by Arellano and Bover (1995) and Blundell and Bond (1998)[5] with robust standard errors corrected for finite samples using the Windmeijer (2005) correction procedure. The two-step system GMM is used for several reasons. First, the GMM estimator allows us to examine the link between migrant remittances and access to drinking water and sanitation while accounting for the dynamic nature of the model and the potential endogeneity[6] of some of the right-hand side variables. Second, the two-step system GMM estimator also takes into account biases that arise due to country-specific effects. Third, the GMM method is more efficient than other estimators in the dynamic panel setting (Kpodar, 2005). The consistency of the GMM estimator depends on two things: the validity of the assumption that the error term is not serially correlated (AR (2)), and the validity of the instruments (Hansen test). The key identifying assumption in the Hansen test is that the instruments used in the model are valid and uncorrelated with the residuals. Too many instruments can severely weaken and bias Hansen's test of identification restrictions, and therefore, the rule of thumb is that the number of instruments should be less than the number of countries (Roodman, 2009).

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[5] Using Monte Carlo simulations, Blundell and Bond (1998) show that system-based GMM is more efficient than difference-based GMM.

[6] We highlight the three main sources of endogeneity. First, an inverse causality may exist between remittances and access to drinking water and sanitation. On the one hand, remittances being an additional source of income available to households can allow recipient households to improve their access to drinking water and sanitation. On the other hand, the current level of access to safe drinking water and sanitation, which remains very low in developing countries, can lead people to exert pressure on their family members abroad in order to obtain funds. This pressure may therefore lead compatriots abroad to increase the flow of funds to improve access to these services. Second, measurement error. Data on access to drinking water and sanitation and especially remittances may contain measurement errors, especially when we consider developing country series. It is argued that sources of error in the data often lead to an overestimation of access rates. Third, omission bias. There are omitted variables that are potential determinants of access to water and sanitation and that could therefore bias the results.

4. Results

4.1 Baseline results

The baseline results are presented in Table 2 with the lower part reporting the diagnostic tests. Overall, the results of the diagnostic tests show that our models are well specified. The Hansen test does not reject the validity of the instruments, and the absence of second-order serial correlation is not rejected. A high number of instruments may bias the Hansen test of over-identification restrictions, and therefore, the rule of thumb is that the number of instruments should be less than the number of countries (Roodman, 2009). The results of the system GMM estimates generated a maximum of 95 instruments, which is less than the number of countries, therefore, our results are valid.

Table 2: Baseline results

Dependent variables	Water total	Water urban	Water rural	Gap water	Sanitation total	Sanitation urban	Sanitation rural	Gap sanitation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lag Dep. Var.	0.923***	0.869***	0.953***	0.828***	0.959***	0.984***	0.939***	0.862***
	(0.007)	(0.021)	(0.007)	(0.062)	(0.005)	(0.002)	(0.003)	(0.033)
Remittances	0.036***	0.015**	0.021***	-0.001*	0.029***	0.007**	0.075***	-0.004**
	(0.005)	(0.006)	(0.007)	(0.001)	(0.004)	(0.003)	(0.003)	(0.002)
Income	0.797***	0.580***	0.569***	-0.031**	0.880***	0.274***	1.356***	-0.072*
	(0.116)	(0.125)	(0.120)	(0.015)	(0.121)	(0.044)	(0.066)	(0.039)
Total rents	-0.011***	-0.019***	-0.021***	0.002	-0.017***	-0.001	-0.025***	0.001*
	(0.002)	(0.003)	(0.004)	(0.001)	(0.003)	(0.001)	(0.002)	(0.000)
FDI	0.008***	0.010***	0.030***	-0.000	0.001	0.002***	-0.000	-0.000
	(0.001)	(0.002)	(0.007)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Trade	0.000	0.005***	-0.001	0.000	0.010***	0.001***	0.003***	0.000
	(0.000)	(0.001)	(0.001)	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)
Constant	0.421	7.475***	-0.280	0.454**	-4.424***	-0.710***	-7.000***	0.769**
	(0.479)	(1.143)	(0.564)	(0.196)	(0.704)	(0.264)	(0.410)	(0.340)
Observations	1,701	1,702	1,696	1,696	1,701	1,7	1,696	1,701
Countries	110	110	110	110	110	110	110	110
Instruments	64	64	59	60	70	53	95	36
AR (2)	0.779	0.205	0.282	0.296	0.729	0.112	0.192	0.216
Sargan–Hansen test	0.342	0.634	0.698	0.141	0.265	0.158	0.146	0.996

Notes: *, **, *** indicate statistical significance at 10%, 5% and 1% respectively. Robust standard errors are shown in parentheses.

