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How do transaction costs influence remittances?☆

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ABSTRACT

Using a new quarterly panel database on remittances, this paper investigates the elasticity of remittances to transaction costs using local projections. The findings suggest that cost reductions have a short-term positive impact on remittances within a quarter, before they stabilize at a higher level. According to our estimates, reducing transaction costs to the Sustainable Development Goal target of 3 percent could generate an additional US$32bn in remittances, higher than the direct cost savings from lower transaction costs, thus suggesting an absolute elasticity greater than one. The cost-elasticity exhibits some heterogeneity along several characteristics of the recipient country, notably competition in the remittance market, financial sector deepening, correspondent banking relationships, transparency in remittance costs, financial literacy and ICT development. Micro data from the USA-Mexico corridor confirm that migrants facing higher transaction costs tend to remit less, and that this effect is less pronounced for skilled migrants and those that have access to a bank account.

1. Introduction

Remittances matter for development. They are a key source of funding for developing countries. Migrants send part of their earnings to family members to provide them with basic subsistence and invest in the economy back home. According to World Bank data, remittances to low- and middle-income countries more than doubled during the past 15 years to reach US$550 billion in 2021. Over half of it reaches people in rural areas, and about 75 percent is used to cover basics such as food and medical or school expenses, while the remaining is invested in assets or saved (IFAD, 2021).

Being a major source of income for the poorest households, policy-makers in advanced and developing countries are looking at avenues to encourage remittance flows to grow even further. However, a major stumbling block in sending money home is the high—one could argue excessive—transaction costs involved. Despite the commitments from the international community to reduce the cost of remittances, and the inclusion of the 3 percent cost target in the Sustainable Development Goals (SDGs), progress has been slow in recent years.[1] The strong resilience of remittances during the COVID-19 pandemic has brought back to the forefront the debate surrounding the stubbornly high transaction costs (see Kpodar et al., 2021).

It is accepted wisdom that individuals sending money home in many parts of the world, particularly sub-Saharan Africa, are paying a very high cost, which may dissuade further flows. Considering fees, exchange rate margin and other costs, between 5 and 15 percent of remittances are "lost" due to high transaction costs, depending on the country and the amounts sent home (Ratha, 2021). Because formal remittances involve high fixed costs and hence are expensive to provide, low-income individuals refrain from remitting, or are incentivized to use cheaper informal alternatives (Gibson, McKenzie and Rohorua, 2006; Yang, 2011). Against this backdrop, this paper attempts to address the following questions: How elastic are remittances to changes in transaction costs? And what are the factors or policy interventions that may help explain cross-country differences in the cost elasticity of remittances?

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[1] The SDGs include the objective to "by 2030, reduce to less than 3 percent the transaction costs of migrant remittances and eliminate remittance corridors with costs higher than 5 percent" (SDG 10.C).

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This paper is related to several strands of the literature. First, a large body of work looks at the impact of remittances at the macroeconomic and microeconomic levels. Many studies find that remittances stimulate growth, although no broad consensus exists yet on that matter (see *meta*-analysis of Cazachevicia, Havraneka, and Horvath, 2020, and Clemens and McKenzie, 2018 for recent discussions). This favorable impact builds on the premise that remittances are an important source of development financing, a significant source of international reserves, and often arrive countercyclically. At the micro-level, remittances respond to income shortfalls and, in that way, have the potential to smooth households' income, thereby reducing risks to the family (Choi and Yang, 2007). Remittances are also linked to improved economic, health and education outcomes as well as higher financial inclusion. Recent work by Khanna et al. (2022) on the Philippines, which better identifies remittances, illustrates that shocks to migrant incomes magnify in the longer run, leading to substantial increases in incomes in the domestic economy in migration-origin areas, including through better education. Similarly, Dinkelman and Mariotti (2016) using newly digitized census and administrative data on access to mine jobs in South Africa show the causal effect of remittances from South African mine workers largely explains Malawi's structural transformation away from non-farm employment (see also Dinkelman et al., 2022).

However, there are also potentially some deleterious effects observable at the macroeconomic level (Chami, Fullenkamp, and Jahjah, 2003). Besides producing Dutch Disease-type effects, potentially reducing the quality of institutions, or delaying needed fiscal adjustment, remittances may also complicate the monetary transmission mechanism, making monetary policy harder. There is also evidence that remittances may breed dependency by discouraging receiving household members from working, possibly trapping countries into anemic long-run growth (see Amuedo-Dorantes, 2014, for a summary).

Second, a narrow set of studies investigates the determinants of remittance transaction costs. For instance, Freund and Spatafora (2008) use cross-country data for 66 countries and find that recorded remittances depend positively on stocks of migrants and negatively on transaction costs and exchange rate restrictions. Transaction costs are also lower when financial systems are more developed, and exchange rates are less volatile. Similarly, Beck and Martinez Peria (2011) conclude, based on a dataset covering 119 country corridors, that the size of the migrant population, banking competition and lower barriers to access banking services are conducive to lower remittance costs. More recently, Beck, Janfils, and Kpodar (2022) exploit a richer remittance cost dataset to show that cost- and risk-based constraints as well as market structure hinder affordable remittance transaction costs. Corridor and firm-specific analysis reveals that higher income per capita, easier geographical access to financial institutions, larger remittance market, shorter distance between sending and receiving countries, competition in the remittance market, and pegged exchange rate regime are associated with lower transaction costs. In the same vein, da Silva Filho (2021) underscores that the drivers of remittance costs are multiple and complex, with regulatory issues (such as exclusivity clauses, stringent AML/CFT regulation, and restrictive licensing), a lack of price transparency, a higher number of banks and a thin remittance market being likely to have detrimental effects on remittance costs.

Third, several selected studies focus on the cost elasticity of remittances. These range from cross-country and panel studies (e.g.; Freund and Spatafora, 2008, Ahmed, Mughal, and Martínez-Zarzoso, 2021) to country-specific studies (Ferriani and Oddo, 2019, on migrants in Italy; Kosse and Vermeulen, 2014, on migrants in the Netherlands; Kakhkharova, Akimovb, and Rohdeb (2017) on migrants in Russia; Ahmed and Martínez-Zarzoso, 2016, on migrants from Pakistan; and Gibson, McKenzie, and Rohorua (2006) on migrants from Tonga). Overall, these studies document a significant and negative effect of transaction costs on formal remittance inflows, partly due to high transaction costs encouraging informal remittances. Nevertheless, these studies do not go beyond the cost elasticity estimate to investigate how this varies across countries with different characteristics.

In this paper, we improve on existing studies along several dimensions. First, we exploit a new quarterly database on remittances, allowing us to investigate the elasticity of remittances to cost with high-frequency data in a dynamic setting using local projections (Jorda, 2005). As such, this paper sheds light on the short- and medium-term impact of a shock to transaction costs on remittances and how persistent this effect might be. Second, unlike previous studies, this paper undertakes a systematic analysis of factors that can shape the cost elasticity of remittances. One should note that we are not taking a view on whether having a low-cost elasticity to remittances is good—a low elasticity implies less reduction in remittance flows when transaction costs increase, but also a lower increase in remittances occurs when transaction costs are reduced. The reason to focus on elasticities is that a lower elasticity will imply that fewer remittances flow informally, migrants can easily identify the lowest cost options or remittance costs are sufficiently low to become a less binding constraint.

Two broad categories of factors/policies are considered: (i) cost-mitigation policies that directly tackle the root causes of high remittance costs (e.g. policies to promote competition in the remittance market, foster financial sector development, and safeguard correspondent banking relationships) and (ii) cost-adaptation policies that do not primarily address the cost of remittances, but promote more efficient remittance choices (e.g. policies to enhance price transparency, financial literacy and information and communication technologies (ICT) development). Third, this paper uses microdata from the USA-Mexico corridor to ascertain the cost elasticity of remittances and their heterogeneity with respect to financial literacy, thus providing more granular results to support the evidence found at the macro level. Studying the USA-Mexico corridor is noteworthy from several standpoints. It is the largest corridor in the world; has several remittance service providers with a large array of products; and has in-depth publicly available data.

With a sample covering 71 countries over the period 2011Q1-2020Q4, the findings suggest that a 10 percent reduction in transaction costs leads to a 0.9 percent increase in remittances received in the first quarter after the shock, with the impact becoming statistically insignificant from zero in subsequent quarters. This implies that the response of remittances from a decline in transaction costs is essentially of a short-term nature, but remittance levels reach a new higher steady state. This result suggests that moving from the 2020 level of transaction costs (6.3 percent) to the SDG target of 3 percent will generate an additional US $32 billion in remittances, much larger than the direct cost savings. Put differently, migrants would not only fully pass on the cost savings to their families, but also send more, implying that the absolute elasticity of remittances received to remittance cost reductions is greater than one. The results are robust to an instrumental variable approach.

In investigating the cost-mitigation and adaptation factors, this paper finds that the elasticity of remittance to transaction costs is much lower in countries where competition in the remittance market is high, the financial system is developed, and ties with correspondent banks holds up. This indicates that remittances are less sensitive to transaction costs where alternative informal channels for the repatriation of money exist. Likewise, less opaque remittance transaction costs, improved financial literacy and higher ICT development (along its multiple dimensions: ICT use, access, capability and affordability) help explain why some countries may have a lower cost-elasticity of remittances. Finally, evidence from the USA-Mexico corridor, using an annual survey of the Bank of Mexico during 2013–2017 and covering over 37,000 individuals, confirms that migrants who face higher transaction costs tend to remit less, even after controlling for socio-economic characteristics. More importantly, education level or access to a bank account, a proxy of financial literacy, mitigates the cost-elasticity of remittances, consistent with the findings from the panel data.

The paper is structured as follows. Section II presents data and some stylized facts on remittances and transaction costs and lays out the empirical model and methodology employed. Section III discusses the

key results of the paper, with additional findings relegated to the annexes, while Section IV concludes with some policy recommendations.

2. Data and empirical strategy

2.1. A. Cost of remittances and remittance flow data

The most authoritative source on remittance cost data is the "Remittance Prices Worldwide" dataset compiled by the World Bank. This database provides information on 365 corridors (consisting of a combination of 48 sending and 105 receiving countries) and by remittance service provider regarding the fee paid by the sender for sending the equivalent of US$200 and US$500 in local currency. It also contains the exchange rate applied to the transaction, if available, the type of the remittance service provider (e.g., Money Transfer Operator-MTO), the time it takes for the money to become available to the receiver, the payment instrument that can be used by the sender and the form of the payment to the receiver (e.g. cash to cash) as well as the access point for the remittance service. The data are available on a quarterly basis from 2011Q1 onwards. In the analysis below, the remittance cost as a share of the amount transferred averaged at the country level is the main variable of interest.[2]

In addition, the World Bank also compiles a database on remittance inflows covering 215 countries and territories going back to the 1980s. This database is, however, carried out on an annual basis, and therefore does not allow to exploit the quarterly variations in the cost of remittances. Moreover, one would expect remittance flows to respond sharply to short-term variations in transaction costs, which annual data can fail to capture or may "over smooth". To address this issue, we construct, as discussed below, a new and unique dataset of quarterly remittance flows for a sample of 95 countries, consisting of 18 high-income countries, 62 middle-income countries and 15 low-income countries. The data run from 1971Q1 for a handful of countries through 2020Q4 for most countries.[3]

The new quarterly remittance database builds on the monthly dataset from Kpodar et al. (2021). The approach used in this paper is similar, with the main sources being the detailed balance of payments (BOP) and statistical notes published by national central banks and statistical institutes. For some countries, data are reported in local currency or a different currency than the US dollar, in which case, we use the quarterly average exchange rate from the IMF's International Financial Statistics (IFS) database or relevant central banks to convert the remittance flows into US dollars. The compilation of the remittance data follows an internationally accepted definition whereby remittances are the sum of personal transfers and compensation of employees.[4] For countries that do not report personal transfers in their BOP, data on workers' remittances have been used instead as a proxy. When data compensation of employers is missing, they are not accounted for given that these flows are typically marginal compared to the size of personal transfers (on some measurement issues with remittances, see Clemens and McKenzie, 2018).

The combination of the quarterly remittance flow and cost data results in a sample of 71 countries, covering a period from 2011Q1 to 2020Q4 (Annex 1 provides the sample composition). The other variables in the model will be discussed in the subsequent sections as they are brought into the model specification.

2.2. Stylized facts on remittance costs

Fig. 1 illustrates the average fee as a percent of a remittance of US $200 by country during the period 2011Q1 to 2020Q4. The costs for migrants to send money across borders are extremely expensive in southern Africa (e.g. Angola, Botswana and Namibia), where they reached more than 2.5 times the sample average (7.5 percent), often due to high exchange rate margins. Small islands also exhibit high remittance costs, probably reflecting a lack of economy of scale and limited integration into the international financial system. At the other end of the spectrum, the lowest costs are prevalent in Eastern Europe. In between, a wide range of countries at different levels of development exist, with different corridor-specific characteristics.

While remaining high, remittance costs have declined on average by about 5 percent during a five-year period (2016Q1-2020Q1). But this picture masks significant heterogeneity across countries (Fig. 2). Even though more countries have recorded a decrease than an increase in fees, the magnitudes are striking. Remittance costs increased by more than 40 percent in the Gambia, Afghanistan, and the Kyrgyz Republic, albeit from a lower starting point for the latter. The large increase in remittance costs in these countries was mainly driven by higher exchange rate margins on the back of volatile and depreciating currencies. On the other hand, many countries such as Latvia managed to achieve a significant reduction in remittance costs, probably due to adopting the euro in 2014 which reduced the exchange rate risk (and eliminated it for migrants working in the eurozone), enhanced competition and the rise of digital remittances. Nonetheless, the decline in costs observed in Lesotho and Eswatini was temporary, as it reflected the reduction in fees implemented by South African banks to provide relief to customers early in the pandemic.

