Protector or Polluter? Environmental Impacts of Remittances

Abstract

As remittances are widely regarded as potential drivers of financial development and economic growth, their role in contributing to environmental degradation cannot be overlooked. In this paper, we examine the environmental impact of migrant remittances in the Global South. Using panel data from 37 of these developing countries, spanning the period from 1980 to 2014, our results indicate that remittances exacerbate environmental degradation. We thus support the remittances-led emissions hypothesis. Interestingly, we find that remittance inflows do not directly increase CO_2 emissions but rather do so indirectly through channels such as household consumption, private investment, urbanization, and imports. Our findings strongly suggest that policymakers in the Global South should consider the following: (1) treating remittances as a policy tool for designing strategies related to sustainable and responsible investment, and (2) channeling remittances toward green consumption and environmentally friendly investments.

***Keywords**:* Remittances; CO_2 emissions; developing countries.

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Oussama Ben ATTA University Jean Monnet, (oussama.ben.atta@univ-st-etienne.fr)
Refk SELMI éklore-ed School of Management, (refk.selmi@eklore-ed.com)
Farid MAKHLOUF éklore-ed School of Management, (farid.makhlouf@eklore-ed.com)

1. Introduction

Remittances are a significant source of financing for most developing countries (see inter alia, Makhlouf, 2013; Makhlouf et al., 2019; Ratha, 2017). Remittances are not only considered a new financial phenomenon, but they are also perceived as a significant source of income owing to the magnitude of their economic impact (Meyer and Shera, 2017). According to the World Bank, remittances to low- and middle-income countries reached more than $600 billion in 2024. The economic impact of remittances on countries of origin is relatively well supported. However, the environmental impacts of remittances have been devoted much less attention (see, for example, Ahmad et al., 2019; Brown et al., 2020; Sharma et al., 2019), although environmental issues are becoming increasingly important in economic literature. Climatic changes, energy crises, hikes in energy prices, and rapidly climbing carbon emission levels have further added fuel to this debate.

There is a recognized relationship between the environment and population movement (Findley, 1994; Kane, 1995). The impact of remittances on emigration countries is likely to be complex (Makhlouf, 2013). Remittances can have macroeconomic effects, notably on consumption and investment (Bahadir et al., 2018). They can exert a significant impact on the education, health, and cultural norms of recipient households (Acosta, 2011; Amuedo-Dorantes and Pozo, 2011; Acharya and Leon-Gonzalez, 2014; among others).

The relationship between migrants' remittances and CO_2 emissions in their countries of origin can be analyzed by considering the effect on income, investment, consumption, and economic development, as well as the influence of remittances on sustainable standards and practices. Indeed, remittances can increase the consumption of recipient households, particularly the poorest. This in turn amplifies their carbon footprint. It is also possible to use this money for investments. If the investments are not sustainable, they can contribute to increasing CO_2 emissions. However, international migration could be accompanied by transfers of responsible standards and practices, especially from developed host countries. This can sensitize the families of migrants left behind in those countries of origin to be more sustainable in their spending and investment. The use of remittances will depend on the level of wealth of the household receiving them. In this respect, they can be used for consumption and investment (Bahadir et al., 2018; Edelbloude et al., 2017; Makhlouf, 2024). A relatively poor household will spend its money on improving its situation without considering the carbon loan (for example, in the purchase of a vehicle or the installation of electrical household appliances). In general, a household that is relatively affluent will use remittances for cost reduction, such as the installation of machines that consume less energy, the installation of solar panels, or the purchase of new energy-efficient cars. Davis and Lopez-Carr (2010) find that long-term remittances reduce the size of the households receiving them. This result is interesting in the sense that reducing household size can reduce energy consumption in general. More, Day and Içduygu (1999) observe that the conspicuous consumption of Turkish households with a migrant is higher than those without a family member abroad. Therefore, this behavior can have a significant effect on energy in general and CO_2 emissions in particular. Durand et al., (1996) find that in Latin American countries, remittances are used mainly for consumption.

