
PEER REVIEWED ARTICLE

Remittance flows and the environmental degradation-migration nexus

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Abstract

The net effect on the environment from migration into developed countries has received little attention in existing literature. Yet, this issue has important policy implications – e.g., nativists' support of anti-immigration policy for achieving pollution reduction targets. This research uses panel data for 127 countries from years 1971–2012 to analyse how migration affects greenhouse gas (GHG) emissions through remittance flows. The findings suggest higher remittances lead to lower GHG emissions. Further, the estimated decrease in GHG emissions more than compensates for any potential increase in global GHG emissions from migration into developed countries. These results suggest that pollution alone does not justify policies restricting immigration.

Keywords: environmental economics; migration policy; remittances; population growth

1. Introduction

The majority of migration occurs from people moving into developed² countries (United Nations, 2015). Cafaro and Götmark (2019), along with anti-immigration

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2 The development status of a country is determined using various metrics depending on the organisation. For consistency, this analysis uses income groups as classified by the World Bank (developed countries are considered upper middle-income and high-income).

organisations such as the Center for Immigration Studies and the Federation for American Immigration Reform, argue that population growth due to immigration hinders the ability to achieve pollution reduction targets. Weber and Sciubba (2018) agree that immigration increases the difficulty of reaching regional environmental goals, but admit limiting immigration is not a global solution to reducing pollution. In 2014, remittance flows were three times higher than official development assistance and more stable than foreign direct investment (FDI) flows (Ratha et al., 2016). How remittances affect GHG emissions in a specific country depends on several factors, including the level of economic development and stage of demographic transition. This study contributes to the existing literature by conducting an empirical investigation into the net effect of migration on global pollution levels.

The relation between remittance flows and the environment has received little attention in the literature, with no clear consensus. Heilmann (2006) discusses the relation between the environment, remittances and economic development and suggests there may be environmental benefits from migration. This paper builds upon Heilmann (2006) to show that migration, through remittance flows, may have net environmental benefits when considering global GHG emissions. Only a few empirical studies exist analysing the effect of remittance flows on the environment. Khan, Ahmad and Khan (2020) analyse remittances, FDI, income and energy consumption and find remittances are increasing CO₂ emissions in BRICS (Brazil, Russia, India, China and South Africa) countries. Conversely, Oldekop et al. (2018) conclude that remittances have environmental benefits such as accelerating the transition from deforestation to reforestation in several Global South countries. A notable issue is that these previous studies focus solely on the effect of remittances on pollution levels in the country of origin. Additional research is needed to generalise the role of remittances on pollution levels as the relationship is inconclusive in existing literature. This research contributes to filling this gap by showing that remittances have net positive environmental benefits through reduced GHG emissions.

In 2012, greenhouse gas (GHG) emissions per capita (in metric tons) were 5.9 for low and middle-income countries and 13.7 for high-income countries (World Bank, 2020a). If migrants assimilate into their host country and take on similar consumption patterns, then this implies an average increase in global GHG

emissions of 7.8 metric tons for each migrant (holding other factors constant). However, Ma and Hofmann (2019) and Price and Feldmeyer (2011) show that, in the case of the US, a higher concentration of foreign-born residents has no significant impact on certain GHG emissions. Further, Squalli (2010) found that US states with higher proportions of migrants were associated with lower levels for some GHG emissions. Additionally, assuming migration leads to higher emissions ignores any potential benefits on the countries of origin through the transmittance of both remittances and social norms of fertility preferences in the host country (Heilmann, 2006). The net effect of migration – the difference after migrants assimilate into their host country while accounting for any effect on the home country – on global GHG emissions is the more important concern and this study's contribution to the literature.

There is a vast literature on the relationship between economic growth and the environment, most notably that of the Environmental Kuznets Curve³ and IPAT⁴ equation. This study contributes to the literature by determining that migration alters the predictions of these models. Any model attempting to explain environmental impact must consider population beyond just size. Population cannot be used, on a national level, as a scaling factor since the composition of population matters. For example, population growth due to immigration may impact GHG emissions differently from domestic population growth. The possibility that migrants may affect global GHG emissions negatively – an environmental benefit – should be recognised in any future discourse on environmental quality related to immigration.