Looking at the developments in remittance costs over a decade (2011–20), the 5 percent decline in the second half of the period was modest relative to the large reduction achieved in the first half of the period (Fig. 3). While further analysis is required to uncover the factors behind this large decline, including the role of competition, it seems to have coincided with the narrowing of the interest spread, a proxy of financial intermediation cost (associated with the traditional borrowing and lending operations of banks). This may not be surprising as remittance operators, including Fintech companies, often rely on the traditional cross-border payments infrastructure. Fig. 3 also shows that the remittance cost has been consistently higher than the interest rate spread, with the gap having narrowed only marginally over a decade.

There is also some heterogeneity in remittance costs regarding the type of remittance provider. Remittance fees charged by traditional banks tend to be more expensive than MTO's and that of the post office (Fig. 4), reflecting higher regulatory costs faced by banks and remittance services not being the most important product of the larger package of services that their clients receive (Beck et al., 2022).

A clear negative correlation is noticeable between quarterly remittance costs and remittance flows (Fig. 5). Countries with lower remittance costs tend to have higher remittance flows, and conversely higher remittance costs weigh on migrant transfers. While there are certainly other factors affecting remittances beyond costs, it is still not clear whether high remittance costs result themselves from the smaller remittance market, though Fig. 5 offers suggestive evidence that market size matters for transaction costs. The econometric section will help provide a more rigorous answer.

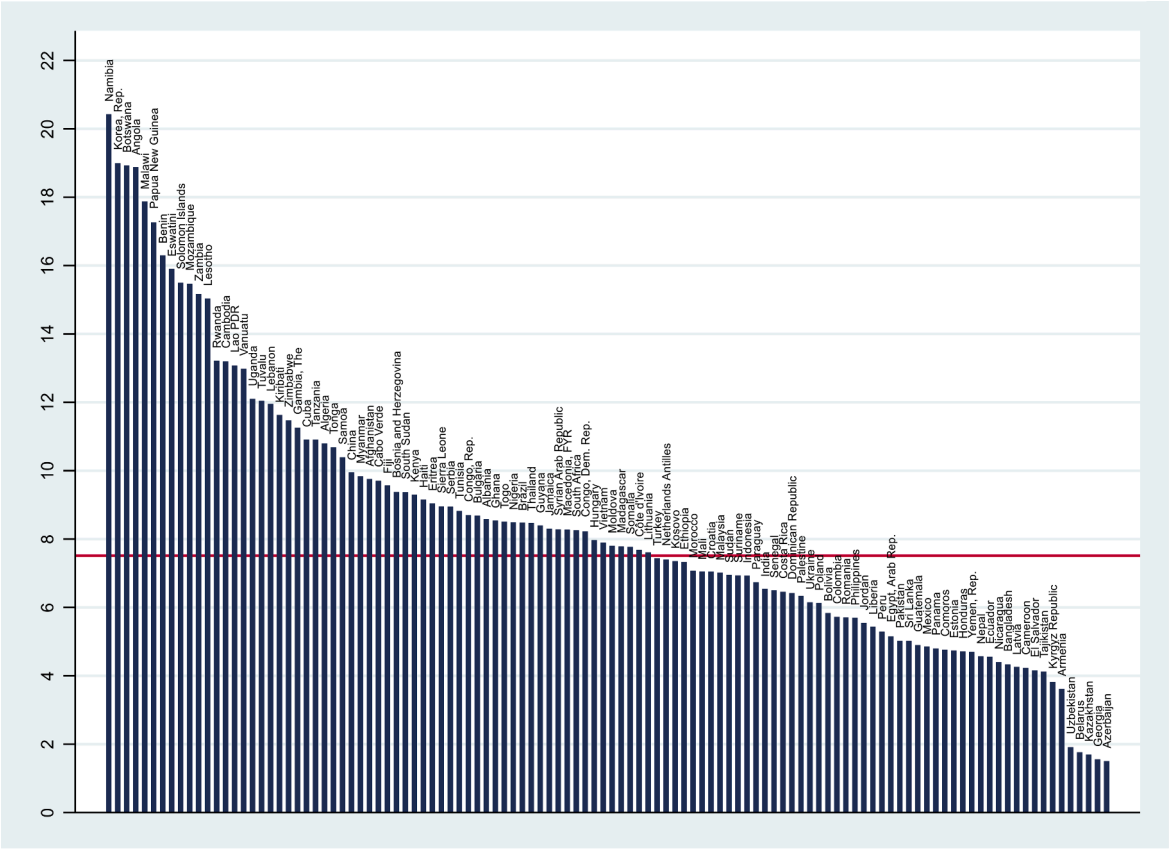
2.3. . The model and econometric approach

To analyze the elasticity of remittance flows to transaction costs, we start with the static version of the model estimated on a sample of 71

[2] A simple average is adopted as data on the market share of the different remittance service providers are not available.

[3] Two countries have quarterly data from the 1970s, and this figure rises quickly to 30 countries in the early 2000s. From 2010, the sample reaches 70 countries before stabilizing above 90 countries from 2017 onwards.

[4] Personal transfers include all current transfers in cash or in-kind between resident and nonresident individuals, regardless of the source of income of the sender and the relationship between households. Compensation of employees refers to the income of cross-border, seasonal, and other short-term workers who are employed in an economy where they are nonresident, or residents employed by nonresident entities.



Note: The red line indicates the sample average
Source: Remittance Prices Worldwide (World Bank)

Fig. 1. Average fee as a share of a $200 USD remittance (2011Q1-2020Q4). (percent). Note: The red line indicates the sample average. Source: Remittance Prices Worldwide (World Bank).

countries with data over the period 2011Q1-2020Q4. The specification is as follows:

$$\ln(Rem)_{c,t} = \alpha + \beta \ln(Cost)_{c,t} + \ddot{\mathrm{I}}\mathrm{X}_{c,t} + v_t + u_c + \varepsilon_{c,t} \quad (1)$$

where:

- *Rem* is the amount of remittances expressed in millions of US dollars received by country c in quarter *t*
- *Cost* stands for the fees per US$ 200-dollar remittance expressed as a share of that amount.
- *X* is a set of control variables which includes the income per capita of the remittance-receiving country and that of the remittance-sending countries to capture the level of development, the US dollar/local currency exchange rate, and the number of migrants originating from the remittance-receiving countries
- *v* is the time dummy for each quarter, *u* is the country-specific effect, and ε is the error term robust to heteroscedasticity, autocorrelation and cross-sectional dependence (Driscoll and Kraay, 1998)

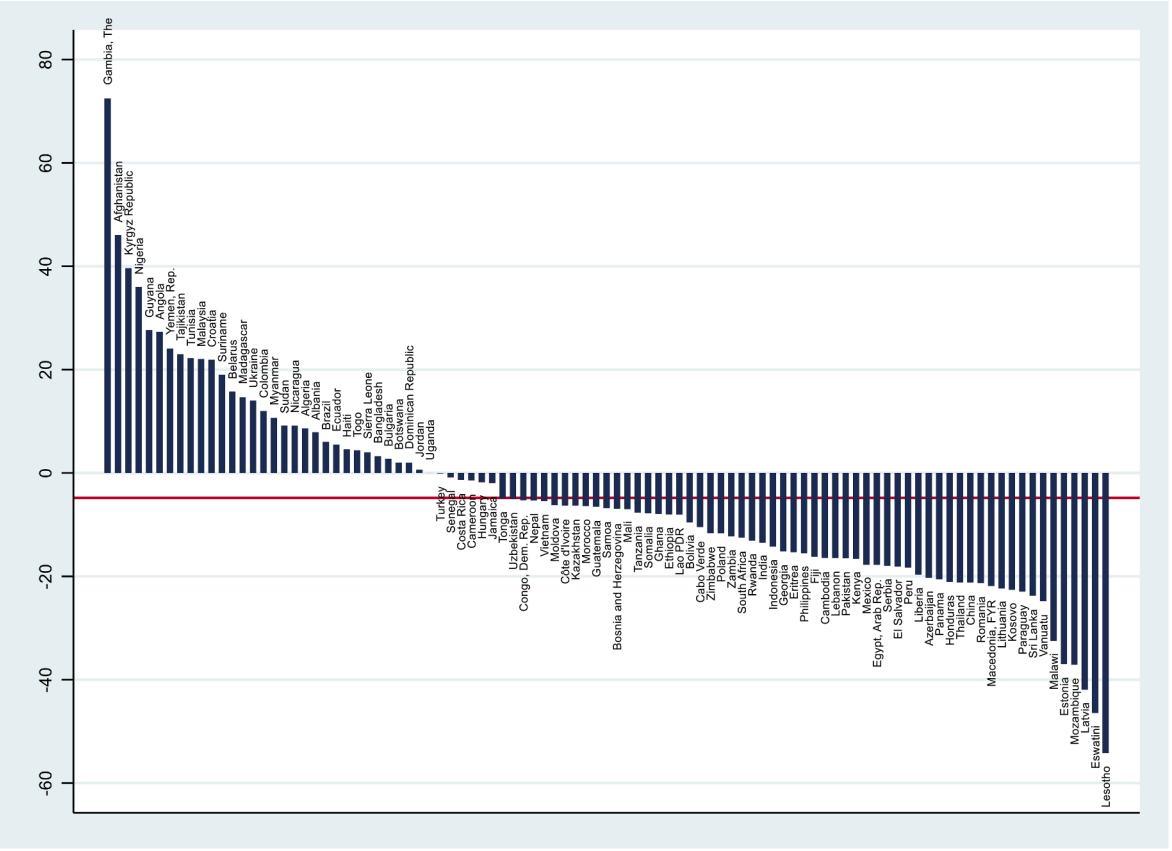
Eq. (1) is estimated with the fixed-effect estimator, allowing to control time-invariant unobserved country characteristics that may affect remittances. The coefficient of interest is β, which denotes the cost-elasticity of remittances following a 1 percent change in transfer cost. It is expected to be negative.

While the static model allows to gauge the contemporaneous impact of a change in transfer costs on remittances, it is unable to address the question of whether the changes in remittances occur in one time period or whether it is more persistent over time. It is plausible that there may be a lag in the response of remittances, in which case, not only the contemporaneous response matters, but also those in the subsequent periods. Further, the static model does not take advantage of the high-frequency data on remittance costs and flows, thus probably missing a richer and more complex relationship. Ignoring the dynamic nature of the response may lead to a bias in the elasticity estimate. As remittance flows may be persistent over time, the other potential issue with the static model is that it does not control for initial conditions (captured by the lagged dependent variable), and therefore may overlook this persistence. In contrast, a dynamic model takes into account lagged dependent variables and feedback effects from past realizations of the explanatory variables, thus enabling to assess short and medium-term responses of the dependent variable following a shock to the explanatory variable of interest.

A common approach to estimate a dynamic model is to rely on conventional Vector Autoregressive models (VARs) to derive the impulse response functions (IRFs).[5] However, should the VAR specification turn out to be non-representative of the data generating process, this can lead to a bias in the estimation of and inference from the IRFs since misspecification errors are compounded with the forecast horizon (Jordà, 2005). A more flexible approach that has been widely used in the recent years is the local projection method (LP) developed by Jorda (2005).

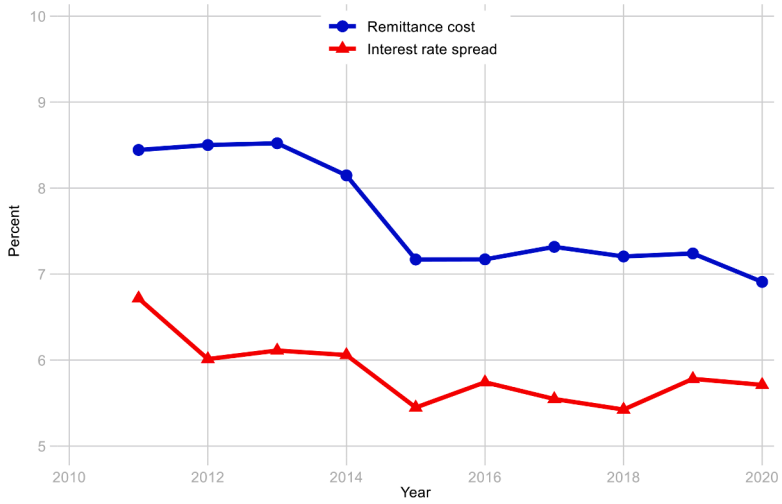
The LP allows to assess the impact of a shock at time *t* on the dependent variable by generating multi-step predictions using direct forecasting models that are re-estimated for each forecast horizon. The

[5] Unlike a static model, the fixed-effect estimations of a dynamic model may be subject to bias in the presence of time-invariant unobserved heterogeneity owing to the inclusion of the lagged dependent variable.



Note: The red line indicates the sample average. The chart excludes Syria and Amenia that recorded an unusually large increase in transaction costs, the former because of the civil war.
Source: Remittance Prices Worldwide (World Bank) and authors' calculations.

Fig. 2. Change in Average fee for a $200 USD remittance (2016Q1-2020Q1) (percent). Note: The red line indicates the sample average. The chart excludes Syria and Amenia that recorded an unusually large increase in transaction costs, the former because of the civil war. Source: Remittance Prices Worldwide (World Bank) and authors' calculations.

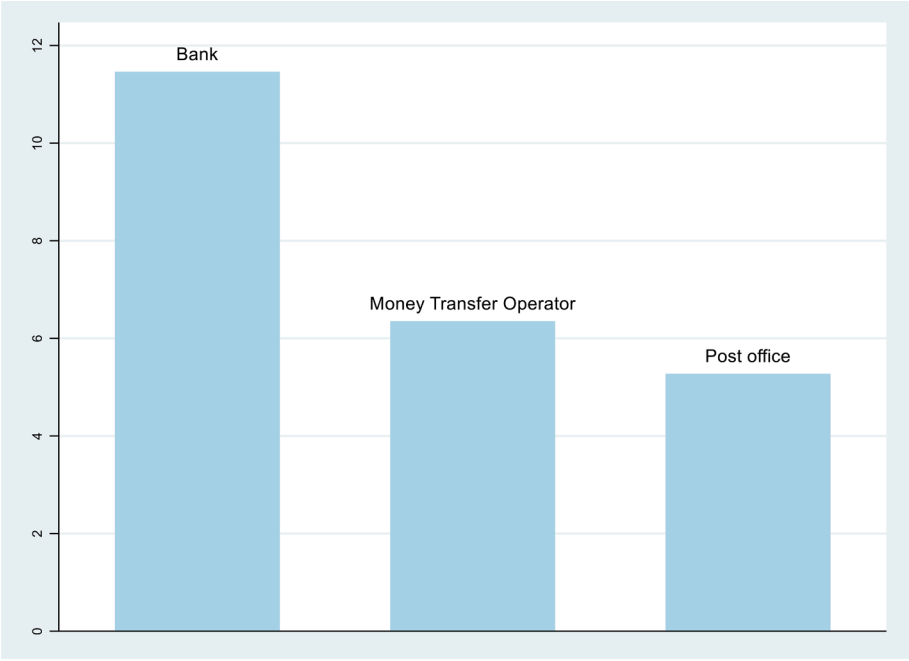


Sources: Remittance Prices Worldwide (World Bank), and World Development Indicators.