Remittances also help to stimulate financial development. Accurately, an increase in remittance inflow prompts an increase in demand for financial services. Moreover, remittances can help small companies by offering capital and enhancing domestic investment, which further improves financial development. Many surveys have been conducted on "the effect of financial development on carbon emissions" (for instance, Ayeche et al. 2016; Farhani and Ozturk, 2015; Li et al., 2015; Mugableh, 2015). All these studies indicated that financial development raises carbon emissions. One can cite three potential factors explaining the impact of financial development on environmental deterioration: First, the enhancement of stock markets' performances to cut back on their financial expenses, expand credit channels, and operational risks, which accordingly makes companies able to improve finance, set up the latest resources, and strengthen their production volume, thus raising CO_2 emissions. Second, the development of the financial system attracts foreign direct investment to improve economic growth and to increase CO_2 emissions. Third, efficient financial intermediation is highly conducive to consumers' loan activities, which allows consumers to buy automobiles, houses, refrigerators, air conditioners, washing machines, etc., emitting more carbon dioxide and threatening the environment. Arguably, Ahmad et al. (2018) found that the positive component of financial development has a positive effect on CO_2 emissions.

Besides, remittances can lead to additional energy consumption, which can increase CO_2 emissions. In that context, Alam et al., (2011) show a positive relationship between energy consumption and CO_2 emissions. As remittances react to the evolution of oil prices (Makhlouf and Kasmaoui, 2017) and impact their consumption (Ahmad et al., 2018), and in turn CO_2 emissions, one can expect an indirect significant environmental impact of remittances. In Jamaica for the period 1976-2014, using the environmental Kuznets curve, Brown et al., (2020) estimate the impact of remittances on CO_2 emissions and find the same classical results of the Kuznets curve. Their main result shows that the relationship between remittances and CO_2 is the inverted U shape. They also find that in the short run there is an asymmetric response of CO_2 to remittances. The relationship between remittances and CO_2 emissions is not linear (Ahmad et al., 2019; Brown et al., 2020). In the case of Nepal, Sharma et al., (2019) find that in the long term there is a negative relationship between remittances and CO_2 emissions, while higher incomes increase CO_2 emissions.

This paper attempts to fill this gap in the existing literature by empirically investigating the effect of remittances on CO_2 emissions in a panel of 37 developing countries. The level of CO_2 emissions from developing countries has fast overcome that of developed countries (WDI, 2014). In fact, the amount of CO_2 emissions in developing countries from energy consumption has been significantly increasing over the last two decades due to the rapid growth of human populations and the increasing levels of urbanization and industrialization processes. The issue of climate change does not have the same resonance in developing countries as it does in developed countries. Our sample is especially interesting as most of these countries are getting drier with global warming, mainly attributed to population growth and rapid urbanization, which could eventually raise pollution levels. Moreover, remittances to developing countries are a major economic and social mainstay. They can amount to as much as around 40% of GDP (WDI, 2019). Due to the magnitude of these financial flows, governments in developing countries are integrating migrant remittances as part of their economic development agenda.

Importantly, it must be stressed at this stage that a major obstacle to studying the causal impacts of remittance inflows on CO_2 emissions is that remittances are potentially endogenous to environmental degradation. Omitted variables are a serious concern. To address this concern, we exploit variations in global per capita remittances to instrument for remittances received by each country. The results reveal that remittances positively contribute to environmental degradation. More specifically, we find that a one percent increase in the remittances' per capita ratio increases CO_2 emissions by 0.3 percent. Next, we document the mechanisms underlying the causal effect of remittances on CO_2 emissions. We robustly show that the positive effect of channels is through household consumption, private investment, urbanization, and importation.

The rest of this paper is organized as follows. Section 2 presents the review of literature. Section 3 introduces the data and describes the conducted methodology. Section 4 reports and discusses the main findings. Section 5 concludes and provides relevant policy implications.