The paper is structured as follows. Section 2 discusses the literature on the environmental degradation – migration nexus. Section 3 describes the data and presents the empirical model specification. Section 4 provides an overview of the key results, robustness checks and an estimate of how migration impacts GHG emissions through remittance flows. Section 5 concludes with policy implications, potential caveats and future extensions of this work.

3 See, e.g., Atasoy, 2017; Franklin and Ruth, 2012; Rupasingha et al., 2004; York et al., 2003; List and Gallet, 1999; Grossman and Krueger 1995; Shafik and Bandyopadhyaya 1992; Meadows et al., 1972.

4 The IPAT equation, introduced by Ehrlich and Holdren (1971), postulates that Environmental Impact = Population X Affluence X Technology.

2. The Environmental Degradation-Migration Nexus

While there is considerable research on how social norms and remittances affect fertility rates, there has been less emphasis on how these factors influence the environment. What research does exist on the link between remittances and pollution is mixed. In examining relatives of migrants in highland Guatemala, Davis and Lopez-Carr (2010) argue that the decrease in fertility attributed to exposure to social norms of high-income countries does not offset the expected increase in consumption from receiving remittances. Further, Ahmad et al. (2019) find that increases in remittances led to increased CO₂ emissions in China. Conversely, Sharma, Bhattarai and Ahmed (2019) show, in the case of Nepal, that increases of remittances reduce CO₂ emissions. Clearly, a consensus on the relation between remittances and environmental quality has yet to be reached.

Ahmad et al. (2019) argue that remittances increase household consumption and savings, which in turn increases aggregate demand and bank savings. This increase in aggregate demand and improvement in the financial sector then leads to subsequent increases in industrial production (Ahmad et al., 2019). However, a number of studies have found that international remittances increase investment spending on education and on health in host countries (Gyimah-Brempong and Asiedu, 2015; Amega, 2018; Askarov and Doucouliagos, 2020). Adams (2006) argues, based on a survey of past research, that families receiving remittances typically have lower purchases of consumer goods and rather spend more on education than households not receiving remittances. Based on these studies I argue, contrary to Ahmad et al. (2019), that increases in consumption and savings from higher remittance flows do not necessarily lead to higher industrial production. Although there is ongoing debate about the effect of remittances on the home country, there is evidence which suggests remittances may reduce purchases of consumer goods, while also increasing investment in education.

Note that, although fertility rates have declined in middle-income countries, from 5.591 births per woman in 1960 to 2.333 in 2018, which is consistent with the demographic transition, for low-income countries the average remains at 4.506 as of 2018 (World Bank, 2020b). As previously discussed, remittances are often used for health and education services, both of which have been shown to lower fertility rates (Naufal and Vargas-Silva, 2009; Beine, Docquier and Schiff, 2013; Paul et al., 2019). The important question is if lower fertility rates – partially affected by the

transmission of social norms of high-income countries and increased spending on healthcare and education from remittances – offset any potential rise in per capita emissions of migrants once transitioning into their host country. Remittances can be used to gauge migrants’ attachment to their home country and as such to measure the transmission of social norms, including fertility preferences, to their home families – the logic being that migrants more connected to their home country will send higher levels of remittances (Naufal and Vargas-Silva, 2009; Davis and Lopez-Carr, 2010; Beine, Docquier and Schiff, 2013; Paul et al., 2019).

Based on the above literature, the assumption that the level of attachment of migrants to their home country is transmitted through remittance levels is maintained. In taking this approach, the short-term effect of remittances on GHG emissions is directly captured by the inclusion of total remittances. The inclusion of total population should capture any long-term effect on GHG emissions from exposure to social norms of lower preferred fertility rates. Although Ahmad et al. (2019) assume increased industrial production necessarily results in increased CO₂ emissions, this is not the case, as many factors, such as the technological level of the economy and energy sector, must be considered. For this reason, GHG emissions are used to better capture the effects on the economy more broadly and take into consideration the level of alternative energy used in the energy sector.

