The Foreign Currency Risk of International Remittances *

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Abstract

Money transfer operators quote international remittance fees before acquiring the destination currency, so the foreign currency risk raises their marginal cost of delivery whenever hedging is incomplete. We formalize this channel and test it using 35,489 cash-to-cash products across 342 corridors from 2011 to 2024. Remittance fees move with exchange rate volatility, as a measure of foreign currency risk. We establish this using conditional variation across corridors and the quasi-experimental increase in volatility on third-party currencies that followed the Swiss National Bank's decision to abandon the franc's euro floor in 2015. Operators raise the exchange rate margin rather than the fixed fee. The increase is largest where hedging markets are thin and operators are geographically concentrated, and it is followed by lower profits and by exit. A structural model attributes 10 to 25 percent of remittance prices to currency risk, with these magnitudes being comparable to the contribution of mark-ups.

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1 Introduction

International remittances are the largest source of external finance for many low and middle income countries, and the price of sending them is one of the few internationally monitored consumer financial prices in the world. However, a decade of digital entry, high level of bankruptcies, mobile money, and regulatory attention has left the global average cost of a small transfer close to twice the target set by the international policy community, with wide and persistent dispersion across corridors that serve otherwise similar populations (World Bank, 2024). The conventional account attributes this to limited competition, informality, and the fixed costs of compliance and cash distribution (Beck and Martínez Pería, 2011). We propose and quantify a distinct determinant that operates on the supply side of the market and through wholesale currency markets: the cost to the intermediary of bearing foreign exchange risk that it cannot hedge.

The mechanism follows from how a money transfer operator (MTO) actually delivers a transfer. The operator quotes a price, in the form of a monetary fee plus a margin over the interbank exchange rate, at the moment the sender walks in. It commits at that point to delivering a fixed amount of destination currency. It sources that currency afterwards, through spot purchases, correspondent banks, or pre-funded local balances. The gap between the quote and the settlement leaves an uncovered currency requirement that must be closed. Where forward and swap markets in the destination currency are deep, closing it is nearly costless and the operator's price need not reflect volatility. Where those markets are thin, expensive, or unavailable, the operator absorbs the residual through spot trading at unfavourable moments, through local borrowing, or through holding precautionary balances. Volatility therefore enters the operator's marginal cost of delivering a transfer, rather than appearing as a risk premium on a position the firm chose to take. The distinction matters for interpretation: an operator can compete vigorously on price, and still charge more when the destination currency becomes volatile.

We formalise this mechanism in a model of horizontally differentiated money transfer operators. Firms set prices before the exchange rate is realised and incur an additional cost when adverse exchange-rate movements create an uncovered currency requirement. Greater volatility raises equilibrium prices and reduces short-run profits. With endogenous entry, the same cost shock reduces the equilibrium number of operators. The model also distinguishes currency risk from market power. Concentration determines the mark-up over marginal cost, while imperfect hedging changes marginal cost itself. Observed remittance prices can therefore remain high even in markets where firms compete actively.

Our main source of data come from the World Bank's Remittance Prices Worldwide database. This sample contains 35,489 cash-to-cash transfer products offered by money transfer operators between 2011 and 2024. An observation identifies an operator, a sending country, a receiving country, and a quarter-year. We restrict the sample to same-day transfers that require currency conversion and pay out in the destination country's local currency. For each product, we observe the monetary fee and the spread over the interbank exchange rate. We match these data to daily exchange rates and implied volatility from Bloomberg, FX and derivatives turnover from the Bank for International Settlements, operator financial statements from Orbis and FactSet, and bilateral remittance volumes from the World Bank and KNOMAD.

Identifying the effect of foreign currency risk on prices is difficult because volatility in a destination currency is typically the endogenous outcome of local conditions that also move remittance demand, migrant income, and the cost of cash distribution. We address this in two steps. We first document the conditional correlations, using bilateral corridor volatility and, separately, episodes in which corridor volatility exceeds two standard deviations above its historical mean. We then turn to a source of variation that affects the corridors under study but originates outside them. On 15 January 2015 the Swiss National Bank unexpectedly discontinued the franc's peg to the euro. The franc appreciated sharply and investors unwound positions funded in francs, which raised volatility disproportionately among the currencies that had served as the investment leg of those positions. Auer et al. (2021) use the same event to study exchange rate pass-through into Swiss import prices. We instead exploit the differential unexpected volatility between currencies exposed to this carry trade (like the Norwegian Krone) and unexposed (like the Euro) with third-country currencies (like the Moroccan Dirham) to identify how changes in currency risk, exogenous to local economic characteristics, affect remittance operators and fees.

Our measure of predetermined exposure uses each currency's 2014 interest-rate differential relative to the Swiss franc, scaled by its option-implied volatility, capturing the attractiveness of positions in each currency before the policy change. The exposed group consists of 142 bilateral corridors, 30% of which belong to the treatment group. Following the removal of the floor, the volatility of exposed currencies increased between 49 and 62 per cent of its unconditional mean relative to the control group. The increase appears abruptly in the first quarter of 2015, persists for up to one year, and is absent before the event.

The event-study compares transfers to the same destination countries from exposed and unexposed high-income sending countries. We exclude transfers involving the Swiss franc and destinations experiencing severe contemporaneous depreciations to focus on the quasi-experimental heightened currency volatility induced in the market. The treatment and control groups are balanced on observed macroeconomic and demographic characteristics. Corridor fixed effects absorb persistent differences across sender-recipient country pairs, while firm-quarter fixed effects absorb time-varying shocks common to an operator (such as changes in pricing decisions). We estimate dynamic effects using the Borusyak et al. (2024) estimator, which accommodates heterogeneous treatment effects through a two-stage imputation procedure.

The price response is immediate and economically meaningful. In the quarter of the Swiss franc shock, the cost of a $200 transfer from an exposed country rises by 0.78 percentage points relative to the control group. This increase is equivalent to approximately $1.60 per transaction and 11 per cent of the sample mean. The estimate is consistent with the evidence from the full sample. A one-standard-deviation increase in ordinary bilateral volatility is associated with a price increase of 0.08 percentage points, while an exceptionally large and persistent volatility episode raises prices by 0.51 percentage points. The larger responses to abrupt shocks indicate that the relation is nonlinear: routine fluctuations have modest effects, whereas movements that disrupt foreign currency markets produce substantial repricing.

Operators adjust the component of the tariff most directly connected to currency conversion. The Swiss franc shock and the broader volatility measures raise the variable fee, which largely reflects the margin applied to the market exchange rate. The fixed monetary fee does not respond systematically, despite accounting for approximately half of the average price. This composition is consistent with a shock to the marginal cost of supplying foreign currency. It is harder to reconcile with a general increase in administrative costs, which would naturally affect the fixed component, or with a common change in an operator's pricing policy, which the firm-quarter fixed effects absorb.

The cross-section of price responses provides further evidence on the mechanism. We use turnover in forwards, swaps, currency swaps, and options as a proxy for the depth of the destination currency's hedging market. Price pass-through is weaker for currencies with deeper derivatives markets and becomes materially stronger during exceptional volatility episodes when hedging markets are shallow. Operators' geographic scope produces a similar pattern. Firms active in more countries or corridors raise prices less following currency shocks than geographically concentrated operators. The result is consistent with firms using diversification as an operational hedge, because exposures and funding needs can be offset across markets.

Several results distinguish the supply-side interpretation from changes in remittance demand. Annual bilateral and country-level remittance volumes do not increase following the Swiss franc shock. The dynamic estimates also show no differential volume response among exposed countries. While the frequency of the volume data limits our ability to detect short-lived changes in demand, it is still useful as evidence against a demand surge large enough to account for the price increase. The timing of market structure responses points in the same direction. Prices rise in the quarter of the currency shock, whereas the number of operators declines only in subsequent periods. This sequence is consistent with an initial increase in operating costs followed by delayed market exit.

To assess whether volatility shocks affect operators through changes in marginal costs, as suggested by the previous results, we examine firm financial statements, which provide direct evidence on profitability. A one-standard-deviation increase in the share of an operator's corridors experiencing exceptional volatility is associated with a 1.7 percentage point reduction in its EBIT margin. Exposure to the Swiss franc episode produces a larger decline, although the smaller firm-level sample warrants caution about its precision. At the corridor level, the shock is followed by the loss of approximately 0.7 operators, around 20 per cent of the unconditional mean. Currency risk therefore affects consumers through both its immediate pass-through into prices and its subsequent effect on market participation.