2. Literature review

Recently, Rahaman and Islam (2024) analyze the relationship between remittances and energy consumption and pollution in 46 developing countries. Their study confirms the environmental Kuznets curve hypothesis. As regards the relationship between remittances and CO_2 emissions, their study shows a negative link, suggesting that remittances improve the environment by enabling recipient households to obtain financing for energy transitions. The link between remittances and the reduction of CO_2 emissions is the use of renewable energies. Awad et al., (2024), looking at the Sub-Saharan African region, find that remittances have a negative impact on long-term environmental quality. The authors suggest, however, that better institutional quality can mitigate the negative effects of remittances on the environment. In the same context, Agradi (2023) investigates whether remittances influence energy poverty, and shows that remittances reduce energy poverty, which can increase CO_2 emissions. In another context, analyzing the case of Pakistan (considered one of the largest remittance-receiving countries) Ahmad et al. (2022) find, for the period 1980-2018, that a positive shock from remittances contributes to pollution emissions. Khan et al. (2022) analyze the relationship between remittances and CO_2 emissions in G20 countries, and their results show that remittances indirectly increase CO_2 emissions, contributing to environmental pollution. However, this study includes developed countries, which, in our view, is not of sufficient interest from a remittance point of view. Examining possible links between remittances and carbon dioxide (CO_2) emissions in China using time series data from 1980 to 2014, Ahmad et al. (2019) show positive shocks to remittances are higher than negative shocks to remittances. Taking countries whose share of remittances in GDP is relatively high, Uche, E. (2022) finds that the remittances contribute to pollution and have a significant impact on environmental quality. The effect of remittances on CO_2 emissions can be mediated through economic growth, a result supported by Naseem et al., (2024), and similarly by Neog and Yadava (2020) in the case of India. In other words, a positive shock in remittances leads to an increase in CO_2 emissions.

3. Empirical strategy and data

This paper covers a panel of 37 developing countries over the period running between 1980 and 2014[1]. The variables required to isolate the effect of remittances on CO_2 emissions are standard. All data on variables are drawn from the World Bank database. Our dependent variable corresponds to CO_2 emissions (per capita). We follow the literature and consider the latter as our environmental degradation indicator. The interest variable, remittances, is defined as the sum of two components: personal transfers and compensation of employees. To account for heterogeneity in the demographic size of countries, we standardize our measure of remittances as the amounts of remittances per capita. Regarding the control variables, we consider a broad set of variables commonly employed in the literature (in particular, urbanization and trade openness). Descriptive statistics are provided in Table 1. We also show the evolution of CO_2 emissions per capita and remittances per capita between 1980 and 2014 in Figures 1 and 2. The increasing trend of CO_2 emissions over the whole period is shown in Figure 1. In Figure 2, we observe that per capita remittances diminished between 1980 and 2000[2], and it is only in the last two decades that the trend is growing.

Table 1: Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Carbon emissions	1,225	-.4481825	1.267061	-3.110603	2.300529
Remittanes per capita	1,083	.5781621	2.046612	-6.446126	4.583524
Urbanization	1,225	3.675015	.5153034	1.552021	4.514994
Trade openness	1,225	3.913902	.5108327	2.212206	5.006985
HH consumption	1,061	24.02346	1.635102	20.7084	28.05421
Investment	1,189	2.984225	.3297559	1.711844	4.492966
Imports	1,225	3.313065	.5371134	1.108484	4.590428
Financial development	1,216	3.156237	.7498105	.4796638	5.11502
Remittances per capita (World)	1,084	3.088194	.7725199	1.987674	4.535076

Note: All variables are in log (Source: WDI and authors' calculations)

[1] The classification of countries in terms of income follows the World Bank conventions.

[2] The decline in the ratio of remittances per capita between 1980 and 2000 can be explained by the population growth rate exceeding that of remittances. In addition, it should be noted that it is only starting in the 2000s that remittances are measured more precisely (Clemens and Mckenzie, 2014).