3. Data and Model

3.1 Data

The data is collected from the World Bank, World Development Indicators database, and includes annual data for 127 countries over the time period 1971–2012.⁵ GHG emissions, in kilotons (kt) of CO₂ equivalent, are used as a measure of economy-wide environmental impact and Gross National Income (GNI), in constant 2010 US dollars, as a measure of wealth. Total energy use, in kilograms of oil equivalent, is included to capture growth in the manufacturing and transportation sectors, as well as urban growth and the relative price of energy. Alternative energy use, as a percentage of total energy, is used as a measure

5 Annual data for 217 countries for the period 1960–2019 were collected from the World Bank. However, due to missing data on some of the key variables in the analysis, the sample used to estimate the preferred empirical specification (see section 4.1) includes only 127 countries over the time period 1971–2012 (see Table 2).

of technological advancement in the economy. The dataset includes 2,858 observations and the unit of observation is country-year. Additional information is listed in the summary statistics in Table 1.

The main variable of interest is personal remittances received. Remittances are predicted to have a negative effect on GHG emissions, since higher (lower) levels of remittances will increase (decrease) the amount spent on healthcare and education which ultimately influences consumption spending. In addition, this spending on improving healthcare and education ultimately affects fertility rates, and thus remittances account for some proportion of the long-term reduction in population growth. Although total population is included, the interaction between remittances and population is beyond the scope of this paper. Nonetheless, population is expected to have a positive coefficient, and though the proportional effect is not directly measured, lower population growth would lead to lower GHG emissions. Therefore, in the long-term remittances are expected to reduce GHG emissions.

As Ma and Hofmann, (2019), Price and Feldmeyer (2011), and Squalli (2010) show, areas with a higher percentage of migrants have either similar, or lower, levels of GHG emissions. Then the worst possible case, regarding GHG emissions, is that migrants fully assimilate into their host country with comparable per capita emissions. In this worst-case scenario the average per capita increase in GHG emissions for each migrant moving from low and middle-income to high-income countries is 7.8 (World Bank, 2020a). In section 4.3, I perform a back-of-the-envelope calculation of the effect of migration, through remittance flows, on GHG emissions to determine if potential environmental benefits on the country of origin offset this worst-case increase in GHG emissions.

3.2 Model Specification

The following empirical model is specified, which is estimated using country and time fixed effects with cluster-robust standard errors:

$$\begin{aligned} \ln GHG_{it} = & \alpha_i + \phi_t + \beta_1 \ln REM_{it} + \beta_2 \ln GNI_{it} + \beta_3 \ln ENG_{it} \\ & + \beta_4 \ln POP_{it} + \beta_5 ALT_{it} + \varepsilon_{it}. \end{aligned} \quad (1)$$

In the above model, $\ln GHG_{it}$ denotes the natural log of total greenhouse gas emissions in kt of CO₂ equivalent for country i in year t . α_i and \varnothing_t are the country and year fixed effects, respectively. $\ln REM_{it}$ is the natural log of total remittances in current US dollars, $\ln GNI_{it}$ is the natural log of gross national income in constant 2010 US dollars, $\ln ENG_{it}$ is the natural log of energy use kilogram of oil equivalent, $\ln POP_{it}$ is the natural log of total population, ALT_{it} is the level of alternative energy (as percentage of total energy use), and is an idiosyncratic error term.

4. Empirical Analysis

4.1 Results

Regression output from the estimation of model (1) is presented in Table 3.⁶ Five separate specifications of the model are estimated with the natural log of GHG as the dependent variable. Specification I includes the natural log of total remittances as the independent variable, specification II adds the natural log of GNI, specification III adds the natural log of total energy use in the economy, specification IV adds the natural log of total population, and specification V adds the percentage of alternative energy use. Specification V is the preferred model since the key indicators impacting pollution, as posited by the IPAT equation, are accounted for and the R-squared statistic suggests using this specification. The estimated coefficients for remittances and income, β_1 and β_2 , are negative and positive, respectively, and statistically significant. These results indicate that higher (lower) income increases (decreases) GHG emissions, while higher (lower) remittance flows decrease (increase) GHG emissions, as expected. The remaining coefficients are each statistically significant and have the expected effect, β_3 and β_4 are positive, while β_5 is negative.