We quantify the importance of this channel by estimating a model of remittance demand, marginal cost, and endogenous entry. The approach adapts Leone et al. (2025) and the entry framework of Berry and Waldfogel (1999) to the remittance market. We instrument a corridor's price with the lagged average price of other remittance products originating in the same sending country. The estimated price elasticity of formal remittance volumes is 1.82 in absolute value. Combining this elasticity with the observed number of operators identifies mark-ups and marginal costs, while exchange-rate volatility identifies the currency-risk component of marginal cost. A one-standard-deviation increase in volatility raises estimated marginal cost by approximately 14 per cent.

The model attributes between 10 and 25 per cent of the final remittance price to currency risk, depending on the destination region. The contribution is largest in South America and sub-Saharan Africa, where currency risk accounts for approximately 25 and 22 per cent of price, respectively. These estimates are comparable to the model-implied contribution of operating mark-ups. Currency risk also explains approximately 11 per cent of global price dispersion. Financial frictions are therefore quantitatively important for both the level and the cross-market variation of remittance prices.

The paper contributes first to research on the cost and organisation of cross-border payments, which continue to face significant challenges, particularly in corridors serving lower-income countries (Nilsson et al., 2022). Orozco (2006), Freund and Spatafora (2008) and Beck and Martínez Pería (2011) document how remittance costs vary with corridor characteristics, informality, and competition. Du et al. (2026) compare the costs of alternative cross-border payment rails. We identify a supply-side determinant of remittance prices that operates through currency markets, using product-level tariffs and externally generated variation in FX risk. The distinction between the fixed fee and the currency-conversion component, together with the evidence on profits and exit, connects transaction pricing to the underlying cost borne by the intermediary.

The paper also contributes to international finance. Research on FX liquidity and intermediation shows that currency-market depth varies substantially and affects trading costs and risk premia (Ramadorai, 2008; Mancini et al., 2013; Gabaix and Maggiori, 2015; Della Corte et al., 2016a; Ranaldo and De Magistris, 2022; Colacito et al., 2026). Related work studies carry-trade risk, currency crashes, and the exposure of firms to exchange-rate movements (Brunnermeier et al., 2009; Della Corte et al., 2016b; Ready et al., 2017; Amiti et al., 2022; Adams and Verdelhan, 2022; Du et al., 2024; Hommel and Piquard, 2025; Yoshimoto et al., 2025), as well as the role of market liquidity (Coppola et al., 2025, 2026) and technological innovation (Liao et al., 2026) in the context of the international monetary system. Seminal studies (Lustig and Verdelhan, 2007; Lustig et al., 2011, 2014) document the relationship among currency excess returns and global risk factors, while subsequent work provides theoretical foundations for these empirical patterns (Colacito and Croce, 2013; Colacito et al., 2018; Richmond, 2019; Andrews et al., 2024). We establish a link between these wholesale financial-market frictions and the retail price of an essential cross-border financial service. Currency risk affects households even when the end user does not hold foreign assets or trade directly in currency markets.

Finally, a growing body of work has drawn the attention to the design and the affordability of payment systems, especially in the context of low- and middle-income countries (Jack and Suri, 2014; Bourreau and Valletti, 2015; Prina, 2015; Björkegren, 2019; Aker et al., 2020; Brunnermeier et al., 2023; D'Andrea and Limodio, 2024; Breza et al., 2024). A long-standing stream of research in development economics has documented the importance of international remittances, showing how these flows may unlock virtuous cycles of human capital accumulation and economic growth by relaxing liquidity constraints of lower-income households (Yang, 2008b; Dinkelman and Mariotti, 2016; Theoharides, 2018, 2020; Cuadros-Menaca and Gaduh, 2020; Khanna et al., 2022; Egger et al., 2022; Dinkelman et al., 2024) or providing insurance against adverse shocks that hit local communities (Yang and Choi, 2007; Yang, 2008a; Jack and Suri, 2014; Riley, 2018). Our paper adds to the existing literature by showing that heightened currency risk and underdeveloped financial markets impose significant transaction costs on international remittances, to the detriment of the households that rely on them.

This connection has policy implications. Competition and price transparency remain useful for reducing mark-ups. However, they cannot eliminate the marginal cost created by an illiquid currency or incomplete access to hedging. Policies that deepen local FX and derivatives markets, improve operators' access to hedging instruments, or facilitate the netting of exposures across corridors may therefore complement conventional competition policy. The findings also imply that periods of currency instability can reduce market participation and weaken competition after the initial shock has passed. Policies aimed at lowering remittance costs should account for both market power and the financial infrastructure through which operators manage currency risk.

2 Institutional and theoretical framework

2.1 The remittance and foreign exchange markets

This section outlines the main institutional features of the international money transfer business and the FX market, providing the necessary background for the subsequent analysis.

2.1.1 The business of Money Transfer Operators

Money Transfer Operators (MTOs) offer one of the most popular choices to send remittance money across international borders[1]. Among the main reasons behind this preference are the near-immediate availability of funds and the fact that neither the sender nor the recipient is required to hold a bank account. The latter is especially relevant in low- and middle-income economies, where substantial segments of the population remain without access to a financial account (e.g., Demirgüç-Kunt et al., 2022). To provide this service, MTOs rely on a dense network of customer-facing agents and correspondent banking relationships (World Bank, 2007; Du et al., 2026). Consider, for example, a sender wishing to transfer €100 from Italy to India, with the funds to be disbursed in Indian rupees and collected in cash from the payout agent closest to the recipient. When initiating the transaction, the customer is quoted the exchange rate at which the euros she sends will be converted into Indian rupees. The agent in Italy collects the funds and immediately transmits the payment instruction to the agent in India through the MTO's information system. The payout agent in India typically has access to a pre-funded balance provided by the MTO, allowing the funds to be disbursed to the recipient within minutes.[2] This transaction gives rise to two distinct financial obligations on the MTO's balance sheet: a euro-denominated receivable from the agent located in Italy and a rupee-denominated payable to the agent located in India. Therefore, the settlement of the MTO's obligations occurs *with a delay* relative to the time in which the exchange-

[1] See for instance Ardic Alper et al. (2025).

[2] From Worldremit 2021 report: "To enable payment in the local currency, the Group prefunds many correspondent partners typically 24-48 hours in advance in accordance with expected volumes. The Group prefunds those correspondents using its cash balances and working capital facilities from third parties. The Group is exposed to foreign exchange risk during this process which is mitigated through speed of delivery between send and receive, efficient forecasting and regular conversion of send currencies into expected receive currencies. [...] To mitigate the foreign exchange risk further from fluctuations in exchange rates between prefunding correspondent partners and settlement, the Group uses forward contracts to hedge its currency risk".

rate has been agreed. This time lag exposes the MTO to the risk of exchange-rate fluctuations between the initiation of the transfer and the subsequent settlement of the corresponding obligations. Such uncertainty is particularly burdensome when hedging is expensive or liquidity is difficult to source at short notice, as is often the case for thinly traded currencies. We show that these frictions are passed through to end-user prices and quantify the resulting price effect.

2.1.2 The Foreign-Exchange market

The foreign exchange (FX) market is the largest financial market worldwide, with average daily turnover reaching $9.6 trillion in April 2025 (BIS, 2025). Against what could be expected from its big size, the FX market remains highly fragmented and opaque due to its OTC nature. Mancini et al. (2013) document significant variation in liquidity across currency pairs and over time, with relevant implications on trading costs. Moreover, FX markets in most low- and middle-income countries remain relatively shallow compared with those associated with a small number of advanced economies. Figure 1 documents this disparity. For each currency area with a population exceeding 10 million inhabitants, the figure plots data from the 2022 BIS Triennial Survey, reporting the average daily trading volume across all OTC foreign-exchange derivative instruments as a proxy for market depth, against World Bank estimates of GDP per capita. Both variables are shown on logarithmic scales. The figure reveals a clear positive relationship between FX trading activity and income per capita, with the US dollar standing out for its disproportionately high trading volume.

In light of the operational structure of international remittance payments, this stylized fact provides the motivation for our investigation. Because remittance flows are predominantly directed toward low- and middle-income countries, remittance operators must routinely manage substantial exposures to currencies that are often illiquid and risky, and thin derivatives markets further complicate operations.

2.2 Model

In order to have theoretical guidance for our empirical analysis, in this section we illustrate a simple model of the remittance market, building on the work of Salop (1979) on horizontally differentiated firms and extending it to include a currency risk component in the cost function.

There are infinitely many consumers uniformly distributed along a circular line, and each one of them has a unitary demand of foreign currency. Evenly spaced along the line, n identical companies operate and compete in the market.