Figure 1 : CO_2 emissions (metric tons per capita) trend in developing countries

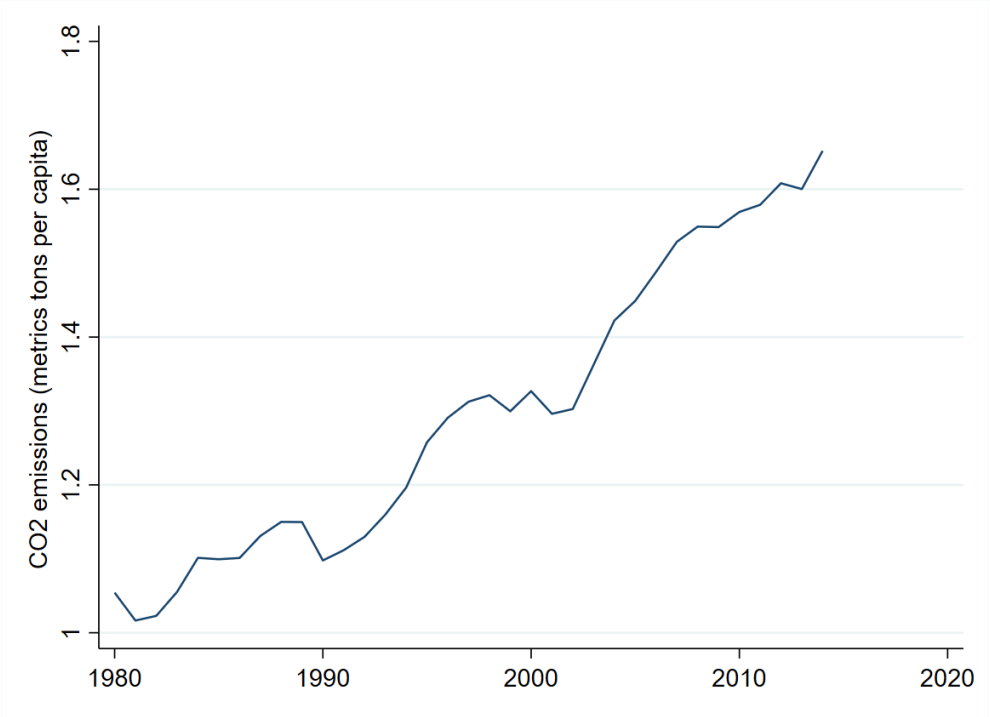
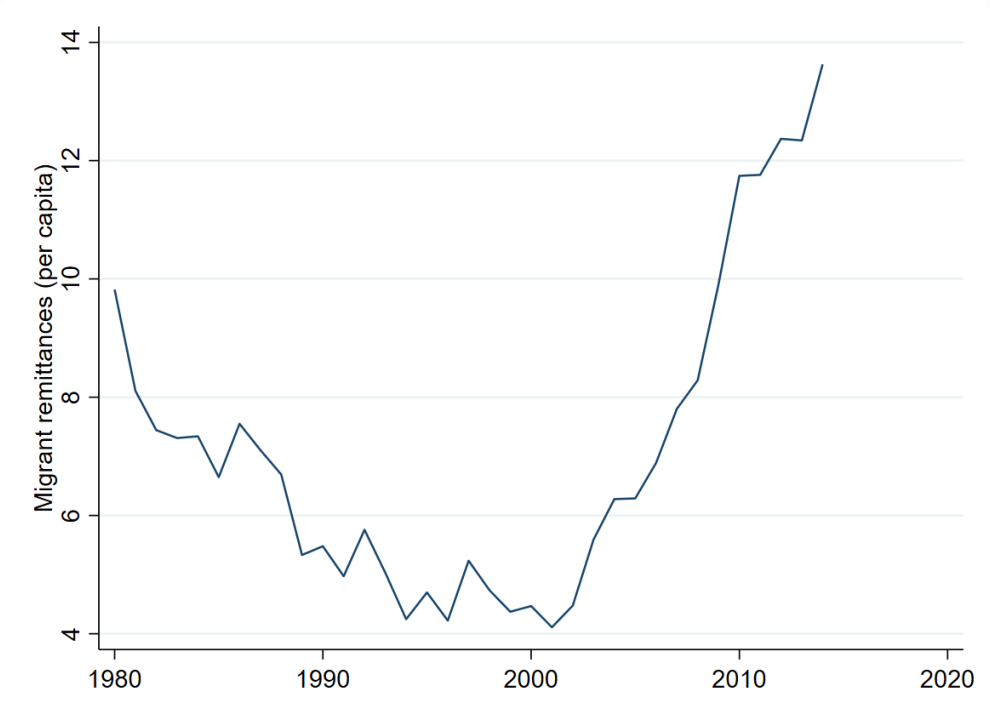


Figure 2 : Migrant remittances (per capita) evolution in developing countries



3.1 Empirical model

To investigate the effect of remittance flows on CO_2 emissions, we rely on the following regression model:

$$Y_{i,t} = \alpha_{it} + \beta X_{i,t} + \omega Z_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where $Y_{i,t}$ is the log of the per capita CO_2 emissions, $X_{i,t}$ is the log of remittances per capita. β, our coefficient of interest, captures the effect of remittances on CO_2 emissions. $Z_{i,t}$ represents the set of control variables previously reported which are urbanization and trade openness (all expressed in logs). Urbanization accounts for the effect of rural/urban migration and trade openness considers the role of trade in environmental pollution. α_{it} is a country-specific intercept and $\varepsilon_{i,t}$ is an error term that is normally and identically distributed (iid). The subscripts *i* and *t* are a country and a time index, respectively.