In the preferred specification, the estimated coefficient, β_1 , indicates a one per cent increase in annual remittances in an average country in the sample results in a decrease in GHG emissions of approximately .042 per cent. While this change initially appears small, note that remittance flows account for about four per cent of global Gross Domestic Product (GDP) and migrants are only around two per cent of the world population (World Bank, 2020a). Further, a small percentage

6 The augmented Dickey-Fuller unit root test is employed to check for stationarity and results suggest all included variables are I(0). The Hausmann test, F test and Breusch-Godfrey/Wooldridge tests indicate using fixed effects and clustered standard errors.

change can have important real-world implications when considering GHG emissions, as will be demonstrated in section 4.3.

4.2 Robustness Checks

The income classification groups, low and middle-income and high-income, are estimated separately using model (1) and reported in Table 4.⁷ More specifically, specification VI estimates model (1) including only low and middle-income countries, while specification VII includes only low and middle-income countries and removes total energy use and percentage of alternative energy use. Specification VIII estimates model (1) including only high-income countries, and specification IX estimates model includes the additional independent variable of FDI as a percentage of GDP. The main interest is on β_1 , which is found to remain statistically significant, and negative, in all robustness checks. Further, the magnitude of β_1 remains similar across each specification, though it drops more noticeably in specification VIII, which is expected for high-income countries.⁸ In specification VI, β_3 and β_5 , are not statistically significant, while β_2 , and β_4 remain statistically significant. Further, when removing the energy related variables from model (1), which is specification VII, β_4 is noticeably higher. For the high-income countries the estimated coefficients remain statistically significant except β_2 . In addition, β_3 becomes markedly higher. There are no substantial changes to the estimated coefficients for remittances or GNI. These results suggest that population, along with GNI and remittance flows, have significant impact on GHG emissions in low and middle-income countries, while total energy use and percentage of alternative energy are more influential in high-income countries.

The amount of foreign investment flowing into a country has many possible economic implications, such as altering the types of manufacturing and pollution intensity of production processes. The inclusion of FDI in specification IX

7 Due to lack of observations for the low-income group, low and middle-income grouped are combined for this estimation.

8 Although classified as high-income, some countries may still be considered developing economies (World Bank, 2020a). That β_1 drops to -0.025 and remains statistically significant for the high-income group is expected given the included countries.

acknowledges the pollution haven, and halo, hypotheses⁹ which may impact GHG emissions. This robustness check confirms the results of model (1) and the output is reported in Table 4. There are no substantial differences to report on the previously included variables. For FDI, the estimated coefficient, β_6 , is approximately zero and not statistically significant. I note the validity of the pollution haven, or halo, hypotheses is beyond the scope of this paper and these results should not be interpreted as evidence for either case.

4.3 The Impact of Migration on GHG Emissions

The average number of migrants for the 127 countries included in the sample is approximately 1.1 million, with average annual remittance flows of about 1.7 billion. Thus, the annual amount of remittances per migrant is around 1,500 US dollars, accounting for 0.00009 per cent of average annual remittance flows.

Using the preferred estimate of β_1 , -0.042, I conduct a back-of-the-envelope calculation to capture the potential effect of migration on GHG emissions through the corresponding expected change in remittance flows. The percentage change in remittance flows from restricting one migrant is multiplied with β_1 to obtain the estimated effect on GHG emissions. The result implies that an increase of 0.0000038 per cent in average GHG emissions for the sample countries, or about 360 thousand kilotons, yields an increase in GHG emissions of approximately .0137 kilotons, or 13.7 metric tons. Recall that the worst-case increase from migration is 7.8 metric tons per migrant, which is clearly lower than the estimated increase from restricting one migrant due to the loss of remittance flows.