2.2.1 Demand

Consider an individual that lives in between firm i and firm j, and let $x \in \left[0, \frac{1}{n}\right]$ be the distance from the former. Her utility from choosing firm i is

$$u_i = -p_i - tx,$$

where p_i is the price charged by firm i, and t a cost associated to the distance from a certain product. Then she will choose the service of firm i if $-p_i - tx > -p_j - t(\frac{1}{n} - x)$. The utility of the marginal consumer–indifferent to the choice between the two firms– is such that $u_i = u_j$, and given the uniformity of consumers' tastes, the demand for firm i's service can be easily derived from this equality by solving for $2x$:

$$D_i(p_i) = \frac{p_j - p_i}{t} + \frac{1}{n}.$$

This expression defines a standard downward-sloping demand function for a competitive market with differentiated products.

2.2.2 Supply

For each unit of foreign currency sold, firm i charges its customers the price p_i *before* the exchange rate at which the actual transaction will be done is known. The exchange rate is $\varepsilon \sim \mathcal{U}[-v, v]$, uniformly distributed over $[-v, v]$, where the parameter v represents volatility, as modelled in Choudhary and Limodio (2022).

If the realised exchange rate is lower than the price p_i, the firm makes a profit equal to the difference between the two, $p_i - \varepsilon$. However, and crucially, if the realised exchange rate is higher than the price charged by the firm, the firm has to pay an additional cost c for each unit of foreign currency:

$$\pi_i(p_i) = \begin{cases} (p_i - \varepsilon)D_i(p_i) & \text{if } p_i \geq \varepsilon \geq 0 \\ (p_i - \varepsilon - c)D_i(p_i) & \text{if } p_i < \varepsilon \end{cases}$$

A possible interpretation for this asymmetric cost function is that each extra unit of foreign currency purchased on the market that is not financed with the revenues received upfront has to be covered by costly borrowing. An alternative interpretation could be that c represents the cost of trading in an illiquid spot currency market whenever the firm is a net buyer of foreign currency.

Each firm then has to maximise its expected profits:

$$\max_{p_i} \ \mathbb{E}[\pi_i(p_i)] = \left(p_i - c\int_{p_i}^{v} d\mathcal{U}(\varepsilon)\right) D_i(p_i) \tag{1}$$

FOC yields:

$$\left(1+\frac{c}{2v}\right)\left(\frac{p_j-p_i}{t}+\frac{1}{n}\right)-\frac{1}{t}\left[\left(1+\frac{c}{2v}\right)p_i-\frac{c}{2}\right]=0$$

A symmetric solution (i.e. such that $p_i = p_j = p$) yields the following equilibrium price:

$$p^* = \frac{t}{n} + \frac{c}{2+\frac{c}{v}}$$

It is easy to show that the equilibrium price is increasing in v, and decreasing in n. Moreover, expected profits are given by:

$$\mathbb{E}[\pi_i(p^*)] = \left(1+\frac{c}{2v}\right)\frac{t}{n^2},$$

clearly decreasing in v and n.

2.2.3 Endogenous entry

In order to pin down the number of competing firms, we need non-null fixed costs F to operate in the market. Once we update the profit function to include fixed costs, we can set up the zero-profit condition and solve for n:

$$\left(p_i - c\frac{v-p}{2v}\right)\left(\frac{p_j-p_i}{t}+\frac{1}{n}\right) - F = 0. \tag{2}$$

This yields:

$$n^* = \sqrt{\left(1+\frac{c}{2v}\right)\frac{t}{F}}$$

and

$$p^* = \sqrt{\frac{tF}{1+\frac{c}{2v}}} + \frac{c}{2\left(1+\frac{c}{2v}\right)}.$$

We can now write down a full set of propositions that will guide our empirical analysis.

Proposition 2. *An increase in volatility v leads to:*

I. an increase in equilibrium prices p^*

II. a decrease in firms' profits π^* in the short-run

III. a decrease in the number of firms n^* in the long-run

Clearly, with an endogenous number of firms, we can not get formal predictions on the effect of volatility on profits, as we set them to zero. However, we can test the short-run prediction on the negative impact of currency risk on profitability, and we acknowledge that, in the long-run, in principle the effect is ambiguous, as on the one hand, volatility represents a cost for firms, but on the other hand, it also reduces competition in the market.

3 Empirical setting: data, samples and identification

How does currency risk affect the money transfer industry? Our empirical analysis to address this question proceeds in several steps.

We start by documenting a set of empirical facts that align with the theoretical framework outlined in Section 2. We rely on two different samples, each tailored to the specific empirical strategy employed, and on different levels of aggregation of the data. The first sample is the full set of cash-to-cash transfers available in the World Bank dataset we use after our cleaning and filtering procedure (cf. section 3.1), while for our event study around the Swiss Franc appreciation episode, we restrict our attention to a more homogeneous group of treated and control transfers. We use product-level data to study the pricing of money transfers, firm-level data to study the impact of currency risk on profit margins, and corridor-level data to examine implications on competition and aggregate volumes.

In this section, we first describe the data sources we draw from, then we present the two samples we use for our analysis, and finally we illustrate the institutional background that allows us to identify the effect of interest.

3.1 Data sources

Remittance Prices Worldwide database The main source of information for our analysis is the World Bank's Remittance Prices Worldwide (RPW) database[3].

The World Bank has collected information on the cost of sending money from a selected list of 48 remittance sending countries to 105 destinations, covering 367 corridors (pairs of sending and receiving countries) at a quarterly frequency, both contacting via telephone surveys and connecting to the websites of those companies whose market shares are supposed to add up at least to 80% within each corridor[4]. The result is an extraordinarily rich set of information on transfer fees that vary across corridors, firms and types of service offered. Its multidimensional structure allows us to examine variation at a level of granularity that complements existing contributions to the literature.[5] As of our last download, the dataset covers information from 2011Q1 until 2024Q3, for a total of 234,188 observations, each representing an option

[3] Available at `http://remittanceprices.worldbank.org`

[4] `https://remittanceprices.worldbank.org/methodology`

[5] Previous studies that used this dataset have generally considered more aggregate levels of variation, such as the cross-section of corridors and firms (Beck and Martínez Pería, 2011), or a more restricted timespan to provide comparisons with alternative payment rails (Du et al., 2026).

of sending money from a country to another choosing a certain type of service and operator.

The data come with a shape that is not immediately usable for our analysis, so we carefully cleaned it to obtain a sample that is suitable for our purposes — our procedure is described in detail in appendix A.

We restrict our analysis to money transfer operators (MTOs) only (no banks or other financial institutions), and focus on cash transfers sent from an MTO agent location and received in cash within the same day, in order to ensure a sample of homogeneous products. Importantly, we further restrict the attention to transfers that involve a service of currency conversion (i.e. the currency in which the transfer is sent is different from the one in which it is paid out) and paid out in the local currency of the country of destination of the transfer.

After our cleaning procedure, we are left with 34,680 observations corresponding to transfer options which are uniquely identified by a sender country s, a receiving country r, a firm f and a quarter t.

Exchange rate data from Bloomberg From Bloomberg, we download daily quotes of bid, ask and closing prices for all currencies in our sample against the US dollar. Using these data we also compute cross-currency exchange rates. Then, we construct two measures of currency risk, that we are going to describe in detail in section 3.3.

We also use Bloomberg data on the implied volatility of At-the-Money (ATM) options on the exchange rates to build our measure of exposure to the appreciation of the Swiss franc (the "carry-to-risk ratio"; see section 3.3).

Firm-level data from Orbis and Factset We carefully matched the firms in our sample with their financial information from Factset and Orbis databases based on their name and economic activity. Finding data for the MTOs in our sample is challenging, as many of them are small and private companies. We addressed this challenge by leveraging two data sources, Factset and Orbis, to mitigate potential gaps in coverage and increase the likelihood of correctly identifying firms through our name-search procedure. From these sources, we retrieved annual financial statements and obtained our profitability measure, that is the "EBIT margin (%)"; whenever this was not explicitly reported, we computed it as the ratio of Earnings Before Interest and Taxes (EBIT) to Revenues. We relied on consolidated financial statements whenever available, except in cases where the parent company's core business is not or not exclusively related to money transfers. For example, for Western Union, we use the group's consolidated data, which includes operations from subsidiaries incorporated in other countries (e.g., Western Union International Bank GmbH). In contrast, for iSend LLC, we use the company's standalone financials, rather than those of its parent company, Ezetop Unlimited, which is a holding company incorporated in Ireland and primarily active in software services[6].