As a starting exercise, we estimate Eq.1 using an ordinary least square (OLS). In fact, under the assumption that remittances are exogenous, an OLS model would give unbiased estimate of the remittances effect. However, since the amounts of remittances may be linked to unobserved country-level confounders or may have encountered a reverse causality and measurement error issues, we expect that the estimates of the coefficient of interest, β, will be skewed using standard regression models and can no longer be given a causal interpretation. We effectively address this issue in the following.

3.2 Identification strategy

The identification of the remittances' impact on CO_2 emissions is plagued by the endogeneity of remittances. First, we may encounter the unobservable heterogeneity issue. There may be unobservable country-level factors that may jointly affect remittances and CO_2 emissions. This can arise because it is likely that high-carbon-emitting countries may receive large amounts of remittances. Second, there exists a reverse causality concern. Precisely, while remittances might impact CO_2 emissions, carbon emissions might also determine the level of remittances. In fact, it was recently documented in the literature that climatic factors affect migration (Beine and Parsons, 2015; Burzynski et al., 2018; Cattaneo et al., 2019). Climate change may lead to a reduction in income and therefore lead to an increase in migration flows. Increasing migration flows normally result in an overall increase of remittances. As a conclusion, CO_2 emissions may affect remittances. Finally, the third endogeneity source refers to measurement errors. The remittances considered in our study are those of the World Bank and only include remittances made through official - formal - channels. Hence, in such a case, the magnitude of remittances may be underestimated. The issue of unobservable heterogeneity may be appropriately solved by including country fixed effects. However, fixed effects cannot tackle the two other possible causes of endogeneity.

Our strategy consists, therefore, of estimating Eq. (1) by instrumentalizing the variable 'remittances'. To do so, we follow Gapen et al., (2009) and consider the amounts of remittances to the rest of the world as an exogenous variation of remittances received by each country. The underlying intuition is that an overall increase in remittances worldwide provides an explanation for the change in remittances within each country. In fact, as outlined by Gapen et al., (2009), this instrument permits us to capture the effects of lower transaction costs of remitting and further

systematic changes in the microeconomic determinants of remittances, as such changes are expected to increase remittances flow worldwide. As our variable of interest corresponds to remittances per capita, we employ more narrowly as an instrument the global remittances as a ratio of world GDP.

4. Results

4.1 Baseline estimates

This section presents the preliminary results when using the OLS estimator. Table 2 reports the correlation between remittances per capita and CO_2 emissions. The first column links remittances per capita and CO_2 emissions without any control variables. It shows that remittances may drive an increase in carbon emissions. The second column of Table 2 relates CO_2 emissions to remittances per capita, urbanization, and trade openness. The coefficient of the remittance variable is positive and statistically significant, meaning that as the remittances per capita ratio increases, carbon emissions may increase. A 10% increase in remittances per capita is associated with a 0.2% increase in CO_2 emissions. The third model (column 3) adds country fixed effects as an additional control to limit unobservable heterogeneity. We prefer this specification given that it increases the explanatory power of the model. The variable of interest remains significant, supporting the positive correlation between remittances and CO_2 emissions. We note that the environmental impact of remittances seems stronger in this case. An increase of about 10% in remittances per capita leads to a rise in CO_2 emissions of about 1%. Lastly, the coefficients associated with control variables have the expected sign. Specifically, urbanization and trade openness are positively correlated to CO_2 emissions.