5. Conclusion and Policy Implications

The results suggest that remittances are not merely treated as additional income, but rather allocated in such a way that GHG emissions are reduced if remittances are increased. This conclusion supports the claim that increased remittance flows likely increase expenditure on healthcare and education, rather than increasing consumer spending on consumption goods. Further, there is no indication that

9 The pollution haven hypothesis posits that firms may shift production of certain goods to less developed regions to take advantage of fewer environmental regulations and lower production costs (Garsous and Koçluk, 2017). Conversely, the pollution halo hypothesis suggests that more efficient technology, introduced as a result of foreign investment, ultimately improves environmental quality (Balsalobre-Lorente, D., Gokmenoglu, K.K., Taspinar, 2019).

increased remittance flows necessarily lead to higher industrial production due to increased aggregate savings. Also, note that increased industrial production does not strictly imply an increase in air emissions, as the level of technology used in the economy plays a large role in this outcome. As discussed earlier, the pollution haven, or halo, hypotheses are beyond the scope of this paper, but investigating the role of remittance flows in the context of industrial production and technological knowledge transfer between migrant's home and host countries is a potential extension of this work.

The estimation of migration's impact on GHG emissions through remittance flows in section 4.3 does not consider migration from low-income into middle-income countries. However, most international migration occurs from low and middle-income countries to high-income countries (United Nations, 2015). If immigration into high-income countries is restricted, then migration from low to middle-income countries is likely to increase. As per capita emissions are least in low-income countries, then an increase in GHG emissions from this migration is still expected. Additionally, remittance flows are averaged over the sample period and the data suggest that remittance flows have increased substantially in recent years. For example, annual remittance flows from high-income countries have recently been over 1,800 dollars per migrant, whereas annual amounts were barely above 100 dollars per migrant in 1970 (adjusted to constant 2010 US dollars). Still, continued growth in annual remittance flows should not affect the results since, if the amount of annual remittances increases, restricting immigration and thus reducing remittances, would then have a larger effect on GHG emissions. The International Monetary Fund (IMF) estimates the value of unofficial remittances to be at least 150 per cent of the official remittance flows (Ratha, 2020). Considering this underestimate of remittance flows, the impact on GHG emissions in the analysis is likely an underestimate.

In recent years, there has been increasing political debate on limiting immigration in many high-income countries (e.g., the US and Germany which host the first and second highest migrant populations, respectively). Further, the use of alternative energy since 2015 has noticeably increased. Unfortunately, due to the lack of availability the data from these trends are not included in the analysis. However, these recent trends suggest that more research is needed as the environmental degradation – migration nexus continues to increase in relevance to public policy.

The ambiguity in previous research on migration and pollution has many policy implications. For example, if policymakers assume that immigration in high-income countries raises global pollution levels, then anti-immigration policies could be argued for to help achieve environmental and sustainability targets. The analysis shows the positive benefit of remittance flows on the environment, through lowering GHG emissions, outweighs any potential increase in GHG emissions caused by migration into high-income countries. These findings suggest that limiting immigration on the grounds of reducing pollution is misguided.

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Appendix

Table 1. Summary Statistics

Variable	Mean	Std. Dev	Min	Max
Greenhouse gas emissions (1,000s of kilotons)	360	1000	1.6	1200
Remittances (billions current US dollars)	1.71	3.9	.000006	68.8
Gross National Income (billions 2010 US dollars)	490	1430	1.44	1570
Energy Use (billions of kilotons)	91.3	281	.598	2910
Alternative energy (% total energy)	7.25	9.82	0	55.58
Population (1,000,000s)	51.2	152	.318	1350

Table 2. Countries in Sample

Low Income	Lower Middle Income	Higher Middle Income	High Income
Mozambique	Vietnam	Turkmenistan	Hungary
Congo, Dem. Rep.	Senegal	Botswana	Estonia
Ethiopia	Sudan	Namibia	Cyprus
Niger	Cote d'Ivoire	Colombia	Trinidad and Tobago
Bangladesh	Ghana	Mauritius	Portugal
Cambodia	Cameroon	Jamaica	Oman
Nepal	Yemen, Rep.	Bosnia and Herzegovina	Czech Republic
Togo	Nicaragua	Iraq	Malta
Tanzania	Zambia	Iran, Islamic Rep.	Saudi Arabia
Eritrea	Sri Lanka	Panama	Israel
India	Uzbekistan	Bulgaria	Greece