Remittance volumes from KNOMAD and World Bank We incorporate estimates on annual bilateral remittance flows from 212 sending countries to 188 destinations, for the period 2015−2021, sourced from KNOMAD (Global Knowledge Partnership on Migration and Development), an initiative led by the World Bank active until 2024 that disseminated data and analyses on global migration. We also collect data from the World Bank's World Development Indicators on country-level outgoing annual remittance flows, spanning our whole sample period (2011−2024).

Country-level information We enriched our dataset with multiple World Bank's series on country-level characteristics. In particular, we collected annual information on countries' average income ("GDP per capita, PPP (constant 2021 international $)"), on total population ("Population, total"), on the share of employed population on the total, ("Employment to population ratio, 15+, total (%) (modeled ILO estimate)"), on CPI inflation ("Inflation, consumer prices (annual %)"). We also collect data on each country's migrant stock from the "Global Bilateral Migration" series.

For data on currency trading volumes we rely on the BIS Triennal Surveys. The Bank for International Settlements (BIS) conducts a triennial survey among central banks to collect "information on the size and structure of global over-the-counter (OTC) markets in foreign exchange (FX) and interest rate derivatives".[7] From this publicly available dataset, we access data on the total annual turnover of OTC spot and FX derivative transactions to get a measure of the depth of each currency market.

Finally, in order to construct a measure of interest rate differential between countries (cf. section 3.3), we used short-term interbank rates taken from the Federal Reserve Economic Data (FRED) database. In particular, we downloaded the se-

[6]According to Factset: "Ezetop Ltd. provides a website for mobile top-ups. It offers international and online mobile top-up and call services. The company was founded in 2006 and is headquartered in Dublin, Ireland."

[7]https://www.bis.org/statistics/rpfx22_fx.htm

ries “3-Month or 90-Day Rates and Yields: Interbank Rates” for all countries with available data.

3.2 Samples description

Throughout the paper, we are going to refer to two different samples extracted from the RPW database, the *full sample* (for the baseline analysis) and the *CHF shock sample* (for the event study around the Swiss Franc shock — cf. section 3.3).

Full sample The full sample consists of 34,680 transfers sent in cash from an agent in a sender country s and received in cash in a receiving country r, operated by a firm f in a given quarter t, in the period 2011Q1-2024Q3. Table 1 reports summary statistics for this sample, for all the different levels of aggregation we will use in the analysis. Negative values and the top 1% of the distribution of the main continuous variables (FX volatility and total cost of \$200 transaction) have been trimmed. Moreover, because of the presence of extreme outliers in the distribution of operating profits (“EBIT margin”), mainly driven by crisis periods in which losses are large relative to revenues, we winsorize the variable at the 5th and 95th percentiles of the distribution.

Panel A of Table 1 reports summary statistics at the product-level. The main variable of interest is the price of the transfer (“Total cost (%)”), which is computed as the sum of a monetary fee, expressed as a percentage of the amount sent, and the spread over the interbank exchange rate (“FX margin (%)”), measured in percentage points. In our sample, sending a \$200 transfer is on average more expensive than sending a \$500 transfer (an average cost of 7.2% compared to 5.2%). This suggests the presence of a two-part tariff pricing scheme, and for this reason we computed the fixed and the variable components of the price for each transfer that are implied by the observed prices. The procedure we followed is described in appendix B. In our analysis, we will focus primarily on the total cost of sending a \$200 transfer, but we will also report separate results for the spread applied to the exchange rate (“FX margin (%)”), the variable component (“Var. fee (%)”) and the fixed component (“Fix. fee (%)”) of the price. Any change to the latter implies a change to the total transaction cost that is heterogeneous across different transferred amounts.

Figure A1 shows the average price of a \$200 transfer in our sample, by quarter. It can be seen that, while average prices have been decreasing over time, they still nowadays hover around 7% of the total amount sent, and a large dispersion has persistently existed over time, with an interquartile range consistently around 5 percentage points throughout the whole sample period.

Figure 2 examines the relationship between remittance prices and various country-level characteristics. The left panel compares the average cost of sending a $200 transfer to a given receiving country r with the country's GDP per capita, offering an initial view of how remittance costs correlate with economic development. The center panel plots the same average cost against the volatility of country r's currency return (against the USD), capturing an important dimension of exchange rate risk. The right panel illustrates the relationship between remittance prices and the number of firms operating in the receiving country, serving as a proxy for local market competition. While the average price of sending money abroad does not seem to be related to the GDP per capita of the receiving country in any meaningful way, it correlates positively with the volatility of its currency and negatively with the number of firms operating there, consistently with the theoretical model presented in section 2. Overall, two (non mutually exclusive) candidate explanations for the large dispersion in money transfer prices emerge, namely currency risk and market power. In this paper we provide an attempt to disentangle and quantify these two forces.

Panel B and C of Table 1 also offer interesting insights. At the firm-level, we can see that profit margins are very heterogeneous across operators and quarters, with a mean of 7.82% (indicating a small but positive profitability on average), and a standard deviation of 18.23%. At the market-level, we document an average number of 3 firms per corridor, with a standard deviation of approximately 2 firms, and half of the distribution between 2 and 4 companies per market. Finally, at the annual level, we can see a large dispersion in the volume of remittances sent across countries ("Flows$_{sry}$ - Bn. $"), with an average of 1.2 billion USD per year (above the 75th percentile of the distribution, suggesting a very right-skewed distribution) and a standard deviation of almost 3 billion USD.

CHF shock sample For our event-study analysis around the Swiss franc shock, we restrict the full baseline sample by focusing only on transfers directed to destinations that receive remittances from at least one exposed country (i.e. whose currency was exposed to the Swiss Franc appreciation according to our criterion set out in section 3.3). This selection procedure is aimed at achieving greater sample homogeneity, ensuring that we are in fact comparing treated and control transfers directed to the same destination.

To keep the set of sending countries comparable, we restrict attention only to high-income ones, following the classification adopted in the RPW dataset. Furthermore, we exclude transfers involving the Swiss Franc (CHF) to avoid potential confounding effects arising from its economic implications in Switzerland—cf. Auer et al. (2021).

Finally, to avoid capturing confounding effects due to idiosyncratic episodes of currency destabilization during the period under study, we exclude destination countries that experienced severe depreciation around the time of the shock. The procedure we follow is described in Appendix C.

Descriptive statistics for the CHF shock sample are presented in the right-hand panel of Table 1. The distribution of the variables closely resembles that of the full sample, providing reassurance regarding the representativeness of the restricted dataset: the average cost of sending international transfer is 7%, firms' average EBIT margin is 6%, and the number of firms in a corridor is 3 on average. The treatment group consists of 30% of the observations at the product-level.

A possible concern is that the countries in the treatment group are systematically different from those in the control group. To mitigate concerns of selection into treatment, we also conduct a balance test comparing observable characteristics between the treatment and control groups, which is presented in Table A2. The statistics for the treatment group are computed considering only the pre-shock period, i.e. before 2015. The table reports the number of observations, group means, standard errors, and the result of a t-test for differences in means for a series of variables defined at the level of the sending country. For none of the reported variables — GDP per capita (PPP), GDP p.c. growth, population, population growth, inflation, employment share, unemployment rate, migrants to population — the differences between the two groups are statistically significant. Overall, these results indicate that the treatment and control groups are broadly comparable along observable dimensions, mitigating concerns of selection bias and supporting the validity of the identification strategy employed in the subsequent analysis.

3.3 Currency risk measures and exogenous variation

Aiming to capture variations in exchange-rate unpredictability, we rely on three different approaches.

Exchange-rate volatility

The first variable, $Volatility_{srt}$, is defined as the standard deviation of daily returns of the bilateral exchange rate between the sending country s and the receiving country

r over quarter t. This measure captures the overall uncertainty around the exchange rate and, in the product-level dataset, has a mean of 0.50%, a standard deviation of 0.32 percentage points, and an inter-quartile range of 0.39 percentage points, indicating substantial variation across pairs and time (see Table 1).

Volatility shocks

While the volatility of returns is a rather standard proxy for currency risk, it may fail to capture important nonlinearities and the impact of disruptive, large exchange-rate movements that can alter market conditions.

To this end, we construct a binary variable, $VolatilityShock_{srt}$, that takes the value of 1 if the exchange rate between country s ("sender") and r ("receiving") has persistently been experiencing a volatility level of more than 2 standard deviations above the historical average[8], up to a period of maximum one year. In order to make sure that the shock is sizable, we also require the volatility to be in the top quartile of the overall distribution of all currency pairs. Figure A2 shows an example of how we defined this variable at the currency pair-level. With this proxy we aim to capture unexpected, relevant and possibly persistent increases in the riskiness of the exchange rate that can substantially impact the structure of a market, and not just moderate fluctuations.