Table 2: Baseline estimates

VARIABLES	(1) CO_2 emissions	(2) CO_2 emissions	(3) CO_2 emissions
Remittances per capita	0.115***	0.0220*	0.102***
	(0.0188)	(0.0132)	(0.00730)
Urbanization		1.907***	0.338***
		(0.0469)	(0.0501)
Trade Openness		-0.127**	0.284***
		(0.0534)	(0.0340)
Constant	-0.583***	-7.016***	-1.450***
	(0.0399)	(0.248)	(0.205)
Country FE	NO	NO	YES
Observations	1,083	1,083	1,083
R-squared	0.034	0.620	0.963

Standard errors in parentheses
***p<0.01, **p<0.05, *p<0.1
Model (1) links CO_2 emissions to remittances per capita without any controls. Model (2) includes controls. Model (3) adds country FE.

4.2 Estimation and discussion

The estimates we show in the last subsection cannot be interpreted as causal, as we discuss in subsection 2.2. The estimated association between remittances and CO_2 emissions may in some ways reflect an independent "third" variable effect. A further concern we discuss is the reverse causality between remittances per capita and carbon emissions, as well as the measurement error of the remittances variable. In this subsection, we display the estimates when addressing these issues by using an instrumental variable strategy. We will first discuss the first-stage results and subsequently the second-stage estimates.

Table 3: Instrumental Variables: Two-Stage Least Squares (2SLS

VARIABLES	(1) Remittances per capita	(2) CO_2 emissions	(3) Remittances per capita	(4) CO_2 emissions
Remittances per capita		0.380***		0.260***
		(0.0294)		(0.0295)
Global remittances per capita	0.380***		0.716***	
	(0.029)		(0.070)	
Urbanization			-1.527***	0.237***
			(.295)	(0.0859)
Trade Openness			0.410*	0.130**
			(0.236)	(0.0524)
Constant		0.838***		-0.546
		(0.0922)		(0.365)
Country FE	YES	YES	YES	YES
First-stage F-stat	145,21		103,98	
R-squared		0.911		0.946
Observations	1,083	1,083	1,083	1,083

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Model 1 (columns 1 and 2) links CO_2 emissions to remittances per capita with country FE and without controls. Model 2 (columns 3 and 4) adds controls.

First-stage results

Table 3 columns (1) and (3) report the results for the first-stage regression. The estimated effects of our instrument on remittances per capita are positive and highly significant, regardless of the specification (with or without controls). This implies that remittances at the global level account for the variation in remittances received for each country, mainly through cost reduction and transfer facility. Lastly, the first-stage F-statistic for the excluded instrument is higher than ten, indicating that the instrument is different from zero and therefore satisfies the instrument relevance[3].

Second-stage results

Table 3 columns (2) and (4) present the second-stage estimates. The coefficients reported in the first row represent the second-stage estimates of the effect of remittances per capita on carbon emissions. The estimates document a positive and significant effect of remittances on CO_2 emissions. In particular, we find that a one percent increase in remittances per capita increases CO_2 emissions by 0.3 percent. It is worth noting that the instrumental variable estimates are substantially larger than the FE-OLS estimates reported in Table 2. Thus, without addressing the endogeneity bias, the true effects of remittances per capita on carbon emissions are underestimated.

4.3 Mechanisms

The estimates discussed earlier support a positive and significant impact of remittances on carbon emissions. However, what are the channels through which the relationship occurs? We provide evidence for four potential channels through which the level of remittances may contribute to more carbon emissions and, in turn, cause more harm to the environment.

First, remittances may serve to relieve the household budget and enhance consumption (Combes and Ebeke, 2011; Dea and Rathab, 2012). Column 1 of Table 4 reports a positive association between remittances and household private consumption. The fact that household consumption increases suggests a rise in aggregate demand and hence additional carbon emissions (Ahmad et al., 2019). This is shown in Column 2.

Next, the second transmission channel helping to explain the relationship between remittances and CO_2 emissions is private investment. Remittances can in fact be allocated to investment purposes (Arif, 1999; Woodruff and Zenteno, 2007; Jena, 2018). Migrants may remit to invest in their country of origin. To further explore this mechanism, we regress private investment on remittances. The results are reported in Column 3 and indicate a positive relationship between remittances and private investment. Moreover, the latter appears to cause greater carbon emissions (Column 4).