Low Income	Lower Middle Income	Higher Middle Income	High Income
Kyrgyz Republic	Bolivia	Costa Rica	Slovenia
Haiti	Nigeria	Malaysia	Spain
Tajikistan	Honduras	Lebanon	New Zealand
Kenya	Egypt, Arab Rep.	Kazakhstan	Hong Kong SAR, China
Pakistan	Philippines	South Africa	Italy
Zimbabwe	Morocco	Romania	Germany
Benin	Moldova	Chile	Finland
Myanmar	Armenia	Argentina	France
	Ukraine	Russian Federation	Austria
	Mongolia	Turkey	United Kingdom
	Azerbaijan	Mexico	Belgium
	Guatemala	Brazil	Iceland
	China	Latvia	Australia
	Tunisia	Poland	Netherlands
	Congo, Rep.	Uruguay	Sweden
	Thailand	Korea, Rep.	Japan
	El Salvador	Gabon	United States
	Jordan	Lithuania	Ireland
	Dominican Republic	Croatia	Canada
	Indonesia	Slovak Republic	Kuwait
	Angola	Venezuela	Denmark
	Peru		Qatar
	Georgia		Norway
	Paraguay		Switzerland
	Belarus		Luxembourg
	Algeria		

Low Income	Lower Middle Income	Higher Middle Income	High Income
	Ecuador		
	North Macedonia		
	Albania		

Notes: Total of 127 countries, grouped by 2012 World Bank income classifications, GNI per capita: Low: less than \$1,025; Lower Middle: \$1,026 to \$4,035. Upper Middle: \$4,036 to \$12,475; High: above \$12,475.

Table 3. Regression Output

Variable	Specification				
	(I)	(II)	(III)	(IV)	(V)
Remittances	0.098*** (0.013)	-0.023+ (0.013)	-0.034* (0.014)	-0.044** (0.015)	-0.042** (0.015)
GNI		0.705*** (0.057)	0.360** (0.126)	0.326** (0.115)	0.352** (0.114)
Energy Use			0.462 *** (0.130)	(0.103) 0.261*	0.278* (0.131)
Population				0.512* (0.231)	0.493* (0.233)
Alternative Energy					-0.008** (0.003)
Constant	8.553*** (0.234)	-5.875*** (1.489)	-7.879*** (2.487)	-10.910*** (1.277)	-10.849*** (2.511)
Country Fixed Effects	yes	yes	yes	yes	yes
Year Fixed Effects	yes	yes	yes	yes	yes
R ²	0.26	0.75	0.82	0.87	0.87
N countries	177	165	136	136	127
N observations	4,663	3,219	2,890	2,890	2,858

Notes: Dependent variable is the natural log of GHG emissions. Unit of observation is country-year. Robust standard errors, clustered by country, are shown in parentheses. + p<0.1; * p<0.05; ** p<0.01; *** p<0.001.

Table 4. Robustness Checks

Variable	Specification			
	(VI)	(VII)	(VIII)	(IX)
Remittances	-0.040* (0.019)	-0.030* (0.014)	-0.025* (0.014)	-0.042** (0.015)
GNI	0.469*** (0.141)	0.449*** (0.087)	-0.061 (0.104)	0.354** (0.114)
Energy Use	0.114 (0.158)		0.743 *** (0.101)	0.259+ (0.131)
Population	0.528+ (0.066)	0.700*** (0.195)	0.435+ (0.222)	0.494* (0.036)
Alternative Energy	0.006 (0.012)		-0.008** (0.003)	-0.008*** (0.003)
FDI				0.000 (0.000)
Constant	-10.904*** (3.026)	-10.812*** (0.000)	-11.186*** (2.970)	-10.845*** (0.000)
Country Fixed Effects	yes	yes	yes	yes
Year Fixed Effects	yes	yes	yes	yes
R ²	0.79	0.83	0.97	0.87
N countries	80	116	47	127
N observations	1,763	2,121	1,095	2,847

Notes: Dependent variable is the natural log of GHG emissions. Unit of observation is country-year. Robust standard errors, clustered by country, are shown in parentheses. + p<0.1; * p<0.05; ** p<0.01; *** p<.001.