We analyse the impact of such volatility shocks on equilibrium outcomes by using the full sample of transfers - cf. section 3.2. In Table 1 it is possible to see that 10% of the observations in our sample are associated with a volatility shock. To make sure that this variable does not capture specific countries' rather than others, raising concerns of limited representativeness, in Table A1 we report the most affected destinations of transfers. Reassuringly, the list includes many different countries across all the continents, with the most recurring one (Nigeria) representing only 7.58% of all the observations associated with a volatility shock. The total number of different affected destinations within our sample is 80, resulting in a very broad coverage.

The 2015 Swiss Franc appreciation and the role of carry trades

Establishing a causal link between currency risk and the outcomes of interest is challenging, as many factors that are concurrent and contemporaneous to periods of high currency volatility could be driving the results. In a currency crisis, for example,

[8] The reference historical period is the last 12 months for both the average and the standard deviation.

the demand for remittances could increase significantly, as macroeconomic conditions deteriorate in the home country, and this in turn could lead to higher prices. In order to isolate and identify the impact of currency risk on the cost of international money transfers in the cleanest possible way, we leverage an episode of increased volatility of currencies commonly used in carry trades as exogenous variation. A carry trade is a popular investment strategy in the foreign exchange market that consists in borrowing in a low-yielding currency (the "funding" currency) and investing in a high-yielding currency (the "target" or "investment" currency), with the expectation that any change in the exchange rate will not offset the gain from the interest rate differential. The profitability of such trades has been proven to be persistent over time, and explained as a compensation for the risk of holding a position in currencies more exposed to global risk factors (e.g. Lustig and Verdelhan, 2007; Lustig et al., 2011).

On Jan 15, 2015, the Swiss National Bank (SNB) removed the peg of the Swiss Franc to the Euro, previously introduced among concerns of excessive appreciation of the national currency amid the Eurozone crisis. This event led to a sudden appreciation of the Swiss Franc, up to 30% against the Euro in a single trading day[9], with significant implications for carry trades. In fact, as a popular funding currency for carry trades, the CHF was used to finance investments in high-yielding currencies, such as AUD and NZD (among others), based on the assumption of a stable exchange rate and no sudden appreciation of the short leg of the trade. The decision from the SNB forced investors to close their positions to avoid losses and margin calls, sparking a massive sell-off of high-yielding currencies and a prolonged period of volatility, due to the heightened uncertainty and to the fear of similar episodes.

The relevance as well as some implications of the 2015 removal of the Swiss franc's peg to the Euro have already been documented in the literature (Amador et al., 2016; Auer et al., 2021; Fischer and Yeşin, 2022; Balke et al., 2024; Auer et al., 2024; Itskhoki and Mukhin, 2025). In particular, Auer et al. (2021) take advantage of differences in currency invoicing to study how this episode affected import prices and shares in Switzerland. Notably, they find that the effects on prices persist for up to one year after the shock, showing that its impact had long-lasting implications.

Our identification strategy is based on the idea that this episode introduced a new source of risk in the foreign exchange market — one that had not been present before due to the currency peg — and that this shock originated entirely in financial

[9] https://www.bbc.com/news/business-30829917

markets, unrelated to the fundamental drivers of remittance demand. Money transfer companies operating in countries whose currencies were exposed to this shock suddenly faced higher volatility threatening their profits, and so, consistently with the theoretical framework developed in section 2, we expect this cost to be be passed on to the end user in the form of higher fees. We also expect lower profit margins and reduced competition in the quarters following the shock.

Our strategy is to leverage this episode within an event study design to identify the consequences of an increase in currency risk. To this end, we restrict the sample to a set of comparable transfers — cf. section 3.2 — and define a treatment and a control group based on the exposure of the remittance sending country's currency to the shock.

Treatment and control group Ideally, we would like to construct a measure of exposure to the shock based on the outstanding positions of investors in the currency market. However, building such a measure is not possible, as direct data on investors' strategies do not exist[10]. We worked around this issue by constructing the so-called carry-to-risk ratio, a measure commonly used by industry practitioners to assess the expected return of a carry trade strategy per unit of risk:

$$CarryToRisk_c^{2014} = \frac{i_c^{2014} - i_{CHF}^{2014}}{\sigma_c^{IV}}, \tag{3}$$

where i_c^{2014} is the interest rate associated to currency c in 2014 as sourced from FRED database, while σ_c^{IV} is the 3-month implied volatility for At-The-Money options between currency c and the Swiss Franc, at daily frequency, sourced from Bloomberg[11]. Only very few currencies have data available for implied volatility against the CHF, which we take as evidence of the fact that options defined on other currency pairs are rare or non-existent, and hence carry trades defined on such pairs were not so popular. Figure A3 displays the 2014 average carry-to-risk ratio for the currencies in our sample, ranked in ascending order. We define the treatment and the control group based on the median value of the distribution and obtain a set of "exposed"

[10]It is notoriously challenging to track the activity of carry trade investors, as documented in BIS Quarterly Review, September 2024.

[11]On Bloomberg, this variable is defined as follows: "Implied volatility is a measure of the market expected future volatility of a currency exchange rate from now until the maturity date. The future volatility is the single undeterminable variable in the common Black Scholes option pricing model. Bloomberg ATM implied volatilities can be used to obtain the correct Black Scholes price for a delta neutral straddle struck at maturity."

currencies that is largely consistent with anecdotal[12] and academic (Ready et al., 2017) evidence on carry trades: AUD, CAD, ILS, NZD and NOK.

Treatment group's volatility In order to take advantage of this setting, we first need to make sure that the shock we are considering did in fact impact the volatility of the currencies exposed through carry-trade positions in a significant way.

To this end, we estimate a difference-in-difference specification around the event to study the evolution of FX volatility of the exposed currencies comparatively to the control group. Using exchange-rate series from Bloomberg, we construct a balanced panel for both all sending currencies within our sample quoted against the USD and all cross-currency pairs formed by the corresponding sending and payout currencies. We then estimate the following specification:

$$Volatility_{pt} = \beta_0 \; Exposed_p \times 2015Q1_t + \beta_1 \; Exposed_p \times Post15Q1_t + \delta_p + \delta_t + \varepsilon_{pt} \quad (4)$$

where $Volatility_{pt}$ is the standard deviation of returns of currency pair p in quarter t, $Exposed_p$ is a dummy equal to 1 if the base currency of the pair[13] is among the ones classified as exposed (cf. 3.3); $2015Q1_t$ is a dummy isolating the quarter of the shock (to capture the immediate effect on volatility) while $Post15Q1_t$ groups all the other subsequent periods under the same indicator (to capture long-run effects). Currency pair and quarter fixed effects are included.

Results are reported in Table 2, for both levels of variation (currency and cross-pair) and estimated via both OLS and the event study methodology developed by Borusyak et al. (2024) (BJS henceforth). The results show that currencies exposed via carry trade positions to the Swiss franc de-anchoring in 2015Q1 experienced a statistically significant and economically meaningful increase in volatility compared to the control group. The coefficient on the interaction term $Exposed_p \times 2015Q1_t$ is very precisely estimated at 0.217 for the currency-level regressions under both estimation regimes. Similarly, currency-pair level regressions show OLS and BJS estimates very close to each other, with an estimated effect on volatility of around 0.235 in the quarter of the shock. These estimates correspond to a very sizable effect,

[12]See for instance this article by Saxo Bank, this article by the Financial Times, BIS Quarterly Review December 2007, September 2024, BIS bulletin, 90.

[13]In the conventional FX notation, a currency pair is composed of a base currency (the first one) and a quote currency (the one used as a unit of account). For example, for the pair AUD/USD, quoted in dollars, AUD is base currency and USD is quote currency, and this pair would be considered as exposed according to our classification.

ranging from 49% to 62% of the unconditional mean.

We also estimate a "dynamic" version of our event-study specification that allows a separate coefficient for each quarter. Figures 3a and 3b illustrate the temporal evolution of the estimated effect together with their 95% confidence intervals for a window of (-4,+4) quarters around the shock. At the currency level (Figure 3a), a clear and sharp increase in exchange rate volatility of exposed currencies is visible in 2015Q1, with statistically significant estimates remaining elevated in the following quarters up to a year after the shock, indicating a persistent disturbance in currency markets beyond the initial event. Before the shock, estimates are not statistically different from zero, showing no pre-existing differences in volatility trends between the two groups of currencies. The effect on the volatility of the treated group remains visible at the cross-currency pair level (Figure 3b): although somewhat noisier, the estimated difference in volatility between the treatment and control groups is consistently positive and above pre-shock levels for all quarters following the shock.