Third, the relationship between remittances and pollution can be linked via imports. As remittances can be targeted to meet the consumption needs of recipient households, the latter may demand more goods. If domestic production cannot satisfy agents' domestic demand, the overall

[3] We may believe that remittances at the global level affect CO_2 emissions through other channels, in particular worldwide interactions among countries. This may imply that our instrument does not meet the exclusion criterion restriction. Two points: let us discard this potential threat. First, we have generated remittances at the global level by excluding remittances received by each country. Second, if the instrument affects CO_2 emissions, it will pass through the exchange of trade between countries. As we control in our model with trade openness, we capture the degree of exposure of countries to the rest of the world

supply/demand balance may be achieved by means of imports. In our case, we found a positive association between remittances and imports (Column 5). Also, previous empirical studies show that trade openness has an influence on CO_2 emissions (Hossain, 2011; Ren et al., 2014). We provide support for this evidence and find a positive and significant connection between imports (one of the components of trade openness) and carbon emissions (Column 6).

Lastly, urbanization may be one mechanism that accounts for the positive effect of remittances on environmental degradation. In fact, it is quite reasonable to believe that remittances allow rural households to migrate to urban areas (Column 7). It is also clear that urbanization contributes to environmental degradation with greater carbon emissions (Martinez-Zarzoso and Maruotti, 2011; Zhu et al., 2012; Sadorsky, 2014). Column 8 of Table 4 indicates a positive association between urbanization and CO_2 emissions.

Table 4: Mechanisms results (FE-OLS estimates)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	HH consumption	CO_2 emissions	Private investment	CO_2 emissions	Imports	CO_2 emissions	Urbanization	CO_2 emissions
Remittances per capita	0.129***		0.0311***		0.0667***		0.0281***	
	(0.0124)		(0.00713)		(0.0107)		(0.00522)	
HH consumption		0.512***						
		(0.0246)						
Private-investment				0.287***				
				(0.0390)				
Imports						0.430***		
						(0.0422)		
Urbanization								0.782***
								(0.0859)
Constant	24.34***	-11.36***	3.398***	0.163	3.238***	-0.273**	4.004***	-2.037***
	(0.0735)	(0.600)	(0.0304)	(0.131)	(0.0352)	(0.139)	(0.0414)	(0.349)
Country FE	YES	YES	YES	YES	YES	YES	YES	YES
Observations	948	1,061	1,053	1,189	1,083	1,225	1,083	1,225
R-squared	0.960	0.969	0.535	0.948	0.803	0.945	0.905	0.949

4.4 Robustness checks

We now investigate how various econometric specifications and sample data may change our estimates, which has a reflection on the robustness of the results. First, we replicate the analysis by excluding oil-producing countries, which are presumably the most polluting. The results are displayed in column 1 of Table 5. The estimates are unchanged. In column 2, we exclude India, the second largest emitter of CO_2 in 2017. The results show a positive and significant impact of remittances on CO_2 emissions.

Second, we re-estimate Eq. (1) by excluding countries that receive large amounts of remittances (with an average share of remittances in GDP above 5% and 10% respectively for the entire period examined). The results are shown in columns 3 and 4 and indicate a positive and significant association between remittances and carbon emissions.

Thirdly, it is plausible to assume that the relationship between remittances and carbon emissions is driven by country-level observable factors, like economic growth and financial development. If so, the effect we identify may be the effect of such factors omitted from Eq. (1). To look into this issue, we included GDP per capita and financial development as additional relevant control variables in our main specification. The results are shown in column 5 and support the previous estimates as well. In column 6, we also include the quadratic term of GDP per capita according to the Kuznets environmental curve. The results remain relatively stable.

Lastly, since the results discussed earlier are based on the identification of global remittances as a source of exogenous variation for remittances within each country, we use lagged remittances as instruments. In column 1, we employ as instruments the two and three period lagged values of per capita remittances. The results also demonstrate a positive effect of remittances on CO_2 emissions. Subsequently, in column 2, we examine the relationship using remittances with a lag of 4 to 5 periods as instruments. The results given in Table 6 remain consistent[4]. We also examine the instruments' validity using the Hansen test of over identifying restriction (J test). In both specifications, the Hansen test indicates that we cannot reject the validity of the instruments (p-values higher than 5%). A potential problem that may arise for these estimates is that the instruments may be correlated with unobserved confounders in the second stage. We assume that this is not the case in our regressions, as we include country fixed effects to capture the country-level unobservable factors that may affect CO_2 emissions.