Looking at the effect of remittances, the results show that the coefficient associated with remittances is positive and statistically significant, suggesting that remittances improve the percentage of the total population with access to drinking water (column 1). At the same time, column (5) indicates that remittances have a positive and statistically significant effect on the total population with access to sanitation. This result suggests that remittances improve the percentage of the total population with access to sanitation. These results can be justified by the fact that remittances, being an additional income available to recipient households, allow the construction of improved wells, toilets, and boreholes. All of this helps to improve access to drinking water and sanitation for the households receiving the funds. A comparative analysis by type of service reveals that remittances are more important in improving access to drinking water. Thus, all else being equal, an increase in remittances of 10 units' leads to an improvement in the percentage of the total population with access

to drinking water and sanitation of 3.59 units and 2.95 units, respectively. When we analyze access to drinking water and sanitation by place of residence, we find that migrant remittances improve access to drinking water and sanitation in both rural and urban areas (columns 2-4 and 6-7). An analysis by geographic area shows that the effect of remittances on access to drinking water and sanitation is greater in rural areas than in urban areas. This result can be explained by the fact that in developing countries, the problem of access to safe drinking water and sanitation is much more severe in rural areas. Additional income such as remittances will provide a greater incentive for people in rural areas to improve their access to these services than those in urban areas who have a relatively high level of access.

Columns (4) and (8) present the effects of remittances on the urban-rural gap in access to drinking water and sanitation, respectively. These results suggest that the coefficient associated with remittances is negative and statistically significant in both cases. These results suggest that remittances reduce the gap between urban and rural populations in access to safe water and sanitation, respectively. The fact that remittances contribute to reducing the urban-rural gap supports the idea that remittances have a larger effect in rural than in urban areas in terms of access to safe water and sanitation. These results are similar to those of Ndikumana and Pickbourn (2017) who found that official development assistance reduces the urban-rural gap in sanitation access in sub-Saharan Africa.

With regard to the control variables, we find that they almost all have the expected signs. Gross Domestic Product (GDP) has a positive and statistically significant effect on access to drinking water and sanitation. We also note that income contributes to reducing the urban-rural gap in access to drinking water and sanitation (columns 4 and 8). The coefficients associated with trade openness show a positive and statistically significant effect on urban populations' access to drinking water (column 2), and on total, urban and rural populations' access to sanitation (columns 5, 6 and 7, respectively). We can also deduce that FDI contributes to improving access to drinking water and sanitation, and also helps to reduce the urban-rural gap in access to drinking water and sanitation. The coefficients associated with natural resources are negative and statistically significant but positive for the gaps. These results suggest that natural resources reduce access to drinking water and sanitation, and increase the urban-rural gap in access to drinking water and sanitation. This result is consistent with those found by Tadadjeu et al. (2020).

4.2 Robustness checks

To test the robustness of our baseline results, we conduct a set of sensitivity analyses: the use of additional control variables and an alternative measure of remittances, namely migrant remittances in current US dollars. Overall, we find similar results to those obtained in Table 2.

First, we estimate our model by introducing three additional control variables, namely, corruption control, government consumption expenditure, and official development assistance received (%GNI). The estimation results contained in Table 3 show that remittances have a positive and statistically significant effect on access to safe drinking water and sanitation for the total, urban and rural populations. In addition, remittances reduce the urban-rural gap in access to these services. This confirms the robustness of our results to the use of additional control variables. We also examine the robustness of our results across income levels. Indeed, our sample of developing countries is composed of 73 low and lower middle-income countries (LMIC) and 43 upper middle-income countries (UMIC) according to the World Bank (2021) classification. It is therefore important to understand whether there is heterogeneity in the effect of remittances across these income levels. The estimation results are summarized in table A1 in appendix. Results show that remittances increase access to water and sanitation and reduces the urban-rural gap in terms of access to these services in both income groups.