4 Empirical specification and results

4.1 Product-level analysis

The first theoretical prediction that we want to test is that an increase in the riskiness of the exchange rate should lead to higher prices. We can observe whether this statement holds true by taking advantage of the granularity of information offered by the RPW dataset to carry out a product-level analysis.

Currency risk and remittance fees We first explore the relationship between different proxies for currency risk and the total cost of sending a \$200-equivalent international transfer, using the following specification:

$$y_{fsrt} = \beta\ CurrencyRisk_{srt} + \delta_{sr} + \delta_{ft} + \varepsilon_{fsrt} \tag{5}$$

where y_{fsrt} is the total cost (as a percentage of the transaction) of sending \$200 from country s to country r in quarter t using firm f's service, and $CurrencyRisk_{srt}$ is a proxy for the riskiness of the exchange rate between country s and country r in quarter t. In particular, using the unrestricted sample of transfers (cf. section 3.2), we first examine the relationship with $Volatility_{srt}$, the standardized quarterly standard deviation of returns of the exchange rate between country s and country r, and with $VolatilityShock_{srt}$, an indicator variable that captures periods of abrupt and significant rises in the volatility of a currency pair (cf. section 3.3). In the context of our event study design, we compare the evolution of remittance fees before and after the shock to the Swiss Franc for a group of treated and control groups of transfers. We do this by replacing $CurrencyRisk_{srt}$ with an interaction between $Exposed_s$, a dummy that takes the value of 1 if the currency of the sending country s is in the treatment group, and $2015Q1_t$, a time indicator equal to 1 for the first quarter of 2015. An additional interaction between $Exposed_s$ and $Post15Q1_t$ (an indicator for subsequent periods) is included, to analyze long-run effects. Summary statistics for all these (non-standardized) variables are shown in Table 1.

Our preferred specification focuses on within-market variation by including corridor (a pair of sending-country s and receiving-country r) fixed effects, while firm-quarter (δ_{ft}) fixed effects remove variation from firm-specific time-varying factors, such as internal policies on agents' remuneration.

Results for equation (5) are shown in Table 3. Across all specifications and proxies, the results consistently reveal a positive and highly statistically significant relationship between currency risk and prices. Column (1) shows that for values of exchange rate volatility that are 1 standard deviation above the mean, the associated cost of sending a $200 transfer is 0.08 percentage points higher, which corresponds to an approximately 1% increase on the unconditional mean. The effect is substantially larger, however, around episodes of sudden and sizable spikes in exchange rate volatility. When we look at the relationship between our $VolatilityShock_{srt}$ indicator and remittance prices, under column (2), the price of sending a $200 transfer increases by approximately 0.51 percentage points, which is about six times larger than the estimate obtained with our first proxy and corresponds to roughly 7% of the unconditional mean; in monetary terms, a 0.51 increase corresponds to an extra cost of approximately $1 on a $200 transaction. Finally, column (3) of Table 3 shows the estimate for the static specification of our event study design and confirms that fees for transfers from countries whose currencies were exposed to the appreciation of the Swiss Franc increased significantly in response to the shock. Specifically, in the quarter of the shock, the magnitude of the effect is extremely high (0.78), with a 11% increase on the unconditional mean. In Figure 4, we also report a visual representation of the dynamic evolution of the effect of this shock on transaction fees, plotting quarter-specific estimates as well as their 95% confidence intervals. The estimates starkly show a sudden increase in the prices of transfers from countries whose currencies were subject to carry trades unwinding in the aftermath of the shock, with a clear discontinuity with respect to the preceding period. After the first two quarters, the effect fades over time and loses statistical significance.

Variable vs fixed fees The pricing of international money transfers is typically composed of two components, a monetary fee and a spread on the exchange rate, often resulting in a non-linear scheme where MTOs charge a fixed fee plus a component proportional to the transacted amount. We explore how MTOs adjust these components in response to changes in currency risk by running the same specification as in equation (5), but using as dependent variable either the total cost, the spread on the benchmark exchange rate, the variable component of the cost, or the fixed component of the cost. While the first two variables are directly provided within the original World Bank RPW dataset, the others are computed according to the procedure in appendix B.

Results are shown in Table 4. Notably, the effect seems to be entirely driven by the variable component of the cost, and in particular by the margin charged on the market exchange rate. In contrast, the fixed fee component, while accounting for approximately the same weight in the final transaction price (3.6% on an average 7.2% cost), shows no systematic association. This distinction emerges consistently across all specifications. As an exemplary case, one-standard deviation increase above the mean in FX volatility is associated with a 0.08 percentage point higher variable component of the transaction price, while the fixed fee only increases by 0.001 percentage points. A possible interpretation is that when operators face rising marginal costs due to increased uncertainty around the exchange rate, it is easier to pass these costs onto consumers through more flexible and "hidden" components of the price.

4.2 Heterogeneity analysis

In this section, we explore currency and firm heterogeneity at the product level to delve deeper into the channels through which currency risk drive the effects shown above. In particular, we show that, as foreign currency risk intensifies, price increase more in thinner currency markets and among firms with less diversified activities, highlighting the crucial role of firms' ability to hedge against exchange-rate risk.

4.2.1 Financial hedging

A well-functioning financial market requires the availability of instruments that allow participants to share risk and hedge against adverse fluctuations. As we show below, however, access to such instruments remains limited in many low- and middle-income countries.

We proxy for the availability of these instruments using the BIS Triennial Central Bank Survey of Foreign Exchange and OTC Derivatives Markets, which provides internationally comparable information on OTC market activity and reports average daily turnover in April of each survey year. We measure market depth as currency-level turnover in FX derivative instruments (outright forwards, FX swaps, currency swaps and FX options), interpreting higher turnover as evidence of a more developed hedging market for the corresponding currency. Currencies with no coverage in the Survey are assigned a value of zero, interpreting the absence of reported activity as negligible volume and hence the lack of a sufficiently developed derivatives market.

We conjecture that shallow markets and limited hedging possibilities result in substantially higher costs for money exchange and transfer activities, so that the pass-through of exchange rate volatility to prices should be weaker for transfers involving deeper currency markets.

Table 5 presents the result of estimating the same specification as in (5), but including the interaction with the turnover of the currency of destination countries, averaged over the entire sample period and in log units. The interaction with FX OTC volume is negative across all specifications, indicating that deeper hedging markets attenuate the pass-through of exchange rate risk to prices. In other words, exchange rate volatility has a stronger effect on transfer pricing when the uncertainty it generates cannot be effectively hedged through appropriate financial contracts. This effect becomes statistically significant in episodes of exceptional volatility, as shown by specifications (2)-(3). Still, the interaction does not fully offset the increase in prices, suggesting that remaining market frictions or the difficulty to predict demand and FX movements may prevent intermediaries from fully hedging against this risk.

4.2.2 "Operational" hedging

The second channel we explore is firms' ability to manage the risks they face through the diversification of the sources of costs and revenues in their operations. In particular, we conjecture that the impact of volatility on remittance prices should be stronger for operators that run their business in a single corridor or country, possibly as a result of strategic specialization choices or arising from constraints to scale expansion. Cases like this are not uncommon: examples include Caribe Express, a remittance operator specializing in serving the Dominican diaspora worldwide, and Pacific Way, which initially focused exclusively on the Australia–Samoa corridor, and later expanded its operations to New Zealand. On the other hand, firms that operate on a global scale should be better equipped to mitigate the effects of adverse idiosyncratic exchange-rate fluctuations.

To test this channel, we define an indicator variable $Diversified_f$ equal to one if the median number of countries to which an MTO operates is more than 1. Firms with $Diversified_f = 0$ are fully exposed to shocks affecting a given market, as they cannot smooth risks across multiple corridors. To capture whether geographic diversification moderates the effect of currency risk, we interact this indicator with the volatility of the recipient country's currency rather than with bilateral exchange-rate volatility. This ensures that the relevant variation derives specifically from fluctuations of the destination currency, which corresponds to the dimension along which we defined our diversification proxy. Accordingly, we expect a negative coefficient on the interaction term. On the other hand, in the context of our event study, since the shock hit some specific sending countries, we rely on a different approach. We define $Diversified_f$

as a continuous measure equal to the number of corridors in which a firm operated in 2014Q4, i.e., immediately prior to the shock. We expect firms operating in a larger number of corridors at the time of the shock to be better able to absorb its negative impact, leading to a lower pass-through of costs to prices. In other words, we again expect a negative coefficient on the interaction term. The variable is standardized to have mean zero and unit variance.