Fig. 3. Trends in Average fee for a $200 USD Remittance and Interest Rate Spread (2011–20). (percent). Sources: Remittance Prices Worldwide (World Bank), and World Development Indicators.

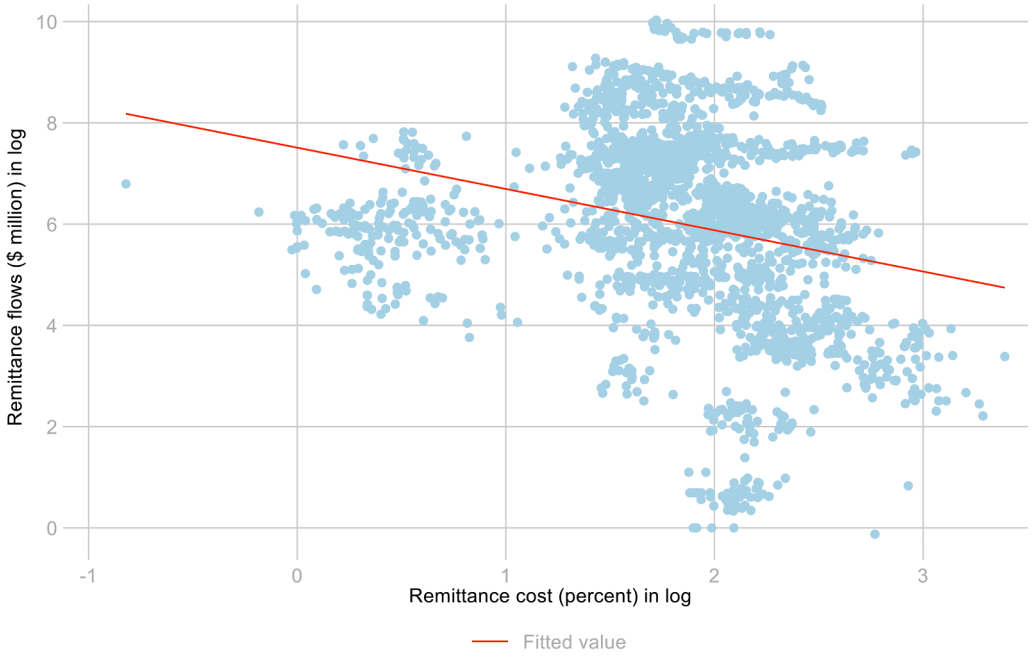
LP is shown to robustly handle highly persistent data and the estimation of impulse response functions (IRFs) at long horizons (Olea and Plagborg-Møller, 2021), and easily accommodates non-linearities (Auerbach & Gorodnichenko, 2013; Ramey & Zubairy 2018).

Further, Jordà (2005) argues that the LP is robust to misspecification of the lag structure as the impulse responses can be defined without any reference to the unknown data generating process. As such, the LP improves on the conventional Vector Autoregressive models (VARs), which



Sources: Remittance Prices Worldwide (World Bank) and authors' calculations.

Fig. 4. Average fee for a $200 USD remittance by Type of Provider (2011Q1-2020Q4) (percent). Sources: Remittance Prices Worldwide (World Bank) and authors' calculations.



Sources: Remittance Prices Worldwide (World Bank) and authors' calculations.

Fig. 5. Remittance Flows and Average fee for a $200 USD Remittance (2011Q1-2020Q4). Sources: Remittance Prices Worldwide (World Bank) and authors' calculations.

require imposing sufficient identifying restrictions to derive the IRFs. Nevertheless, Barnichon and Brownlees (2019) point out that the flexibility of the LP relative to VARs comes at the cost of efficiency. In contrast, Plagborg-Møller and Wolf (2021) note that from an identification and estimation standpoint, the LP is equivalent to VARs. Overall, the ease of the implementation of the LP and the intuitive design make it a preferred approach for this paper. More importantly, the ability to handle nonlinearities is key for this study as we aim to investigate the factors that affect the elasticity of remittances to transaction costs. The specification of the dynamic model estimated by the LP is as follows:

Table 1
Transaction Costs and Remittances: Fixed-Effect Estimates.

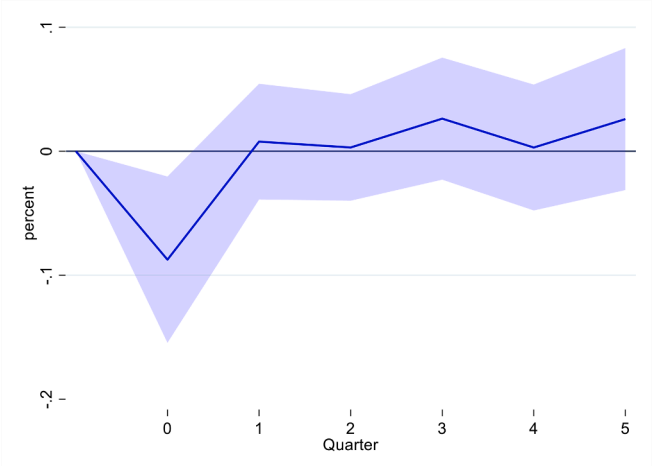
	(1)	(2)	(3)	(4)	(5)	(6)
Transaction cost ($200, log)	−0.201	−0.198	−0.097	−0.091	−0.075	
	[0.046]***	[0.045]***	[0.029]***	[0.026]***	[0.021]***	
Transaction cost ($500, log)						−0.115
						[0.023]***
GDP per capita (log), receiving country	0.400	1.634	0.667	0.609	0.548	0.609
	[0.064]***	[0.744]**	[0.048]***	[0.056]***	[0.052]***	[0.057]***
GDP per capita (log), sending country	0.470	0.501	0.506	0.501	0.438	0.496
	[0.216]**	[0.213]**	[0.152]***	[0.154]***	[0.119]***	[0.154]***
GDP per capita (log) square, receiving country		−0.076				
		[0.045]				
USD exchange rate (log)			0.383	0.334	0.201	0.335
			[0.030]***	[0.035]***	[0.068]***	[0.035]***
Migrant population (log)				0.257		0.271
				[0.096]**		[0.099]***
Total population					1.623	
					[0.355]***	
Constant	−1.645	−6.915	−5.794	0.000	−7.880	0.000
	[2.130]	[3.248]**	[1.666]***	[0.000]	[0.873]***	[0.000]
Observations	2,142	2,142	2,117	2,111	2,117	2,110
Number of countries	71	71	71	69	71	69
R2	0.17	0.18	0.27	0.28	0.33	0.28

Notes. Fixed effect estimations. Time dummies included. Robust standard errors in brackets. *,**,*** denote significance at 10 percent, 5 percent and 1 percent, respectively. USD exchange rate denotes the units of local currency per USD.

$$\ln(Rem)_{c,t+h} = \sum_{i=1}^{n} \alpha_i \ln(Rem)_{c,t-i} + \sum_{i=1}^{n} \beta_i \ln(Cost)_{c,t-i} + \sum_{j=0}^{h} \delta_j \ln(Cost)_{c,t+j} + \theta_h X_{c,t} + v_t + u_c + \varepsilon_{c,t+h} \text{ for h} = 0, \cdots, H \quad (2)$$

where:

- *Rem* is the amount of remittances expressed in millions of US dollars received by country c in quarter *t*
- *Cost* stands for the fees per US$ 200-dollar remittance expressed as a share of that amount
- *X* is a set of control variables which includes the income per capita of the remittance-receiving country and that of the remittance-sending countries to capture the level of development, the US dollar/local currency exchange rate, and the number of migrants originating from the remittance-receiving countries
- *v* is the time dummy for each quarter, *u* is the country-specific effect, and ε is the error term robust to heteroscedasticity, autocorrelation and cross-sectional dependence (Driscoll and Kraay, 1998)
- the number of lags, *n*, is set at 4 considering the quarterly frequency of the remittance data, and the forecast horizon, *h*, is set at 5 quarters.



Notes: Shaded area represents the 90 percent confidence interval.
Source: Authors' calculations.

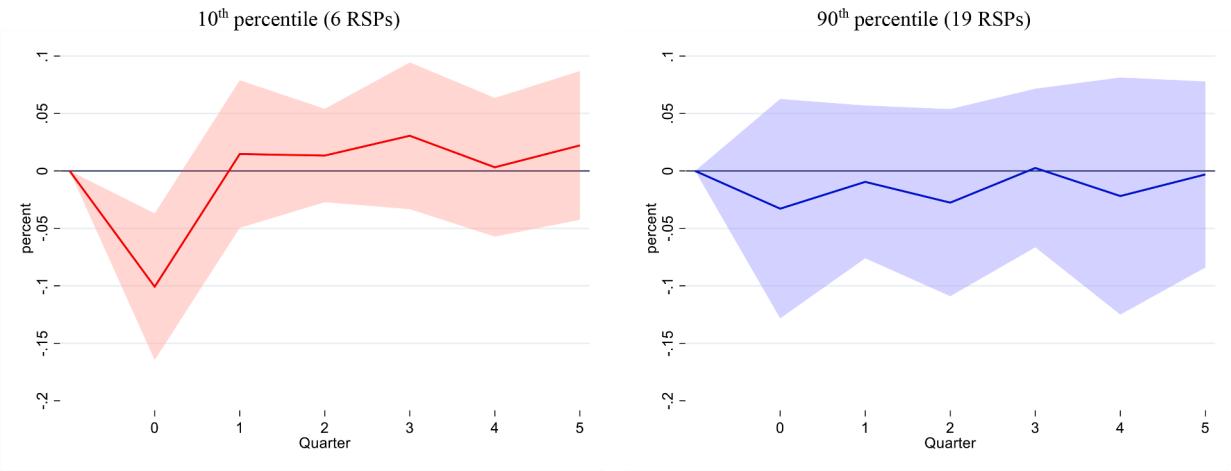
Fig. 6. Cost-Elasticity of Remittances: Local Projections. Notes: Shaded area represents the 90 percent confidence interval. Source: Authors' calculations.

β_i is the coefficient of interest representing the elasticity of remittances for each forecast horizon following a change in transaction costs at the initial horizon (h = 0). A negative β_i would suggest that, as expected, a decrease in transaction costs stimulates remittances. In testing for non-linearities, we aim to show how βi varies with different policy variables.

Although the variables and underlying data for the fixed-effect (Eq.1) and LP specification (Eq.2) are the same, the LP differs in three aspects:

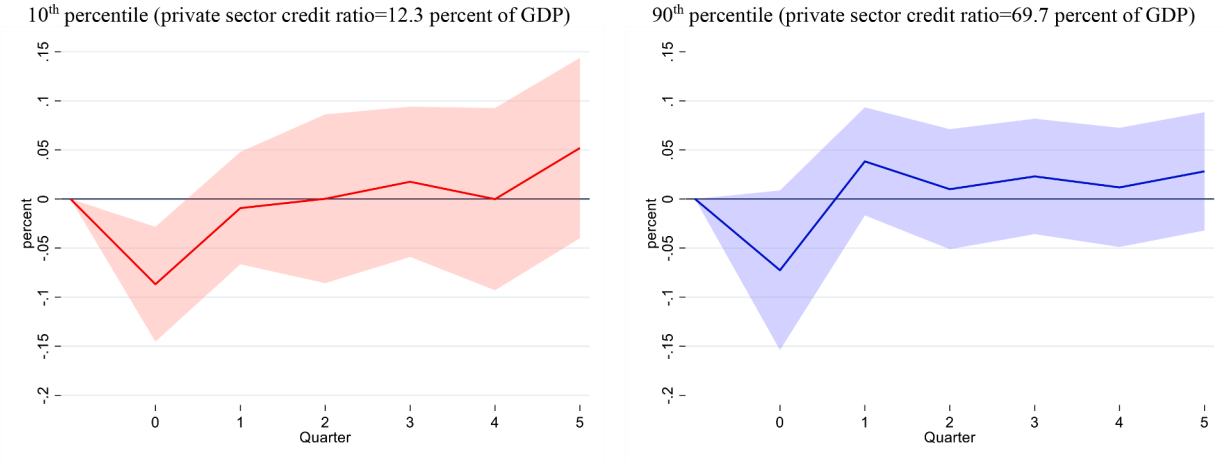
- the dependent variable in the LP is not only the contemporaneous value of remittances, but also its future realizations when the model is estimated at different horizons.
- the LP includes multiple lags of the dependent variable.
- the LP requires a correction factor (Teulings and Zubanov, 2014) to capture changes in transaction costs observed within the forecast horizon. Indeed, when there are subsequent shocks, which is likely, the derived impulse response function also captures the treatment effect given the usual path of subsequent shocks (and not only that of the contemporaneous shock) and the usual behavior of other variables. Teulings and Zubanov (2014) point out that this could lead to a bias in the results, and therefore the LP specification estimated at horizon *h* needs to be expanded to control for shocks occurring between $t+1$ and $t+h$ (embedded in the third term of Eq. 2). In doing so, the effect of potential subsequent shocks (change in transaction costs) is sterilized, thus allowing to isolate properly a change in transaction costs at time *t* on remittance flows a time *t* and over subsequent horizons.