[4] The first-stage results associated with these two specifications are available upon request.

Table 5: Robustness estimates - IV second-stage results

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	CO_2 emissions					
Remittances per capita	0.337***	0.263***	0.271***	0.258***	0.139***	0.172***
	(0.0477)	(0.0302)	(0.0398)	(0.0299)	(0.0397)	(0.0438)
Urbanization	0.141	0.225**	0.150*	0.144*	0.0143	0.0149
	(0.0984)	(0.0874)	(0.0838)	(0.0816)	(0.0669)	(0.0690)
Trade Openness	0.0874	0.177***	0.106	0.135**	0.0617	0.0589
	(0.0925)	(0.0522)	(0.0652)	(0.0535)	(0.0376)	(0.0412)
Financial Development					0.0482	0.0302
					(0.0294)	(0.0326)
GDP per capita					0.597***	1.358***
					(0.104)	(0.428)
GDP per capita SQ						-0.0564*
						(0.0293)
Constant	-0.930	-0.689**	-0.108	-0.191	-4.402***	-6.789***
	(0.601)	(0.351)	(0.375)	(0.343)	(0.820)	(1.626)
Country FE	YES	YES	YES	YES	YES	YES
Observations	877	1,048	849	984	1,074	1,074
R-squared	0.927	0.947	0.954	0.952	0.969	0.965

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Lags as instruments

	(1)	(2)
VARIABLES	CO_2 emissions	
Remittances per capita	0.132***	0.135***
	(0.0133)	(0.0216)
Urbanization	0.244***	0.204**
	(0.0908)	(0.0951)
Trade Openness	0.266***	0.261***
	(0.0403)	(0.0441)
Constant	-0.960***	-0.733*
	(0.341)	(0.391)
Country FE	YES	YES
First-stage F-stat	203.32	47.04
Hansen test, p-value	0.2693	0.6365
Observations	959	884
R-squared	0.966	0.970

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5. Conclusions and some policy implications

The objective of this paper was to study the impact of remittances on CO_2 emissions. Using historical data for a panel of developing countries, we found that, in general, remittances have an adverse effect on the environment. This result seems to be robust to changes in the number of countries and to the specifications considered. Remittances are rather used for energy-intensive goods. Governments of countries of emigration should channel remittances for appropriate use and, more interestingly, should focus on responsible, sustainable, and environmentally friendly financial expansion to prevent the detrimental consequences of remittances on carbon emissions. Our results also provide compelling evidence that the countries under study could gain from international trade, but this depends on the level of their integration in world trade. In general, the more trade circumstances liberalize, the more efforts are undertaken to meet international environmental standards for international trade and competition aims (Galeotti and Lanza, 1999). Trade liberalization reinforces the need for environmental cooperation and encourages the importation of less polluting techniques to promote clean production. Finally, remittances are widely perceived as one of the potential factors of financial development. Given this, governments should formulate lending policies in such a way that financial institutions lend money to firms that effectively follow environmentally friendly production processes. In such a context, the harmful impact of remittances can be mitigated. Moreover, governments should support the financial sectors to encourage investing in renewable energy sectors so that dependency on adverse sources of fossil fuels will be lessened. Overall, the results of this study are expected to be useful for providing a better understanding of the current environmental challenges and for identifying ways in which the adverse impacts of CO_2 emissions can be reduced. They may offer a new basis for discussion on the effective design and implementation of environmental and energy policies for developing countries.

Emigration countries can direct migrants' remittances towards sustainable projects by setting up specific programs and incentives. They could use tax leverage to enable migrants to choose to invest in projects that respect the environment or contribute to sustainable development. They could also set up platforms to help migrants invest in environmentally friendly businesses. Authorities in countries of the Global South should also invest in education and raise awareness of environmental issues among their populations in general.

Despite the relevance of our findings, this research has some limitations. Most notably, access to data was limited, and only annual data was available. The performed technique may offer distinct findings if the data set is expanded to reflect quarterly or monthly evolution. Also, while this paper brings interesting insights into the effects of remittances on pollution, micro-economic studies on the effects of remittances can supplement this work.

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