Table 6 reports results from the baseline specification in (5), interacting our currency risk proxies with these measures of business diversification. The results provide consistent evidence that diversifying the scope of operations is an effective way for MTOs to remain competitive in the face of exchange-rate risk. In column (1), a standard deviation increase above the mean in exchange rate volatility raises total costs by about 0.62 percentage points, but this effect is almost entirely offset for diversified firms, for which the interaction term is negative and of similar magnitude (-0.54). A similar pattern emerges in column (2): while the volatility shock increases costs by roughly 2 percentage points, the effect is reduced by about 1.4 percentage points for diversified firms.

Column (3) confirms these findings in the CHF shock setting. The baseline effect of the shock on exposed firms is an increase in costs of around 1.35 percentage points; however, this effect declines sharply with the number of corridors in which a firm operates. The estimated coefficient of -1.5 implies that a one standard deviation increase in diversification substantially dampens the pass-through of the shock to prices. Overall, these results indicate that firms with more diversified operations are significantly better able to absorb exchange rate fluctuations, limiting their impact on final prices.

4.3 Firm-level analysis

According to the theoretical framework presented in section 2, currency risk enters firms' profit maximization problem as a marginal cost component, hence if it increases we should expect lower profits. In this section, we study the impact of currency risk on operators' profitability by running an analysis at the firm-year level.

Currency risk and profit margins To study the impact of currency risk on profitability, we estimate the following regression:

$$EBIT\ Margin_{fy} = \beta\ CurrencyRisk_{fy} + \delta_f + \delta_y + \varepsilon_{fy} \tag{6}$$

where $EBIT\ Margin_{fy}$ is the percent EBIT margin (our proxy for operating profits, calculated as Earnings Before Interest and Taxes divided by revenues) of firm f in year y, while $CurrencyRisk_{fy}$ is an yearly measure of the firm's exposure to currency risk. In particular, $Volatility_{fy}$ is the (standardized) average standard deviation of annual FX returns across all corridors served by firm f in year y, while $VolatilityShock_{fy}$ is firm f-annual average of the homonymous variable defined in section 3.3, standardized to facilitate interpretation. In our event study of the Swiss franc appreciation, we classify a firm as exposed if it operated in at least one of the affected countries in 2014 according to the RPW dataset. For this specification, we estimate the coefficient for the interaction between this dummy variable, $Exposed_f$, and a time indicator for the year of the shock, 2015_y. We include firm and year fixed effects to account for time-invariant firm-level characteristics and shocks common to the whole sector. Before interpreting the results, an important caveat is in order. Our proxies for firms' exposure to currency risk are based on their presence in the RPW dataset and are therefore subject to the coverage limitations of the latter. For each time period, we implicitly assume that the set of corridors observed in the data is representative of firms' overall exposure to exchange rate risk. Finally, the distribution of EBIT Margin is winsorized at the 5% and 95% level in all regressions, to account for the presence of extreme outliers.

Table 7 presents the results. Across all specifications, we document a negative association between profitability and firm-level exposure to currency risk. All estimated coefficients are negative, and their magnitude increases substantially when moving from standard measures of exchange rate volatility to large and exceptional volatility episodes. While the coefficient on baseline volatility is not statistically significant, the estimates associated with volatility shocks and the 2015 Swiss franc episode are economically large and statistically significant. Our definition of volatility shock is meant to capture abrupt deviations from normal exchange rate fluctuations, and it is therefore reasonable that it is associated with substantially larger losses in operating profitability. Following a 1–standard deviation increase in the fraction of corridors affected by volatility shocks, EBIT margins are expected to decline by about 1.7 percentage points, corresponding to almost 20% of the unconditional mean. In the case of the 2015 Swiss franc shock the estimated effect on profitability is particularly pronounced, although we acknowledge that the relatively limited number of observations warrants some caution when interpreting the precision of the estimate.

Overall, these estimates strongly confirm the theoretical prediction that currency risk negatively affects the profit margins of these operators, especially during periods of severe exchange rate instability.

4.4 Market-level analysis

What are the implications of episodes of high currency risk at the market level? Consistently with our theoretical predictions (cf. section 2), we expect a negative impact of currency risk on the number of competing firms. In this section, we aggregate the data at the level of sending and receiving country pair and show results on competition and transaction volumes.

Competitiveness and currency risk We test the theoretical predictions on the impact of currency risk on the competitiveness of a market by estimating the following regression:

$$Nfirms_{srt} = \beta\ CurrencyRisk_{srt} + \delta_{sr} + \delta_t + \varepsilon_{srt} \tag{7}$$

where $Nfirms_{srt}$ is the number of operators providing cash-to-cash remittance services in a given quarter, for each pair of sending and receiving countries, according to the RPW database. Corridor and quarter fixed effects are included in all specifications.

Estimates for equation (7) are shown in table 7. In line with our theoretical predictions, we find negative relationships between the number of firms operating in a corridor and the different measures of currency risk. A one standard deviation increase in the volatility of the exchange rate is associated with a statistically significant reduction of approximately 0.07 firms. On the other hand, following a sudden spike in volatility ($VolatilityShock_{srt}$), the number of firms operating in the corridor shrinks by approximately 0.1. When we look at corridors exposed to the appreciation of the Swiss franc, while the effect is weak in the quarter of the shock, we observe an average reduction of 0.7 in the number of firms operating in a market in the subsequent periods — approximately a 20% decline compared to the unconditional mean. This large effect is confirmed by Figure 5a, where we plot the coefficients of the dynamic specification of the event study. It can be seen that, although the effect is not immediate, there is a steady decline in the number of firms operating in corridors exposed to the Swiss franc shock. This is reasonable, as we do not expect a reduction in the number of firms to be immediate: realistically, any decision to exit a market comes with a delay with respect to the observed negative performance.

Remittance volumes and currency risk The last aspect we want to investigate is whether currency risk can affect the demand for international transfers, at least through formal channels, because of the higher costs. We run the following year-level specification:

$$\log(RemittanceVolume)_{sry} = \beta\ CurrencyRisk_{sry} + \delta_{sr} + \delta_y + \varepsilon_{sry} \tag{8}$$

where $\log(RemittanceVolume)_{sry}$ is the logarithm of bilateral remittance flows from sending country s to receiving country r in year y, sourced from KNOMAD database. Since these data are available only after 2014 though, for our event study setting we use World Bank data on outgoing remittances at the (sending) country level instead. Our proxies of currency risk are the same as the ones mentioned above — cf. section 4.1 —, but collapsed at the year level: $Volatility_{sry}$ is the annual standard deviation of exchange rate returns, whereas $VolatilityShock_{sry}$ is a dummy equal to 1 if within year y at least a volatility shock — as defined in section 3.3 — occurred. For the event study around the CHF shock, we define a country as exposed if its currency is in the treatment group, and we estimate the coefficient of the interaction between the variable $Exposed_s$ and 2015_y, that is simply 1 in 2015 and 0 otherwise. $Post2015_y$ is an indicator for the subsequent years.

Results, shown in Table 8, present mostly small or insignificant effects on the transacted volumes. While the statistically significant coefficient on $Volatility_{sry}$ indicates a negative correlation between remittance volumes and market volatility, this relationship becomes statistically insignificant in our more tightly identified specifications. If anything, these findings reinforce our interpretation of the previous results by providing no evidence that increased contingent demand drives the observed rise in prices. Figure 5b, which reports the coefficients from the dynamic event-study specification around the CHF shock, confirms the absence of any significant effect on remittance volumes. Overall, we conclude that while currency risk significantly affects pricing and competition, at least at the annual frequency the demand-side of the market seems to be quite inelastic to episodes of FX market fluctuations.

5 Estimating marginal costs and mark-ups

A central implication of this paper is that unhedgeable currency risk affects the supply side of the remittance industry by significantly increasing firms' costs. Although these are not directly observable, in this section we overcome this limitation by modeling and estimating them, thereby providing additional evidence on the underlying mechanism. Building on Leone et al. (2025), we adapt and replicate their approach to estimate a standard industrial organization model that explicitly incorporates the supply side, allowing us to recover cost parameters and shed light on the role of market power (Bresnahan, 1989; Berry and Waldfogel, 1999).

In the context of the remittance sector, we define a market as a pair of a sending country s and a receiving country r in year y, and carry out our estimates at this level of aggregation. In this section we illustrate the empirical specification for our estimates as well as the moment conditions included in a joint GMM estimation to infer the parameters of the model. Then, we present the estimation results and an analysis of the relative importance of currency risk and market power in determining prices based on the structural estimates. A comprehensive description of the theoretical framework underpinning our modeling choices is reported in appendix D.