With regard to the control variables, income per capita is at annual frequency due to the lack of quarterly GDP data for many countries. For the stock of migrants, we have only two data points, one for the period 2011–15 and the other for the period 2016–2020. The size of the population which is available annually is also used as an alternative indicator since it captures well the relative size of the remittance market



Notes: Shaded area represents the 90 percent confidence interval. RSPs denote remittance service providers.
Source: Authors' calculations.

Fig. 7. Cost-Elasticity of Remittances with Respect to Competition in the Remittance Market. Notes: Shaded area represents the 90 percent confidence interval. RSPs denote remittance service providers. Source: Authors' calculations.



Notes: Shaded area represents the 90 percent confidence interval.
Source: Authors' calculations.

Fig. 8. Cost-Elasticity of Remittances in Countries with Low and High Financial Development. Notes: Shaded area represents the 90 percent confidence interval. Source: Authors' calculations.

(from the recipient side). Like remittance flows and transaction costs, the US dollar/local currency exchange rate is available on a quarterly basis. For a given remittance-receiving country, the income per capita of the remittance-sending country is calculated as the weighted average of the income per capita of all countries hosting migrants from that country, with the weight being the host country's share of total migrants. Annex 2 provides the summary statistics and correlation matrix.

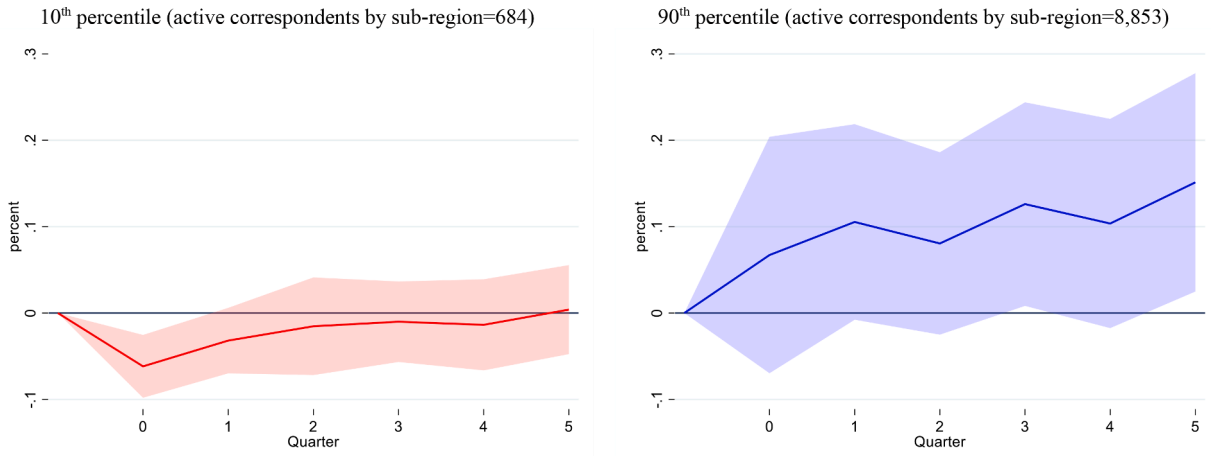
3. The results

3.1. A. How elastic are remittances to transaction costs?

Table 1 shows the results of the static model using the fixed-effect estimator. The findings suggest a clear, and negative association, between transaction costs and remittance flows with the coefficient of the transaction costs being statistically significant at the 1 percent level in all specifications. The magnitude of the marginal impact appears sizeable. For instance, a 10 percent decrease in transaction costs could stimulate remittance by about 2 percent (columns 1 and 2). This elasticity is halved once we control for the exchange rate (column 3), most likely reflecting the fact that the exchange rate is also an important cost factor driving the amount migrants decide to send home. Using the transaction cost of a US$500 remittance confirms the result obtained with the transaction cost of a US$200 remittance. The results also hold using the ratio of remittances to GDP or the ratio of remittances to the size of the country's population, or with additional control variables.[6]

As for the control variables, income per capita in the receiving and sending countries is positively associated with remittance. One could expect that as income per capita rises in the receiving country, remittances might start to decline beyond a threshold. While the squared coefficient of income per capita of the receiving country enters the regression with a negative sign, this coefficient is only marginally statistically significant at the 11 percent confidence level. The implied threshold is estimated at US$46,000, beyond which remittances decline with increasing income per capita. None of the countries in our sample is close to that level (the maximum income per capita is about US$25,000),

[6] These include real GDP growth, trade openness, inflation, deposit rate, terms of trade, and quality of institutions in the remittance-receiving country, The results not shown in the paper are available upon request.



Notes: Shaded area represents the 90 percent confidence interval.
Source: Authors' calculations.

Fig. 9. Cost-Elasticity of Remittances and Correspondent banking relationships. Notes: Shaded area represents the 90 percent confidence interval. Source: Authors' calculations.

which may explain why the coefficient of the square term is barely significant.

The coefficient on the exchange rate is positive and significant at the 1 percent level in all regressions, suggesting that remittances in US dollar terms increase with a depreciation of the local currency. Mandelman & Vilán (2020) observe this intertemporal substitution in the case of Mexico as a stronger dollar provides immigrants with additional incentives to send more resources back home. This result also makes sense from the cost perspective because a depreciation of the currency of the recipient country means that the cost of acquiring 1 unit of the local currency has dropped, hence the demand for the local currency by migrants increases, *ceteris paribus*. We also observe in the regressions that, as expected, the stock of migrants (the supply side of remittances) is positively correlated with remittances, and this result holds when the population of the recipient country (the demand side of remittances) is used as an alternative indicator.

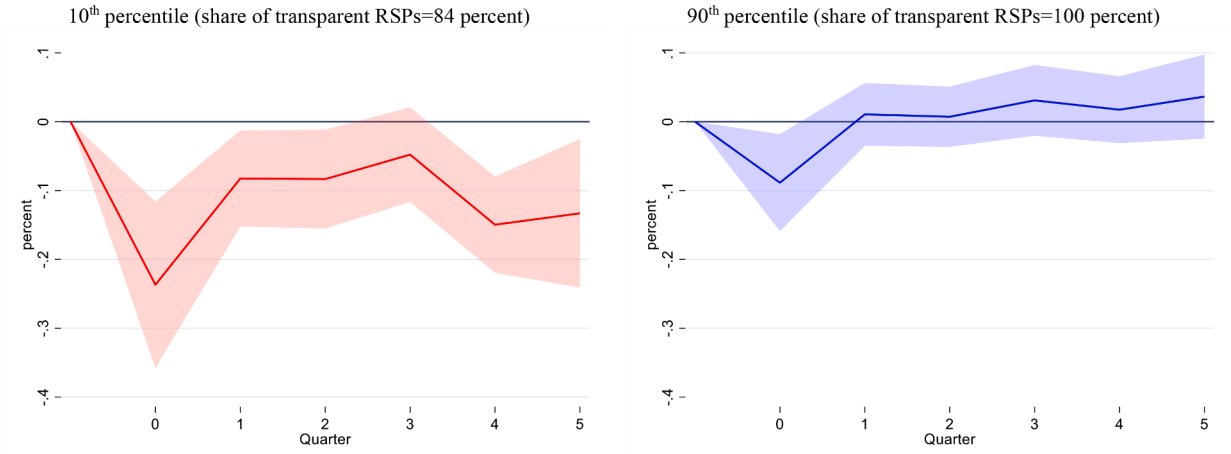
Turning to the full-fledged dynamic model, the IRF obtained from the LP corroborates the findings from the fixed effect estimations. As shown in Fig. 6, a 10 percent reduction in transaction costs results in a 0.87 percent rise in remittances in the first quarter (Table A1 presents the underlying regressions), close to the estimate in the fixed-effect regressions. The short-term response of remittances to transaction costs is predictable and consistent with the classic price-demand curve, whereby the demand for remittance services increases as the price decreases. The impact of the shock in the subsequent quarters is not significantly different from zero, indicating that the effect on the change in remittances is not persistent over time. Nevertheless, the level of remittances will be persistently higher after the negative shock to transaction costs dissipates. We also use the median cost of a US$200 remittance, and the result is similar. Further, using the average and median cost of a US$500 remittance does not alter the finding above.[7]

The estimated elasticity is economically meaningful. Taking the size of remittances to low and middle-income countries in 2020, amounting to US$705.5 billion, and the average transaction cost which stood at 6.3 percent in 2020, and bringing transaction costs to the UN target of 3 percent would result in an additional US$32 billion income for households in the receiving countries.[8] This is US$8.9 billion more than the savings in costs for the migrants, suggesting that migrants would return to their families much more than the savings from lower remittance costs. In order words, estimates of remittances lost using the difference between the actual cost and the UN target (implicitly assuming that a US $1 reduction in cost translates to a US$1 dollar increase in remittances) significantly underestimate the true burden of high transaction costs on remittances (one way to think about the "true burden" is the money lost during the transfer process – the difference in the amount of remittances beyond what is redistribution within the migrant family). This result points to a transaction cost reduction as a very powerful tool to boost remittances.

To ensure that our result is not driven by a simultaneity bias between the size of remittance and transaction costs, the IRF is rerun with an instrumental variable (IV) approach. Indeed, a small remittance market may be associated with higher transaction costs, potentially due to the limited number of remittance service providers (and therefore less competition), a lack of economy of scale and the nature of the fee structure, whereby small amounts are subject to higher transaction costs. We use the share of MTOs in the remittance service market as an instrument of transaction costs as this variable is unlikely to be correlated with the size of remittances. As shown in Fig. 4, banks tend to charge higher remittance fees than MTOs, and therefore where MTOs are more prevalent, remittance fees should be lower. This is supported by the first-stage regression (see Table A2) where transaction costs are regressed on the share of MTOs in remittance service providers and the other explanatory variables of the remittance model. The coefficient on the share of MTOs is negative and highly significant. This result is also consistent with Beck, Janfils, and Kpodar (2022) who find a positive and significant relationship between the share of banks among market participants in a corridor and remittance costs. The IRF-IV tends to support

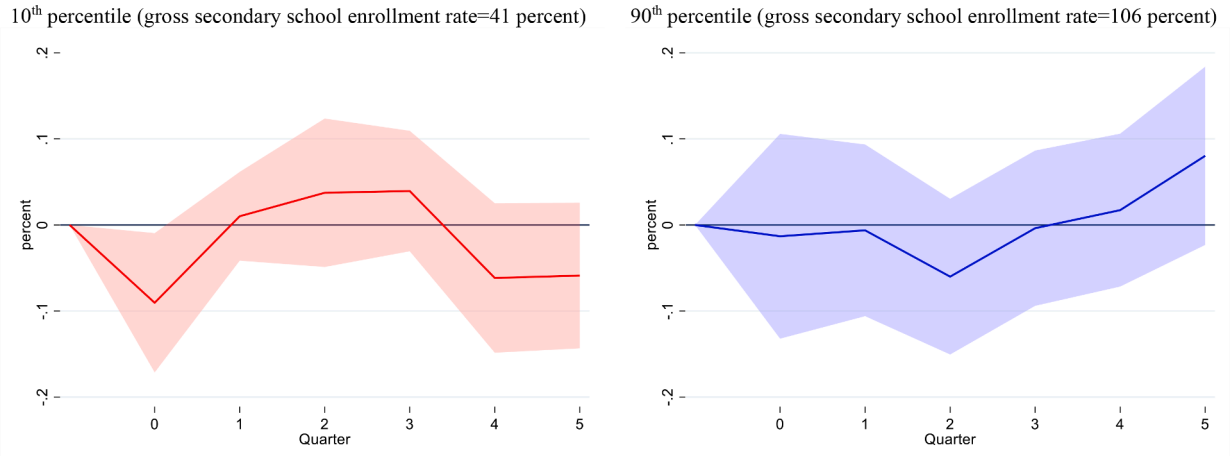
[7] We also introduced in the regression an interaction variable between transaction costs and the dummy for the year 2020 and found that the cost-elasticity to remittances was lower during the pandemic year than in the previous ones. This might reflect the limited opportunities for migrants to use informal channels for sending remittances given the border closures.

[8] A drop in transfer costs from 6.3 percent to 3 percent represents a 52.4 percent decrease, which multiplied by the elasticity of 0.087 results in a 4.5 percent increase in remittances (equivalent to $32.2 billion based on the size of remittances in 2020). On the other hand, the accounting approach which assumes that a $1 dollar saved on transaction costs by migrants results in an additional dollar for their families gives $23.28 billion ((6.3–3)*705.5).



Notes: Shaded area represents the 90 percent confidence interval.
Source: Authors' calculations.

Fig. 10. Cost-Elasticity of Remittances and Price Transparency. Notes: Shaded area represents the 90 percent confidence interval. Source: Authors' calculations.



Notes: Shaded area represents the 90 percent confidence interval.
Source: Authors' calculations.

Fig. 11. Cost-Elasticity of Remittances and Education level. Notes: Shaded area represents the 90 percent confidence interval. Source: Authors' calculations.

the previous finding that higher transaction costs undermine remittance flows (see Annex Fig. 1).