Second, we test the robustness of our results using an alternative measure of our independent variable, namely migrant remittances in current US dollars. The estimation results summarized in Table 4 show that remittances in current dollars positively and significantly affect access to safe drinking water and sanitation for total, rural and urban populations. In addition, remittances reduce the urban-rural gap in access to these services. This confirms the robustness of our results to the use of an alternative measure of migrant remittances.

Table 3: Additional Control Variables

Dependent variables	Water total	Water rural	Water urban	Gap water	Sanitation total	Sanitation rural	Sanitation urban	Gap sanitation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lag Dep. Var.	0.914***	0.934***	0.835***	0.880***	0.971***	0.949***	0.973***	0.769***
	(0.004)	(0.004)	(0.056)	(0.015)	(0.012)	(0.013)	(0.013)	(0.037)
Remittances	0.037***	0.049***	0.028*	-0.001***	0.034**	0.067***	0.036**	-0.010***
	(0.004)	(0.004)	(0.015)	(0.000)	(0.017)	(0.023)	(0.016)	(0.003)
Income	1.036***	1.130***	0.668**	-0.017*	0.175	0.727*	0.532*	-0.117***
	(0.073)	(0.068)	(0.323)	(0.010)	(0.315)	(0.387)	(0.295)	(0.043)
Total rents	-0.013***	-0.025***	-0.017**	0.000	0.003	-0.015	-0.017*	0.002*
	(0.001)	(0.002)	(0.008)	(0.000)	(0.006)	(0.011)	(0.009)	(0.001)
FDI	0.014***	0.024***	0.006	-0.000	-0.004	-0.005	0.006	-0.001
	(0.002)	(0.002)	(0.006)	(0.000)	(0.006)	(0.006)	(0.006)	(0.001)
Trade	0.004***	0.001*	0.003	-0.000	0.005	0.008**	0.004	-0.000
	(0.001)	(0.001)	(0.003)	(0.000)	(0.003)	(0.004)	(0.003)	(0.000)
ODA	0.002***	0.027***	-0.027	0.000	-0.043	-0.020	-0.030	-0.001
	(0.001)	(0.002)	(0.018)	(0.000)	(0.030)	(0.013)	(0.032)	(0.004)
Corruption Control	-0.015	-0.005	0.043	-0.011	0.529	0.238	-0.648	-0.044
	(0.056)	(0.066)	(0.291)	(0.014)	(0.356)	(0.428)	(0.523)	(0.072)
Gov. Cons. Exp.	-0.027***	-0.088***	-0.004	0.001	-0.061*	-0.083***	-0.117**	0.012
	(0.006)	(0.009)	(0.013)	(0.001)	(0.035)	(0.030)	(0.059)	(0.008)
Constant	-0.658**	-2.460***	10.205***	0.271***	1.903	-1.558	-0.809	1.160***
	(0.323)	(0.410)	(3.048)	(0.096)	(2.171)	(2.644)	(2.246)	(0.385)
Observations	1,445	1,441	1,517	1,523	1,522	1,522	1,527	1,524
Countries	107	107	107	106	107	107	107	107
Instruments	78	79	84	40	59	77	59	41
AR (2)	0.561	0.176	0.114	0.301	0.755	0.863	0.804	0.107
Sargan–Hansen test	0.210	0.272	0.695	0.933	0.778	0.506	0.751	0.873

Notes: *, **, *** indicate statistical significance at 10%, 5% and 1% respectively. Robust standard errors are shown in parentheses.