3.2. . *Explaining heterogeneities in the cost elasticity of remittances*

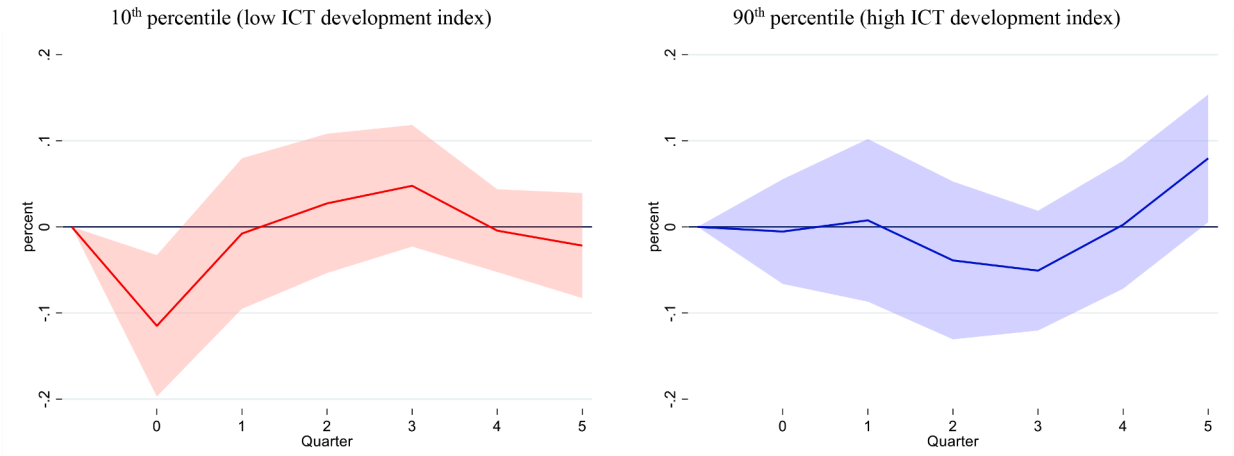
To test country characteristics that could explain why the cost elasticity could vary from one country to another, we introduce in Eq.(1) an interaction term between transaction costs and the indicator of the policy of interest to see how the resulting marginal impact of the transaction costs changes. The policy indicator is also added in additive term to Eq.(1) to be able to properly identify the coefficient of the interaction term.

Although the LP is well suited for non-linearities, represented in a two-dimensional chart, the IRF between a variable x and another variable y conditional to a third variable z requires an additional step. A common approach is to use a dummy variable taking 1 for a low regime of the variable z and 0 otherwise (for instance below and above the average of the variable), and then plot the IRFs for the two regimes. Alternatively, some studies use a smooth transition function between the two regimes (see Auerbach and Gorodichencko, 2013; Furceri, Loungani, and Zdzienicka, 2018), instead of a dummy variable that assumes an abrupt shift. In this paper, we propose a third approach that exploits the variation in the conditional variable z without any transformation or assumption on the smoothness of the transition function. This consists in introducing the interaction terms between the variable x and z, and plotting the IRFs for the 10th and 90th percentile of the distribution of z. Since the marginal impact of x on y is a linear function of z, the IRF for any values of z between its 10th and 90th percentile should lie between the IRF of these lower and upper bounds.[9]

As discussed above, we consider two broad categories of policies.[10] First, the cost-mitigation policies that directly tackle the root causes of high remittance costs. These include enhancing competition in the remittances market, deepening financial development, and addressing correspondent banking relationship issues as discussed below. We start with the premise that the elasticity of remittances to transaction costs would be higher in high-cost countries than in low-cost countries, meaning that the elasticity itself is a function of the level of transaction

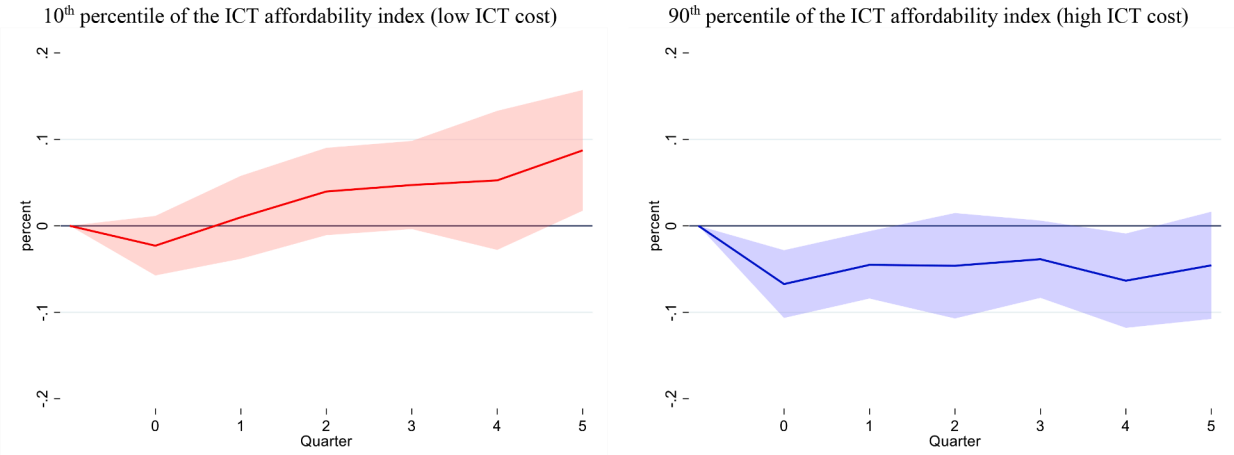
[9] For the 10th or 90th percentile, the confidence band along the IRF is computed as a linear combination of the confidence band of the unconditional marginal impact of x on y and that of the marginal impact conditional on z.

[10] This is not an exhaustive list. The focus is on key policies that have been extensively discussed in the literature.



Notes: Shaded area represents the 90 percent confidence interval. The ICT development index is the average of the ICT access, use and capability sub-indices.
Source: Authors' calculations.

Fig. 12. Cost-Elasticity of Remittances and ICT Development. Notes: Shaded area represents the 90 percent confidence interval. The ICT development index is the average of the ICT access, use and capability sub-indices. Source: Authors' calculations.



Notes: Shaded area represents the 90 percent confidence interval. The ICT affordability index is calculated as the average of the normalized value of the fixed-broadband monthly subscription charge, the price of 3-minute mobile local call (off-peak rate), and the price of a 3-minute local call to a fixed-telephone line (off-peak rate). Variables are normalized to have a zero mean and unit variance.
Source: Authors' calculations.

Fig. 13. Cost-Elasticity of Remittances and ICT Affordability. Notes: Shaded area represents the 90 percent confidence interval. The ICT affordability index is calculated as the average of the normalized value of the fixed-broadband monthly subscription charge, the price of 3-minute mobile local call (off-peak rate), and the price of a 3-minute local call to a fixed-telephone line (off-peak rate). Variables are normalized to have a zero mean and unit variance. Source: Authors' calculations.

cost. This is, because: (i) as average transaction costs decline, the information search cost for the migrant may become higher than the expected savings from a more competitive remittance provider, and as the incentives to search for lower transaction costs decline, remittances would be less sensitive to these transaction costs; (ii) when transaction costs are low, other factors such as the speed of the transaction and the convenience of access to the funds would matter more for migrants and their families, thus outweighing potential effects of a marginal change in transaction costs on remittances. Annex Fig. 2 illustrating the IRFs for low and high-cost regimes supports this hypothesis. The direct implication is that cost-mitigation policies dampen remittance, which will also likely reduce the elasticity of remittances to transaction costs. This suggests that these reforms exhibit decreasing returns to scale, but in practice, remittance costs are still high enough in many developing countries to make the implementation of these reforms appealing to policymakers. Additionally, policymakers are fully aware that there is no magic wand—it will be the combination of reforms in many areas that will cumulatively impact remittance flows.

Second, cost-adaptation policies include price transparency, financial literacy and lowering information costs through information and communication technologies (ICT). The primary purpose of these policies discussed below, is not necessarily to address the issue of high costs, but instead to reduce information asymmetries in the remittance markets. As such, cost adaptation policies seek to ensure that consumers have all the information available as well as the skills required to make an informed decision on the remittance services they opt for. For instance, in a country with high remittance costs, the average cost may hide the fact that some remittance service providers are more affordable than others. Cost-adaptation policies facilitate the discovery of affordable remittance services by lowering information costs. Ultimately, this could result in a reduction in transaction costs country-wide, but the link is not direct. The distinction between cost-mitigation and cost-

Table 2
Transaction costs and remittances in the US-Mexico corridor.

	(1)	(2)	(3)	(4)
Transaction costs (percent of transferred amount, log)	−0.703	−0.677	−0.636	−0.635
	[0.035]***	[0.038]***	[0.037]***	[0.031]***
Income (log)		−0.021	0.085	0.146
		[0.041]	[0.031]***	[0.026]***
Age (log)		−0.589	−0.407	0.028
		[0.079]***	[0.091]***	[0.072]
Gender		−0.298	−0.143	−0.147
		[0.034]***	[0.013]***	[0.014]***
Level of education		−0.032	−0.020	−0.017
		[0.007]***	[0.007]***	[0.007]**
Number of years lived in the US				−0.225
				[0.021]***
Constant	5.585	8.577	6.705	5.069
	[0.051]***	[0.722]***	[0.571]***	[0.469]***
Number of observations	37,389	37,074	37,064	28,297
R^2	0.26	0.29	0.36	0.38
Fixed effects				
US states	no	no	yes	yes
Mexico states	no	no	yes	yes
Year	no	no	yes	yes
Sector of employment	no	no	yes	yes

Notes. OLS and fixed effect estimations. Robust standard errors in brackets. *,**,*** denote significance at 10 percent, 5 percent and 1 percent, respectively. The dependent variable is the annual remittances reported by the survey respondents. Gender is a binary variable equal to 1 for men, and 2 for women. The level of education ranges from 1 (no education) to 13 (postgraduate).

Table 3
Transaction Costs and Remittances in the US-Mexico Corridor: The Role of Financial Literacy.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Transaction costs (percent of transferred amount, log)	−0.636	−0.697	−0.642	−0.729	−0.632	−0.667	−0.774
	[0.037]***	[0.024]***	[0.033]***	[0.023]***	[0.030]***	[0.030]***	[0.029]***
Income (log)	0.085	0.085	0.102	0.102	0.073	0.074	0.125
	[0.031]***	[0.031]***	[0.021]***	[0.021]***	[0.028]**	[0.028]**	[0.016]***
Age (log)	−0.407	−0.406	−0.379	−0.378	−0.364	−0.362	−0.298
	[0.091]***	[0.091]***	[0.054]***	[0.058]***	[0.054]***	[0.055]***	[0.045]***
Gender	−0.143	−0.144	−0.100	−0.100	−0.106	−0.105	−0.095
	[0.013]***	[0.014]***	[0.018]***	[0.018]***	[0.024]***	[0.025]***	[0.021]***
Level of education	−0.020	0.018	−0.023	−0.022	−0.020	−0.019	0.017
	[0.007]***	[0.022]	[0.008]***	[0.008]***	[0.006]***	[0.006]***	[0.017]
Education*Transaction costs (log)		0.012					0.010
		[0.005]**					[0.004]**
Access to a bank account (sender)			−0.229	0.194			0.135
			[0.066]***	[0.151]			[0.154]
Access to a bank account (sender)*Transaction costs (log)				0.133			0.119
				[0.029]***			[0.034]***
Access to a bank account (receiver)					−0.017	0.354	0.263
					[0.019]	[0.060]***	[0.059]***
Access to a bank account (receiver)*Transaction costs (log)						0.111	0.070
						[0.016]***	[0.016]***
Constant	6.705	6.501	6.543	6.262	6.731	6.596	5.599
	[0.571]***	[0.638]***	[0.379]***	[0.437]***	[0.423]***	[0.426]***	[0.327]***
Number of observations	37,064	37,064	20,862	20,862	17,648	17,648	17,636
R2	0.36	0.36	0.39	0.39	0.39	0.40	0.41
Fixed effects							
US states	yes	yes	yes	yes	yes	yes	yes
Mexico states	yes	yes	yes	yes	yes	yes	yes
Year	yes	yes	yes	yes	yes	yes	yes
Sector of employment	yes	yes	yes	yes	yes	yes	yes

Notes. OLS and fixed effect estimations. Robust standard errors in brackets. *,**,*** denote significance at 10 percent, 5 percent and 1 percent, respectively. The dependent variable is the annual remittances reported by the survey respondents. Gender is a binary variable equal to 1 for men, and 2 for women. The level of education ranges from 1 (no education) to 13 (postgraduate).

adaptation policies is, however, not always clear-cut. For instance, ICT development has the unique characteristic of also being a cost-mitigation factor as it enables cost-effective remittance services, through digitalization. In the following paragraphs, we will discuss the findings of the IRFs for these different policies.

3.3. Cost-mitigation policies

- Competition in the remittance market

The degree of competition is a key determining factor of costs in the remittance market (Beck and Martinez Peria, 2011; Mbiti and Weil, 2011; da Silva Filho, 2021; Beck et al., 2022). In a less competitive market, a remittance service provider may have incentives to mark up

Table 4
Transaction Costs and Remittances in the US-Mexico Corridor: Instrumental Variable Approach.

Dependent variable	Remittances (log)	Remittances as a share of migrant's income (log)	Remittances as a share of migrant's income (log)
Estimator	IV Fixed effect	Fixed effect	IV Fixed effect
	(1)	(2)	(3)
Transaction costs (percent of transferred amount, log)	−0.185	−0.867	−0.443
	[0.093]*	[0.013]***	[0.064]***
Income (log)	0.206	−0.967	−0.851
	[0.042]***	[0.004]***	[0.018]***
Age (log)	−0.460	−0.048	−0.128
	[0.083]***	[0.022]**	[0.016]***
Gender	−0.209	−0.054	−0.120
	[0.015]***	[0.008]***	[0.013]***
Level of education	−0.013	−0.005	−0.000
	[0.008]	[0.003]*	[0.004]
Frequency of remittances		−0.418	−0.381
		[0.012]***	[0.021]***
Constant		6.401	
		[0.113]***	
Number of observations	37,061	37,064	37,061
R2	0.15	0.88	0.77
Fixed effects			
US states	yes	yes	yes
Mexico states	yes	yes	yes
Year	yes	yes	yes
Sector of employment	yes	yes	yes

Notes. Fixed effect estimations. Robust standard errors in brackets. *,**,*** denote significance at 10 percent, 5 percent and 1 percent, respectively. Gender is a binary variable equal to 1 for men, and 2 for women. The level of education ranges from 1 (no education) to 13 (postgraduate).

Table A1
Cost-elasticity of remittances: local projections.

Variables \ Horizons		h=0	h=1	h=2	h=3	h=4	h=5
Remittances (log)	Lag 1	0.381	0.270	0.175	0.613	0.270	0.062
		[0.103]***	[0.035]***	[0.041]***	[0.048]***	[0.076]***	[0.051]
	Lag 2	-0.146	0.022	0.526	0.008	-0.130	-0.032
		[0.046]***	[0.038]	[0.048]***	[0.062]	[0.038]***	[0.063]
	Lag 3	-0.015	0.493	0.005	-0.088	-0.007	0.343
		[0.038]	[0.063]***	[0.063]	[0.042]**	[0.058]	[0.065]***
	Lag 4	0.177	-0.111	-0.132	-0.019	0.234	-0.120
		[0.081]**	[0.047]**	[0.040]***	[0.041]	[0.069]***	[0.052]**
Transaction cost (log)		-0.087	0.008	0.003	0.026	0.003	0.026
		[0.039]**	[0.027]	[0.025]	[0.029]	[0.030]	[0.033]
	Lag 1	0.039	-0.028	-0.007	-0.002	0.008	-0.036
		[0.038]	[0.033]	[0.029]	[0.026]	[0.032]	[0.026]
	Lag 2	0.017	0.018	0.032	0.041	-0.003	0.004
		[0.035]	[0.025]	[0.029]	[0.032]	[0.021]	[0.017]
	Lag 3	0.021	0.016	0.023	-0.037	-0.008	-0.026
		[0.039]	[0.029]	[0.027]	[0.021]*	[0.028]	[0.024]
	Lag 4	0.020	0.013	-0.026	-0.007	-0.034	0.008
		[0.034]	[0.024]	[0.020]	[0.018]	[0.028]	[0.039]
	Lead 1		-0.008	0.008	0.010	0.014	-0.008
			[0.038]	[0.028]	[0.024]	[0.035]	[0.026]
	Lead 2			0.008	0.037	0.095	0.062
				[0.057]	[0.039]	[0.051]*	[0.049]
	Lead 3				-0.014	0.001	0.056
					[0.059]	[0.048]	[0.056]
	Lead 4					-0.008	-0.014
						[0.059]	[0.050]
	Lead 5						-0.031
							[0.058]
GDP per capita (log), rec. country		0.220	-0.006	-0.050	-0.058	-0.087	-0.012
		[0.120]*	[0.058]	[0.097]	[0.102]	[0.146]	[0.142]
GDP per capita (log), sen. country		0.322	0.238	0.108	0.058	0.290	0.124
		[0.169]*	[0.120]*	[0.165]	[0.120]	[0.108]**	[0.110]
USD exchange rate (log)		0.218	0.115	0.170	0.191	0.222	0.289
		[0.093]**	[0.070]	[0.086]*	[0.097]*	[0.145]	[0.144]*
Migrant population (log)		0.290	0.315	0.398	0.482	0.633	0.663
		[0.103]***	[0.099]***	[0.129]***	[0.100]***	[0.113]***	[0.109]***
Constant		0.000	-5.244	-4.392	-4.692	0.000	-6.946
		[0.000]	[1.615]***	[2.288]*	[1.572]***	[0.000]	[1.618]***
Observations		1,639	1,567	1,500	1,433	1,365	1,297
Number of countries		69	69	69	69	69	69
R2		0.42	0.45	0.44	0.43	0.33	0.29

Notes. Fixed effect estimations. Time dummies included. Robust standard errors in brackets. *,**,*** denote significance at 10 percent, 5 percent and 1 percent, respectively. The shaded line represents the coefficients of the impulse response function shown in Figure A6.

prices by taking advantage of its market power. In contrast, where there is competition, remitters will tend to switch to cheaper remittance service providers, bringing the average cost down.

To test the effect of competition on the elasticity of remittances with respect to transaction costs, we use the average number of remittance service providers as a proxy for competition and interact it with the transaction cost. The IRFs presented in Fig. 7 shows that in countries with a small number of market players (remittance service providers, RSPs), remittances react more to transaction costs than in countries with a large number of market players, confirming our conjecture.[11] In the first quarter, the elasticity estimated at the 10th percentile of the distribution of the number of remittance providers is −0.1, which declines to −0.3 and becomes insignificant as the number of remittance providers increases to the 90th percentile of the distribution. In other words, in a less competitive remittance market, a rise in remittance costs may discourage remittances (potentially boosting informal flows), while in a more competitive remittance market, there is a limited effect.

- Financial sector development

The main function of the financial sector, which is dominated by banks in our sample, is to mitigate market frictions associated with information asymmetries and transaction costs. This includes facilitating the trading of risk, mobilizing savings, and allocating capital to the best uses, monitoring managers, and easing the trading of goods, services and financial contracts (Levine, 1997). As the financial sector develops, it is expected to perform these functions more efficiently, taking advantage of economies of scale that allow for the provision of financial intermediation at a lower cost. With banks involved in the provision of retail remittance services and facilitating cross-border transactions, financial deepening can lead to a decrease in the cost of remittances, and thus translate into a lower cost elasticity of remittances.

Running the IRFs for a low level of financial depth (measured by the ratio of private sector credit to GDP) and a high level of financial depth, shows that in the latter, the elasticity is not significant at conventional levels (Fig. 8). However, the difference in the elasticity is marginal at best, probably because banks are typically not the cheapest channels for remittances. We also use two alternative measures of financial development: the geographical coverage of financial institutions captured by the number of branches per km^2 and the number of deposit accounts per 1,000 adults; the results are similar, although the difference between the elasticity at the 10th and 90th percentile is larger (see Annex Fig. 3).

- Correspondent banking relationships (CBRs)

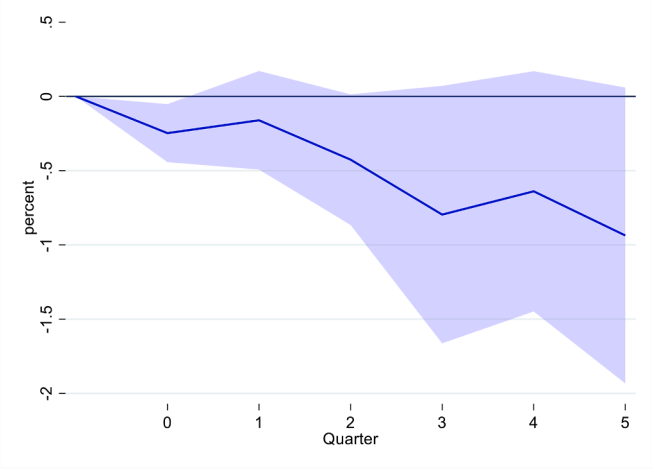
CBRs are essential for the smooth operation of the remittance markets as they facilitate cross-border transactions after small remittance payments are aggregated by remittance service providers, including MTOs. In the past decade, many countries, particularly small states, have been confronted with a sharp decline in CBRs. For some global banks, the risks from maintaining business with some jurisdictions and the compliance costs (and potential fines) associated with anti-money laundering/combating the financing of terrorism (AML/CFT) rules far outweigh the potential profitability from these activities. While

[11] The results are similar using the ratio of the number of MTOs to the number of banks.

Table A2
First-stage regression.

Dependent variable	Transaction cost ($200, log)
Share of MTOs	-0.839
	[0.107]***
GDP per capita (log), receiving country	0.046
	[0.044]
GDP per capita (log), sending country	0.006
	[0.101]
USD exchange rate (log)	-0.107
	[0.049]**
Migrant population (log)	-0.192
	[0.137]
Constant	0.000
	[0.000]
Observations	2,111
Number of countries	69
R2	0.16

Notes. Fixed effect estimations. Time dummies included. Robust standard errors in brackets. *,**,*** denote significance at 10 percent, 5 percent and 1 percent, respectively. USD exchange rate denotes the units of local currency per USD.



Notes: Shaded area represents the 90 percent confidence interval.
Source: Authors' calculations.

Figure A1. Cost-Elasticity of Remittances: Instrumental Variable Local Projections, Notes: Shaded area represents the 90 percent confidence interval. Source: Authors' calculations.

countries that have lost CBRs were able to redirect remittances via alternative channels, generally this has come at a higher cost and reduced the scope of services, resulting in higher market concentration (IMF, 2017).

Unfortunately, the CBRs time series data published by the Committee on Payments and Market Infrastructures (CPMI) are only available at the sub-region level.[12] We use the weighted average number of active correspondents by sub-region[13] to test the heterogeneity of the cost elasticity of remittances with respect to CBR development. The results should be interpreted with caution, given the implicit assumption that CBR trends at the country level are correlated with that of the region. Fig. 9 shows that remittances appear to react more to costs where the number of correspondent banks is smaller.

[12] https://www.bis.org/cpmi/paysysinfo/corr_bank_data.htm.

[13] Average number of active USD, EUR and GBP correspondents, weighted by the volume of USD, EUR and GBP transactions by sub-region.

3.4. Cost-adaptation policies

- Price transparency

Opaque transaction costs create information asymmetries that distort competition and undermine the ability of remittance senders and receivers to choose the most cost-effective option that meet their needs. While the consumer generally is informed of the transfer fee, the awareness of the cost of the foreign exchange is typically unknown (Ratha and Riedberg, 2005). In some cases, a higher exchange rate margin reflects exchange rate risks, but there is mounting evidence that it can also conceal hidden transfer fees.

To measure price transparency, we use the share of remittance providers classified as "transparent" from the World Bank Remittance Prices Worldwide database. A remittance service provider is categorized as transparent if it provides the exchange rate applied to the transaction, and non-transparent otherwise. At the 10th percentile of the sample (85 percent of transparent remittance service providers), the elasticity of remittances is −0.23 in the first quarter following a shock to transaction cost. This elasticity drops to -0.09 for countries where all remittance service providers are deemed transparent (Fig. 10). This implies that for countries with low levels of transparency, cost reduction has a large impact on remittances, but as price transparency improves, this marginal effect declines.

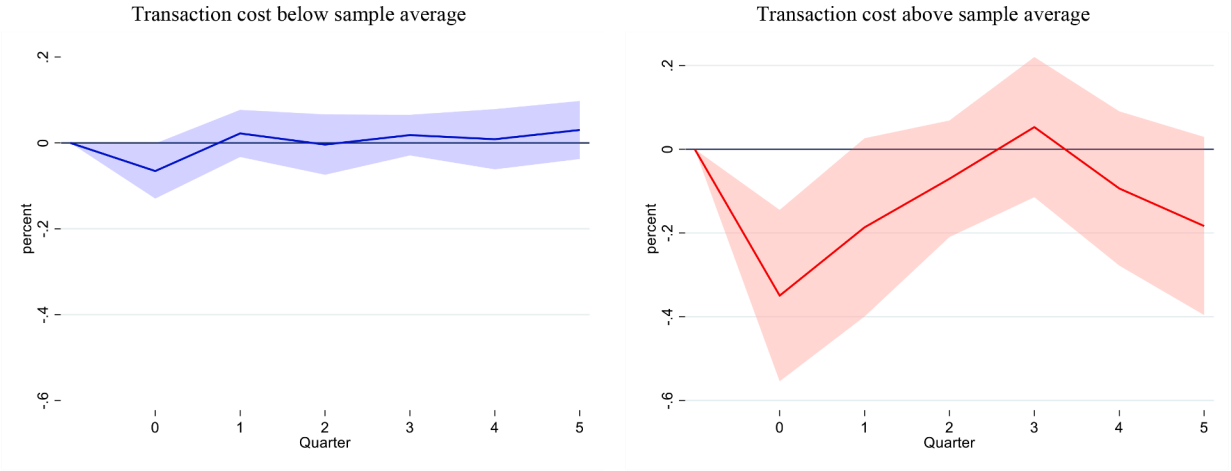
- Financial Literacy

Limited financial literacy constrains the ability of migrants and their families to take full advantage of the range of remitting options available and internalize all information available in the decision to select the most cost-effective option, particularly in an environment where price transparency is a source of concern. Remitters with limited financial literacy may also tend to stick to the remittance service they are used to, potentially forgoing the opportunity to switch to a new remittance provider that is less costly or provides a better service. Put differently, if it is the case that individuals are not familiar with certain products, they will not demand them. Additionally, the lack of financial literacy can also push some migrants to the informal remittance market. Kosse and Vermeulen (2014) find that more highly educated migrants are less likely to transfer cash via informal intermediaries or to carry cash themselves. Considering the above arguments, boosting financial literacy has the potential to spur price awareness and reduce migrants' reliance on informal remittance channels. It also facilitates the adoption of innovative remittance services, and stimulates competition, thereby contributing to reduce costs.

Absent a widely available indicator of financial literacy, the gross secondary school enrollment rate of the home country is used as a proxy in the literature, given that studies document a strong correlation between education and financial literacy (see Van Rooij, Lusardi, and Alessi, 2011; World Bank Group 2017). As expected, the IRF shows that in countries with a highly educated population, remittances appear to be less sensitive to transaction costs than in countries with low levels of education (Fig. 11).[14]

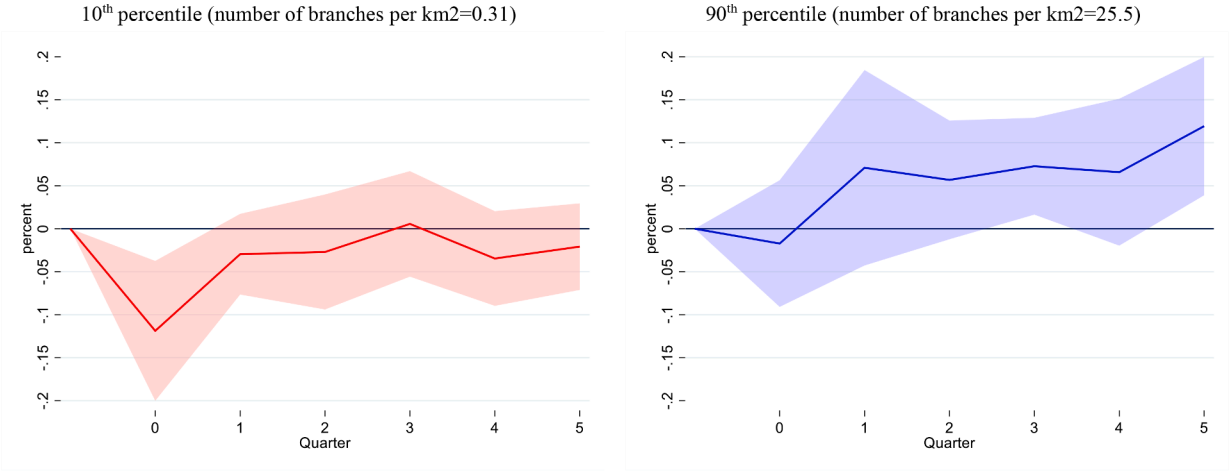
As an alternative indicator of financial literacy, we use the number of deposit accounts with commercial banks, since financial literacy goes

[14] The implicit assumption is that the education level of migrants is correlated with that of their home country. One could argue that those who migrate are typically more educated, and in this case, the elasticity shown in Figure 11 might be smaller in absolute terms. This should not have a material impact on the findings if the difference between the education level of migrants and that of the home country does not substantially vary across countries. In the case it does, the country fixed effects will also help control for that. Additionally, not only does the level of financial literacy of the migrant matter, that of the families at the receiving end also does.