Table 4: Alternative measure of remittances

Dependent variables	Water total	Water urban	Water rural	Gap water	Sanitation total	Sanitation urban	Sanitation rural	Gap sanitation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lag Dep. Var.	0.919***	0.875***	0.925***	0.817***	0.939***	0.958***	0.922***	0.851***
	(0.007)	(0.025)	(0.010)	(0.063)	(0.008)	(0.004)	(0.005)	(0.028)
Remittances[7]	0.143***	0.112***	0.204***	-0.007*	0.221***	0.083***	0.330***	-0.010**
	(0.017)	(0.027)	(0.040)	(0.004)	(0.031)	(0.022)	(0.020)	(0.004)
Income	0.755***	0.498***	0.757***	-0.025**	1.158***	0.725***	1.454***	-0.055*
	(0.102)	(0.124)	(0.147)	(0.012)	(0.164)	(0.078)	(0.098)	(0.030)
Total rents	-0.016***	-0.015***	-0.035***	0.002*	-0.023***	-0.011***	-0.035***	0.002***
	(0.002)	(0.002)	(0.005)	(0.001)	(0.003)	(0.003)	(0.002)	(0.001)
FDI	0.007***	-0.001	0.013***	-0.000	0.001	-0.001	0.002**	-0.001**
	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Trade	0.002***	0.009***	0.007***	-0.000	0.016***	0.004***	0.012***	-0.000
	(0.001)	(0.001)	(0.001)	(0.000)	(0.003)	(0.001)	(0.001)	(0.000)
Constant	-1.774***	5.055***	-4.199***	0.571**	-10.155***	-4.202***	-13.647***	0.865***
	(0.553)	(1.000)	(1.039)	(0.233)	(1.302)	(0.569)	(0.812)	(0.282)
Observations	1,668	1,669	1,663	1,663	1,668	1,669	1,663	1,668
Countries	109	109	109	109	109	109	109	109
Instruments	64	64	59	61	70	53	95	36
AR (2)	0.893	0.403	0.184	0.308	0.238	0.302	0.861	0.211
Sargan–Hansen test	0.285	0.971	0.644	0.190	0.518	0.203	0.401	0.963

Notes: *, **, *** indicate statistical significance at 10%, 5% and 1% respectively. Robust standard errors are shown in parentheses.

5. Conclusion

The objective of this study was to analyze the effects of migrant remittances on access to safe drinking water and sanitation on a panel of 116 developing countries over the period from 2000 to 2017. We use the two-step system Generalized Method of Moments, which allows us to establish robust and strong evidence of a positive and statistically significant effect of migrant remittances on access to safe drinking water and sanitation. We also find that migrant remittances reduce the urban-rural gap in access to safe drinking water and sanitation. Finally, our results remain robust to the use of an alternative measure of migrant remittances and to the use of additional control variables. As policy recommendations, the selected developing countries could offer incentives, such as tax breaks in remittance-induced investment or bank-to-bank deposits with attractive deposit rates for the diaspora, to attract more remittances.

The future studies on this topic can be carried out in multiple ways. First, similar studies can be carried out at the country level so as to take in consideration the context of each country. Second, the study can be undertaken based on the new methodological evidence. As country has different strategies in providing population access with these basic social services, future studies can implement panel vector autoregression method or quantile regression to assess the effect of remittances along the distributional heterogeneity of access to water and sanitation. Third, further studies can be carried out with additional determinant of access to water and sanitation, in keeping

[7] Remittances here stands for the log of Personal remittances, received (current US$) Personal remittances, received (current US$) expressed in logarithms. Personal remittances comprise personal transfers and compensation of employees express in current U.S. dollars

with the chosen context. Four, future researches can further analyze the non-linear relationship between remittances and access to water and sanitation using a more appropriate method such as threshold GMM or Panel Smooth Transition Regression (PSTR). Finally, future works may also examine the effect of remittances on access to various basic services such as access to electricity.