Notes: Shaded area represents the 90 percent confidence interval. The IRFs is obtained by interaction the variable on transaction costs with a dummy variable taking 1 if they are above the sample average and zero otherwise.
Source: Authors' calculations.

Figure A2. Cost-Elasticity of Remittances: Low vs High Transaction Cost, Notes: Shaded area represents the 90 percent confidence interval. The IRFs is obtained by interaction the variable on transaction costs with a dummy variable taking 1 if they are above the sample average and zero otherwise. Source: Authors' calculations.



Notes: Shaded area represents the 90 percent confidence interval.
Source: Authors' calculations.

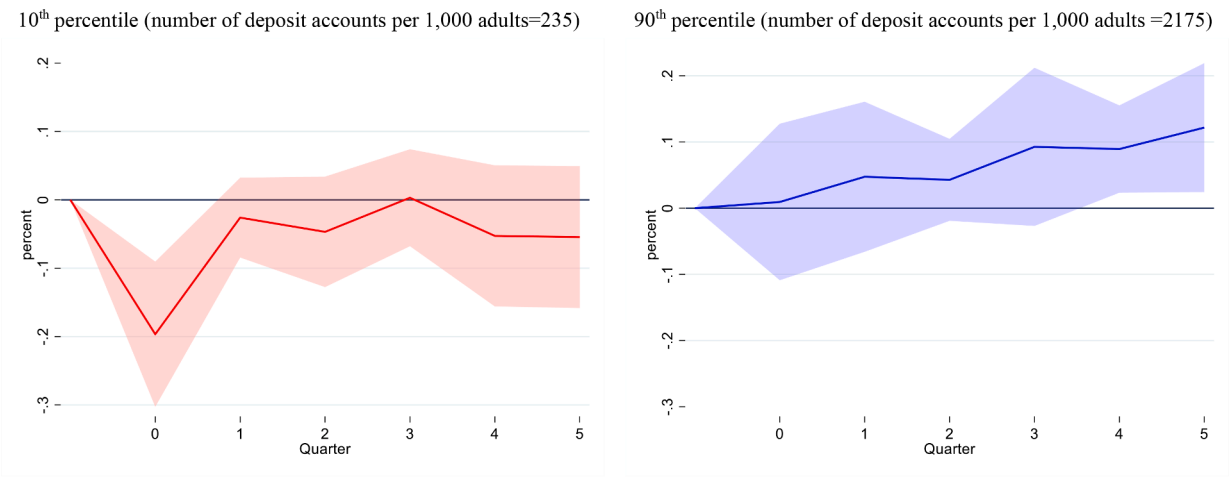
Figure A3. Cost-Elasticity of Remittances with respect to the Geographical Coverage of Financial Institutions. Notes: Shaded area represents the 90 percent confidence interval. Source: Authors' calculations.

hand in hand with financial inclusion. The results support the evidence that where financial inclusion is low (and most likely where the lack of financial literacy is widespread), high transaction costs do have a bearing on remittances (see Annex Fig. 4).

- Information and communication technologies (ICT)

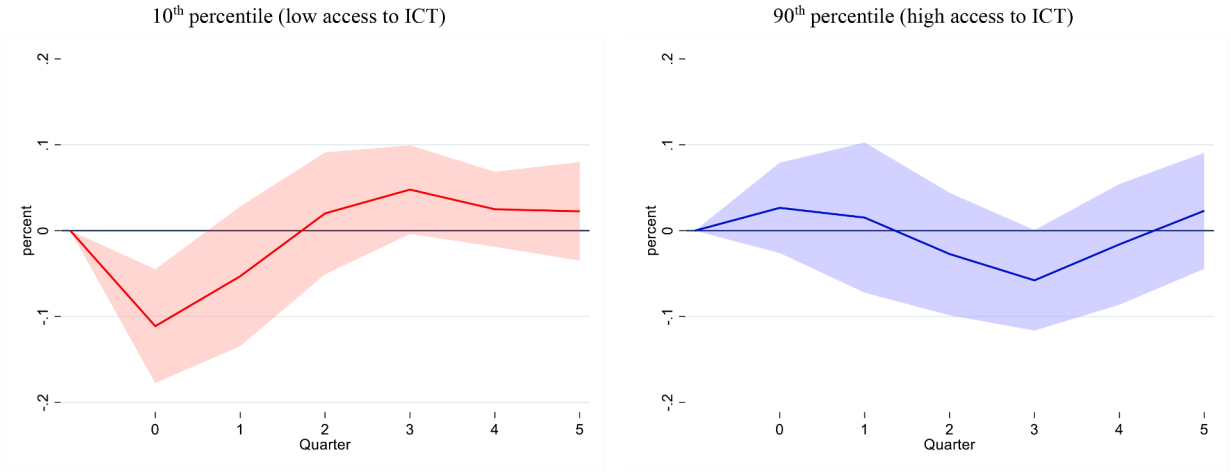
ICT development has transformed the remittance market in several ways. First, it has enabled Fintech companies to enter the market, with the resulting increase in competition has helped bring down transaction costs. Second, it fosters digital remittances, which have increased significantly in the wake of the COVID-19 pandemic. Digital remittances do not require a trip to the remittance provider to initiate the transfer or to receive the fund, and increasingly bypass the traditional payment system, resulting in lower transaction costs for migrants. Advancements in mobile money have already demonstrated that financial services can be provided cost-effectively to unbanked and under-banked populations (e.g.; M−PESA in Kenya;–see also Andrianaivo and Kpodar (2012) on financial inclusion and mobile phone penetration). Not only does ICT development contribute to cost reductions in the remittance market, but it also has the power to reduce information asymmetries. The information economics literature has illustrated how incomplete information raises transaction costs and prevents financial markets from achieving socially efficient outcomes (Stiglitz, 2017).[15] ICT development improves access to the Internet, thus enabling remitters to compare costs across various remittance services and selecting the most competitive option. Therefore, it can reduce considerably information costs where price transparency is weak (De Arcangelis et al., 2023).

[15] A key insight of information economics literature is that social returns to information typically differ from private returns, in some cases, they are greater, and in others, lower. In the case of remittances, the social costs of not being able to send remittances may be even higher than the private costs if remittances get invested by recipients in areas such as health and education that produce high social rates of return.



Notes: Shaded area represents the 90 percent confidence interval.
Source: Authors' calculations.

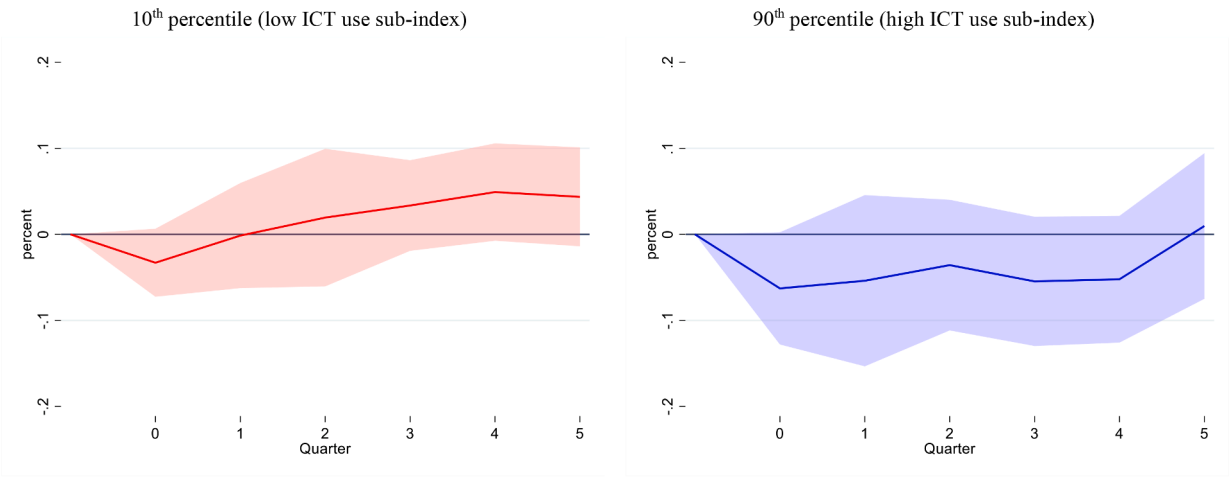
Figure A4. Cost-Elasticity of Remittances with respect to Access to Deposit Accounts. Notes: Shaded area represents the 90 percent confidence interval. Source: Authors' calculations.



Notes: Shaded area represents the 90 percent confidence interval. The ICT access sub-index is calculated as the average of the normalized value of the number of fixed telephone subscriptions per 100 inhabitants, number of mobile-cellular telephone subscriptions per 100 inhabitants, international Internet bandwidth per Internet user, proportion of households with a computer, and proportion of households with Internet access. Variables are normalized to have a zero mean and unit variance.
Source: Authors' calculations.

Figure A5. Cost-Elasticity of Remittances and ICT Access. Notes: Shaded area represents the 90 percent confidence interval. The ICT access sub-index is calculated as the average of the normalized value of the number of fixed telephone subscriptions per 100 inhabitants, number of mobile-cellular telephone subscriptions per 100 inhabitants, international Internet bandwidth per Internet user, proportion of households with a computer, and proportion of households with Internet access. Variables are normalized to have a zero mean and unit variance. Source: Authors' calculations.

To capture ICT development, we use the ICT Development Index (IDI) compiled by the International Telecommunication Union (ITU). The IDI comprises 11 indicators divided into 3 groups measuring ICT



Notes: Shaded area represents the 90 percent confidence interval. The ICT use sub-index is calculated as the average of the normalized value of the percentage of individuals using the Internet, fixed (wired)-broadband subscriptions per 100 inhabitants, and wireless-broadband subscriptions per 100 inhabitants. Variables are normalized to have a zero mean and unit variance.
Source: Authors' calculations.

Figure A6. Cost-Elasticity of Remittances and ICT Use. Notes: Shaded area represents the 90 percent confidence interval. The ICT use sub-index is calculated as the average of the normalized value of the percentage of individuals using the Internet, fixed (wired)-broadband subscriptions per 100 inhabitants, and wireless-broadband subscriptions per 100 inhabitants. Variables are normalized to have a zero mean and unit variance. Source: Authors' calculations.

access,[16] ICT use[17] and ICT capability[18] (see International Telecommunication Union ITU, 2014, for more details).[19] The IDI is the simple average of the 3 sub-indices, themselves computed as the simple average of the normalized value of their components.[20] Fig. 12 shows the IRFs for the high and low regimes of overall ICT development and for the 3 dimensions: access, use, and capability, the results are shown in Annex Fig. 5, 6 and 7, respectively.

As expected, higher ICT development is associated with a lower cost-elasticity of remittances. We find the same result for ICT access and ICT capability, but surprisingly the result is not conclusive for the ICT use sub-index. This suggests that the individual dimension of ICT development may not matter taken in isolation, but in aggregate, their complementarity plays an important role.

A key dimension missing from the IDI is ICT affordability, which has been a severe constraint to ICT diffusion in many developing countries. We construct an ICT affordability index[21] and re-run the IRF. The results show that the elasticity of remittances to transaction costs is stronger in countries with high ICT costs than in those with low ICT costs (Fig. 13). Combining the 4 dimensions of ICT development into an augmented IDI index also confirms the earlier results.[22]

3.5. . *Examining the response of remittances to transaction cost: evidence from microdata from the US-Mexico Corridor*

In this section, the objective is to use micro-data to test the robustness of the results found at the macro-level to the extent that the relevant variables are available. The micro-analysis focuses on the US-Mexico corridor for several reasons. First, it is the largest corridor in the world, with a volume of remittances of about US$25bn in 2017, more than 70 percent higher than the second largest corridor: USA-China. Second, it also one of the most competitive remittance markets, although transaction costs have not declined much in the past decade, given that they were already relatively low to start with. The total number of remittance service providers increased from 20 in 2011 to 26 in 2020, reflecting the entrance of new MTOs. While the number of banks providing remittance transfers declined from 7 in 2011 to 4 in 2020, the number of MTOs increased from 13 to 22 over the same period.[23] Yet, the cost of a US$200 remittance, which stood at 5.5 percent in 2011, only declined slightly to 4 percent in 2020. Third, it is

[16] The access sub-index includes five indicators: fixed telephone subscriptions per 100 inhabitants, mobile-cellular telephone subscriptions per 100 inhabitants, international Internet bandwidth per Internet user, proportion of households with a computer, and proportion of households with Internet access. All data are provided by the ITU.

[17] The use sub-index includes three indicators: percentage of individuals using the Internet, fixed (wired)-broadband subscriptions per 100 inhabitants, and wireless-broadband subscriptions per 100 inhabitants. All data are taken from the ITU database.

[18] The capability sub-index includes three indicators as well: adult literacy, gross secondary enrolment, and gross tertiary enrolment. All data are provided by the World Development Indicators (WDI, World Bank).