Appendix

Table A1: Heterogeneity according to income level

	Low and Lower Middle Income Countries							
Dependent variables	Water total	Water urban	Water rural	Gap Water	Sanitation total	Sanitation urban	Sanitation rural	Gap sanitation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lag Dep. Var.	0.950***	0.869***	0.974***	0.871***	0.956***	0.956***	0.961***	0.782***
	(0.015)	(0.014)	(0.018)	(0.005)	(0.013)	(0.008)	(0.010)	(0.021)
Remittances	0.027**	0.025***	0.026*	-0.001*	0.049***	0.024***	0.065***	-0.005***
	(0.011)	(0.007)	(0.014)	(0.000)	(0.014)	(0.009)	(0.018)	(0.002)
Control variables	yes	yes	yes	yes	yes	yes	yes	yes
Constant	1.083	6.877***	0.894	0.323***	-3.397*	0.180	-4.119***	1.230***
	(0.985)	(0.777)	(1.251)	(0.032)	(1.952)	(1.161)	(1.258)	(0.381)
Observations	1,056	1,059	992	1,014	1,07	995	1,07	1,067
Countries	68	68	68	68	68	68	68	68
Instruments	29	35	29	24	47	39	46	34
AR (2)	0.791	0.593	0.871	0.285	0.429	0.456	0.670	0.235
Sargan–Hansen test	0.403	0.241	0.561	0.109	0.392	0.454	0.506	0.559
	Upper Middle Income Countries							
Dependent variables	Water total	Water urban	Water rural	Gap water	Sanitation total	Sanitation urban	Sanitations rural	Gap sanitation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lag Dep. Var.	0.930***	0.869***	0.948***	0.938***	0.952***	0.974***	0.992***	0.958***
	(0.003)	(0.008)	(0.003)	(0.002)	(0.007)	(0.006)	(0.010)	(0.002)
Remittances	0.005***	0.007***	0.009***	-0.000**	0.033***	0.021***	0.041**	-0.000***
	(0.002)	(0.002)	(0.004)	(0.000)	(0.007)	(0.008)	(0.021)	(0.000)
Control variables	yes	yes	yes	yes	yes	yes	yes	yes
Constant	5.054***	12.905***	2.355***	0.116***	1.642	4.005***	0.527	0.065***
	(0.201)	(0.799)	(0.268)	(0.012)	(1.518)	(1.092)	(2.651)	(0.014)
Observations	639	647	646	608	646	640	572	610
Countries	42	42	42	42	42	42	40	42
Instruments	35	41	41	24	34	34	34	41
AR (2)	0.415	0.226	0.278	0.281	0.404	0.230	0.869	0.380
Sargan–Hansen test	0.359	0.782	0.229	0.320	0.262	0.528	0.808	0.632

Notes: *, **, *** indicate statistical significance at 10%, 5% and 1% respectively. Robust standard errors are shown in parentheses.

Table A2: List of countries (116)

Afghanistan	Colombia	Honduras	Montenegro	South Africa
Albania	Comoros	India	Morocco	Sri Lanka
Algeria	Congo, Dem. Rep.	Indonesia	Mozambique	St. Lucia
Angola	Congo, Rep.	Iran, Islamic Rep.	Myanmar	Sudan
Argentina	Costa Rica	Iraq	Namibia	Suriname
Armenia	Cote d'Ivoire	Jamaica	Nepal	Tajikistan
Azerbaijan	Djibouti	Jordan	Nicaragua	Tanzania
Bangladesh	Dominican Republic	Kazakhstan	Niger	Thailand
Belarus	Ecuador	Kenya	Nigeria	Timor-Leste
Belize	Egypt, Arab Rep.	Kyrgyz Republic	North Macedonia	Togo
Benin	El Salvador	Lao PDR	Pakistan	Tonga
Bhutan	Eswatini	Lesotho	Papua New Guinea	Tunisia
Bolivia	Ethiopia	Liberia	Paraguay	Turkey
Bosnia and Herzegovina	Fiji	Madagascar	Peru	Turkmenistan
Botswana	Gabon	Malawi	Philippines	Tuvalu
Brazil	Gambia, The	Malaysia	Russian Federation	Uganda
Bulgaria	Georgia	Maldives	Rwanda	Ukraine
Burkina Faso	Ghana	Mali	Samoa	Uzbekistan
Burundi	Guatemala	Marshall Islands	Sao Tome and Principe	Vanuatu
Cabo Verde	Guinea	Mauritania	Senegal	Vietnam
Cambodia	Guinea-Bissau	Mexico	Serbia	West Bank and Gaza
Cameroon	Guyana	Moldova	Sierra Leone	Yemen, Rep.
China	Haiti	Mongolia	Solomon Islands	Zambia
				Zimbabwe

Table A3: Determinants of access to water and sanitation

Authors	Determinants of access to water and sanitation	Signs obtained
Tadadjeu et al. (2020)	Total resource rents	negative
Ndikumana and Pickbourn (2017)	Foreign Aid Allocation	positive
Francois et al. (2021)	Quality of institutions	positive
Atangana (2017)	Heavily Indebted Poor Countries Initiative	positive
Fry et al. (2008)	Foreign direct investment	positive
Hopewell and Graham (2014)	GDP/head	positive
Gates et al. (2012)	Armed conflict	negative

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