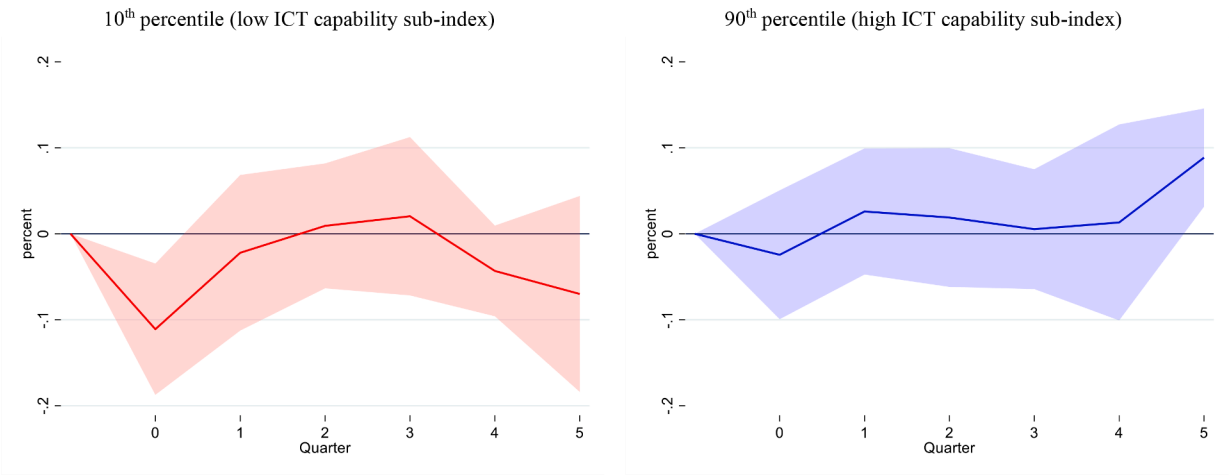
[19] Given that the IDI was discontinued in 2017 pending the addition of newly adopted indicators, for the purpose of this study, we recalculate the index using the underlying variables.

[20] The normalized variables have a zero mean and unit variance. We also used a max–min transformation; the econometric findings are similar. It should be noted that the IDI calculated by the ITU does not normalize the underlying variables. Also, it attributes a 40 percent weight for the access sub-index, 40 percent for the use sub-index and 20 percent or the capability sub-index. In this paper, the underlying variables are normalized to ensure that the scales are fully comparable, and all sub-indices are equally weighted to avoid assigning a subjective weight to a component.

[21] The affordability index used in this paper consists of 3 indicators: fixed-broadband monthly subscription charge, price of 3-minute mobile local call (off-peak rate), and price of a 3-minute local call to a fixed-telephone line (off-peak rate). All data are provided by the ITU.

[22] Since lower ICT affordability is a negative outcome, the multiplicative inverse of this sub-index is used in combination with the access, use and capability sub-indices to compute the augmented IDI index.

[23] The number of remittance operators may not reflect the wide array of remittance services available to migrants. For instance, the "Directo a México" program links the US domestic payment system to Mexico's allowing to send remittances from the US to Mexico at competitive rates.



Notes: Shaded area represents the 90 percent confidence interval. The ICT capability sub-index is calculated as the average of the normalized value of the adult literacy rate, gross secondary enrolment rate, and gross tertiary enrolment rate. Variables are normalized to have a zero mean and unit variance.
Source: Authors' calculations.

Figure A7. Cost-Elasticity of Remittances and ICT Capability. Notes: Shaded area represents the 90 percent confidence interval. The ICT capability sub-index is calculated as the average of the normalized value of the adult literacy rate, gross secondary enrolment rate, and gross tertiary enrolment rate. Variables are normalized to have a zero mean and unit variance. Source: Authors' calculations.

to our knowledge the only corridor with publicly available micro-data[24,25].

The annual survey was carried out by the Bank of Mexico from 2013 through 2017. The survey took place in December of each year and was administrated to Mexican citizens residing in the US who visited Mexico by land or air. It covers demographic characteristics of migrants, the amount and frequency of remittances sent to their families, the fees paid and the means of transfer. The sample size varies over the years from 6,800 to 13,000 individuals. The survey questions also vary somewhat from one year to the next, though it was reasonably straightforward to combine the yearly surveys. It is not a "true panel", as the individuals cannot be tracked over time (De Arcangelis et al., (2023) carry out a novel microstudy along similar lines).

We adopt a simple linear model where we regress the volume of remittances sent in a year per individual on the fees reportedly paid as well as the socio-economic characteristics of the individual. Since the survey does not allow to identify the individuals over time, the identification of the elasticity of remittances to cost relies on the cross-sectional dimension of the dataset.[26]

Table 2 shows the results from the fixed-effect estimations, which provide strong evidence of the detrimental impact of high transaction costs on remittances. The coefficient on transaction costs is negative and highly significant for all specifications, suggesting that migrants who face higher transaction costs tend to remit less, even after controlling for their income level, age, gender, level of education and the number of years lived in the US. The results are similar when the regressions are estimated for each survey year separately (results available upon request). The regressions also include time dummies, fixed-effects for the US state of residence, the state of residence of their families in Mexico and the sector of employment in the US.

Regarding the control variables, income is positively correlated with remittances, while men appear to remit more than women. Age is negatively associated with remittances, but the coefficient becomes insignificant once the number of years the individual lived in the US is controlled for. While this is not surprising since there is a strong correlation between the two variables (the correlation coefficient is 0.7), this result implies that as Mexican migrants stay longer in the US, they send less money back home, probably reflecting loosening family connections with the home country. Consistent with Faini (2007), we also find that more skilled migrants exhibit a lower propensity to remit.

In the previous section, we highlighted the role of financial literacy in dampening the sensitivity of remittances to transaction costs. The same hypothesis is tested with the microdata by introducing an interaction term between the education level of the migrant and the transaction costs. The finding in column 2 of Table 3, points to a lower elasticity among skilled migrants as the coefficient on the interaction term is positive and statistically significant. Since the survey also collect information on whether the remittance sender or receiver has a bank account, this dummy variable is used as a proxy of financial literacy and is interreacted with transaction costs. The results show that access to a bank account for both the sender and remitter (columns 3 to 7) is associated with a lower cost elasticity for remittances.

As remittance providers tend to charge more for smaller amounts, this could raise a concern about a potential endogeneity. Table 4 deals with this issue in three ways. First, the transaction costs are instrumented by the type of service provider or medium of transfer used.[27] The idea is to exploit the cost differential between providers such as banks and MTOs, as done for the panel IRF. The result presented in Table 4 (column 1) shows that the elasticity from the IV estimation is not materially different from the previous estimates in Table 2. Second, since migrants that remit more frequently are those that send small amounts, the frequency of remittances is added to the specification to indirectly control for the size of the remittances. In addition, the share of remittances in the income of the remitter is used as a dependent variable as it is likely to be less correlated with transaction costs than the

[24] See the Bank of Mexico's website for the data: https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=1&accion=consultarCuadro&idCuadro=CE179&locale=en.

[25] There are several studies on remittances to Mexico (e.g Amuedo-Dorantes and Pozo, 2006; Cox-Edwards and Rodríguez-Oreggia, 2009; Demirguc-Kunt, Lopez Cordova, Martinez Peria, & Woodruff, 2011; Alcaraz, Chiquiar and Salcedo, 2012; Chiodi, Jaimovich, and Montes-Rojas, 2012; Mora-Rivera and van Gameren, 2021), but none of them focuses on the transaction costs.

[26] The local projection method is not applicable here because the data are not a true panel, and the time dimension is very limited.

[27] This variable includes 11 categories, with banks and MTOs being the most common.

numerator itself. The result (column 2, Table 4) confirms the previous findings. Third, we kept the specification in column 2, and instrument the cost by the type of service provider as in column 1. Once again, the transaction costs continue to show a statistically significant and negative sign, although the magnitude is lower than previously seen.

4. Conclusion

This paper uses a novel quarterly data set for 71 countries over a 10-year period, from 2011Q1 to 2020Q4, to investigate the elasticity of remittances to transaction costs. The results confirm the priors. A 10-percentage point decrease in transaction costs leads to a 0.9 percent increase in remittance received in the short-run, but has no discernible impact in subsequent quarters, suggesting a short-run effect on the changes in remittances, but a persistent effect on remittance levels. This result implies that moving from the 2020 level of transaction costs (6.3 percent) to the SDG target of 3 percent will generate an additional US $32.2 billion in remittances, much larger than the direct cost savings. Therefore, migrants would not only fully pass the cost savings to their families, but also send more than they used to (implying an elasticity greater than one). This confirms the powerful nature of cost reductions of remittance flows.

Since remittance costs continue to remain high in many countries, the paper looks at two broad sets of policies: cost mitigation and cost adaptation that can help reduce the adverse effects of high transaction costs on remittances. While cost-mitigation policies directly tackle the root causes of high remittance costs, cost adaptation policies seek to reduce information asymmetries in the remittance market. Looking at the cost-mitigation policies, the econometric results suggest that when competition in the remittance market is high, the financial system is more developed, and transactions with correspondent banks hold up, the elasticity of remittance to transaction costs is much lower, *ceteris paribus*. This indicates that high transaction costs have lower impacts on remittances sent in these cases, and lower remittances flowsthrough informal channels. Regarding cost-adaptation policies, the results indicate that more transparency on remittance transaction costs, improved financial literacy and higher ICT development inhibit the sensitivity of remittances to high transaction costs, all else equal. The low level of elasticity reflects the decreasing returns to scale of these policies, but this should not undermine efforts to reduce remittance costs. This is because the low level of elasticity occurs at the frontier of the reform, and many developing countries experiencing high remittance costs are still far from this frontier. Consequently, they stand to gain sizably from implementing these reforms. Further, our results imply that it will be the combination of reforms in many areas that will cumulatively impact remittance flows.

The paper also uses microdata from the USA-Mexico corridor with over 37,000 individuals surveyed during 2013–17 to confirm that migrants who face higher transaction costs tend to remit less, after controlling for socio-economic characteristics. Education levels and access to a bank account in particular diminish some of the cost-elasticity of remittances, confirming the findings from the panel results.

While remittances are mostly an individual decision, governments have an important role to play in influencing that decision: they can promote competition among banks and money transfer operators through adapting regulations. Forcing transfer companies to list transparently all their prices and providing information to migrants and their families could help them choose the most cost-effective remittance services, which would ultimately drive the costs down. Improving educational outcomes to facilitate the acquisition of financial literacy should be enhanced as well.

Although these various factors were identified to individually modify the elasticity of remittances to costs, there is an interdependence also between the various forces that typically reinforce each other. Therefore, moving on several fronts simultaneously would have a multiplicative effect. Deepening the financial system and improving financial literacy simultaneously will support each other further and help the remittance flows. Reducing the cost of remitting to the SDG target could significantly boost remittances, creating an important tool to enhance capital flows to developing countries to finance development without excessive government debt.

CRediT authorship contribution statement

Kangni Kpodar: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Software, Validation, Writing – original draft, Writing – review & editing. **Patrick Amir Imam:** Conceptualization, Methodology, Software, Validation, Writing – original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Annex 1. Sample composition[28]

Figs. A1–A7

Low-income countries	Lower middle-income countries	Upper middle-income countries	High income countries
Benin	Armenia	Albania	Hungary
Comoros	Bangladesh	Azerbaijan	Korea, Rep.
Gambia, The	Bolivia	Belarus	Lithuania
Haiti	Cabo Verde	Bosnia and Herzegovina	Poland
Liberia	Cambodia	Brazil	
Mali	Côte d'Ivoire	Bulgaria	
Mozambique	Egypt, Arab Rep.	China	
Nepal	El Salvador	Colombia	
Rwanda	Guatemala	Costa Rica	
Senegal	Honduras	Dominican Republic	

(*continued on next page*)

[28] According to World Bank classification.

(*continued*)

Low-income countries	Lower middle-income countries	Upper middle-income countries	High income countries
Togo	India	Ecuador	
Uganda	Indonesia	Fiji	
	Kenya	Georgia	
	Kyrgyz Republic	Jamaica	
	Moldova	Jordan	
	Morocco	Kazakhstan	
	Myanmar	Lebanon	
	Nicaragua	Macedonia, FYR	
	Nigeria	Mexico	
	Pakistan	Namibia	
	Papua New Guinea	Panama	
	Philippines	Paraguay	
	Samoa	Peru	
	Sri Lanka	Serbia	
	Tonga	Suriname	
	Ukraine	Thailand	
	Uzbekistan	Turkey	
	Zambia		

Annex 2. Summary Statistics and Correlation Matrix

1. Summary Statistics

Variables	Obs.	Mean	Std. Dev.	Min	Max
Remittances (in million USD, log)	2,165	6.0	1.9	-0.1	10.0
Transaction cost (in percent of a $200 remittance, log)	3,527	1.9	0.6	-0.8	3.4
Transaction cost (in percent of a $500 remittance, log)	3,526	1.5	0.5	-0.7	3.3
GDP per capita (in thousand USD, log), receiving country	3,419	8.0	1.0	5.7	10.1
GDP per capita ((in thousand USD, log), sending country	3,470	10.2	0.6	7.0	11.1
Exchange rate (LCU per USD, log)	3,324	3.9	2.6	-1.2	10.3
Migrant population (log)	3,458	13.6	1.5	8.3	16.7
Population in millions (log)	2,932	2.6	1.7	-2.3	7.2

2. Correlation Matrix

Variables		1		2		3		4		5		6		7		8
Remittances (in million USD, log)	1	1														
Transaction cost (in percent of a $200 remittance, log)	2	-0.25	***	1												
Transaction cost (in percent of a $500 remittance, log)	3	-0.34	***	0.95	***	1										
GDP per capita (in thousand USD, log), receiving country	4	0.00		-0.19	***	-0.21	***	1								
GDP per capita ((in thousand USD, log), sending country	5	0.15	***	-0.04	**	-0.06	***	0.55	***	1						
Exchange rate (LCU per USD, log)	6	0.00		0.14	***	0.17	***	-0.46	***	-0.33	***	1				
Migrant population (log)	7	0.71	***	-0.36	***	-0.39	***	0.09	***	0.02		0.07	***	1		
Population in millions (log)	8	0.68	***	-0.05	***	-0.10	***	-0.13	***	-0.02		0.25	***	0.72	***	1

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.worlddev.2024.106537.

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