5.1 Empirical specifications and estimation

Demand We specify the inverse demand for remittance transfers in a market as a standard[14] constant-elasticity specification

$$P_{sry}(Q_{sry}) = \alpha_{sry}\ Q_{sry}^{-\frac{1}{\eta}}, \tag{9}$$

where α_{sry} is a parameter that shifts demand across markets, P_{sry} is the maximum unit price customers are willing to pay to purchase an amount Q_{sry} of foreign currency, and η is easily proven to be the elasticity of demand to prices.

Taking advantage of the linearity of the log-transformation of equation 9, and assuming that the demand shifter $\ln(\alpha)$ is a function of exogenous market-level characteristics X_{sry} and an unobservable error component ξ_{sry}, we can estimate the following:

$$\ln(Q_{sry}) = \alpha_0 + \alpha_1 \ln(P_{sry}) + X'_{sry}\boldsymbol{\alpha}_X + \xi_{sry} \tag{10}$$

[14] This is a standard choice in the Industrial Organization literature, e.g. Berry and Waldfogel (1999) adopt this specification to model advertisers' willingness to pay in the radiophonic industry.

where Q_{sry} is the flow of remittances from country s to country r in year y - sourced from KNOMAD, P_{sry} is the median price charged by firms for a \$200 transaction from country s to country r, and X_{srt} is a vector of exogenous determinants of remittance demand: the logarithm of GDP per capita (\$, PPP) of the receiving country r, lagged one year to avoid concerns of reverse causality; the logarithm of GDP per capita (\$, PPP) of the sending country s in year y, as the current economic conditions in the sending country may affect the amount of remittances sent as well; the logarithm of total migrant population from country r residing in country s as of year 2000 — the latest available in the World Bank's series — to have a measure of the pool of potential customers in each corridor; the logarithm of population of the sending country s in year y; the logarithm of population of the receiving country r in year y, as a time-varying proxy for the size of the market; and the average return of the bilateral exchange rate between the two countries — with a positive change in this variable indicating a depreciation of the currency —, to control for demand motives driven by higher or lower convenience to send money.

In order to overcome the endogeneity of prices, we construct the following instrumental variable: for each corridor s–r and year y, we consider the average price of sending money from country s in the year $y-1$, excluding transfers directed to country r itself. The idea is that all transfers sent from a specific location are subject to the same country-specific price shocks that are independent of the idiosyncratic demand from a given migrant community. To make sure this is the case, we capture this component by excluding the prices of transfers directed toward country r from the average computation[15]. Further, we consider the lagged value of this variable because we do not want contemporaneous shocks to migrant communities' income to affect the demand for money transfers.

While we estimate all the model parameters jointly via GMM, Table A4 also reports the corresponding 2SLS estimates of equation (10). The first-stage regression shows that the coefficient on our instrument, Z_{sry-1}, is highly statistically significant, and the associated F-statistic comfortably exceeds the conventional thresholds used to assess instrument weakness (Stock and Yogo, 2002; Lee et al., 2022). Consistent with our expectations, money transfer costs are positively correlated with price shocks that are common to the entire sending country. Moreover, a direct comparison with Table A5 indicates that the 2SLS and GMM estimates are almost identical, confirming

[15]This procedure implies the exclusion of destinations whose sending country does not overlap with that of other transfers.

the robustness of our results to the choice of estimation method.

From this specification, we get the first moment condition, $\mathbb{E}[\boldsymbol{Z'\xi(\alpha)}] = 0$, where $\boldsymbol{Z}$ is the matrix of instruments, $\boldsymbol{\xi}$ is the vector of residuals, and $\boldsymbol{\alpha}$ is the vector of parameters to be estimated.

Marginal costs With an estimate of the demand elasticity $\hat{\eta}$, we can infer marginal costs indirectly through the following equilibrium condition - cf. equation (18):

$$\ln(MC_{sry}) = \ln(P_{sry}) - \ln\left(\frac{\hat{\eta}N_{sry}}{\hat{\eta}N_{sry} - 1}\right) \tag{11}$$

where N_{sry} denotes the number of MTOs operating cash-to-cash transfers from country s to country r in year y.

We model marginal costs as a function of currency risk, as proxied by the volatility of the exchange rate, and an orthogonal component that captures other unobserved factors. The specification we estimate is thus the following:

$$\ln\left(MC_{sry}\right) = \beta_0 + \beta_1\ Volatility_{sry} + \omega_{sry} \tag{12}$$

where $Volatility_{sry}$ is the annual standard deviation of returns of the exchange rate between the sending and receiving country's currencies (standardized to have mean 0 and variance 1). To mitigate the effect of extreme outliers, we winsorize the top 5% values of the distribution of this variable.

This equation gives us the second moment condition, $\mathbb{E}[\boldsymbol{C'\omega(\beta)}] = 0$, where $\boldsymbol{C}$ is the matrix of independent variables and $\boldsymbol{\omega}$ is the vector of residuals.

Fixed costs In order to pin down all parameters of the model, these have to be consistent with an entry condition whereby the observed number of firms in a market N_{sry} make a positive profit, whereas $N_{sry} + 1$ firms would not. Such a condition requires to model also fixed costs, that we assume to be a log-linear function of observable covariates:

$$\ln(F_{sry}) = \gamma_0 + \gamma_1\ EntryRegulation_r + \sigma\,\varepsilon_{sry}, \tag{13}$$

where the regressor is a (time-invariant) proxy for regulatory and institutional barriers to entry in the receiving country r ("Starting a business - Score", from World Bank's Doing Business project). In particular, $EntryRegulation_r$ is defined as a measure of "the absolute level of regulatory performance over time", taking into account "the number of procedures, time, cost and paid-in minimum capital requirement for a small- to medium-size limited liability company to start up and formally operate in each economy's largest business city".[16] Finally, we assume $\varepsilon_{sry} \sim \mathcal{N}(0,1)$.

The maximization of the following likelihood function yields the estimates for the parameters of interest (Berry and Waldfogel, 1999):

$$
\begin{aligned}
L_{sry}(\theta) = \Phi\left(\frac{1}{\sigma}\left[\ln\left(\frac{Q_{sry}}{N_{sry}}\left(\frac{-\alpha_1 N_{sry}}{-\alpha_1 N_{sry}-1}-1\right)MC_{sry}\right)-\ln(F_{sry})\right]\right) \\
-\Phi\left(\frac{1}{\sigma}\left[\ln\left(\frac{Q_{sry}}{N_{sry}+1}\left(\frac{-\alpha_1 (N_{sry}+1)}{-\alpha_1 (N_{it}+1)-1}-1\right)MC_{sry}\right)-\ln(F_{sry})\right]\right),
\end{aligned}
\tag{14}
$$

where $\Phi(\cdot)$ is the cumulative distribution function of the standard normal distribution. Importantly, before market entry, we assume that symmetric firms share the same expectation about marginal cost and market share — cf. appendix D.

The last moment conditions are then given by the first-order conditions of the maximization of the likelihood function, $\mathbb{E}\left[\frac{\partial L}{\partial \gamma}\right]=0$, $\mathbb{E}\left[\frac{\partial L}{\partial \sigma}\right]=0$.

5.2 Results

Table A5 reports the estimated parameters of the model. The demand block presents a statistically significant estimate of the elasticity of remittance volumes to money transfer prices: the coefficient on $\ln(\text{Total Cost}_{sry})$ is -1.823, statistically significant, suggesting that a 1% increase in transaction fees leads to around a 2% reduction in remittance volumes. Demand does not seem to be inelastic with respect to the price of the service, and this may reflect the availability of alternative, potentially informal channels to remit funds, which are harder to monitor but may offer lower costs.

Demand is also strongly associated with macroeconomic and demographic factors. The (log) GDP of both the sending and the receiving country are confirmed to be important predictors of remittance flows, with both coefficients statistically significant at the 1% level. Population of the sending and receiving country as well as migrant population in the sending country are also significant explanatory variables, all positively associated with remittance volumes, and so is the the average exchange

[16] https://subnational.doingbusiness.org/en/data/exploretopics/starting-a-business/score

rate return over the year.

Turning to the results on marginal costs, these confirm the importance of currency risk in shaping MTOs' cost structure. The volatility of the exchange rate have a positive and statistically significant effect on marginal costs, supporting the hypothesis that exchange rate uncertainty increases operational costs for providers. Specifically, according to our estimates, one standard deviation increase in exchange-rate volatility translates in a 14% increase in marginal costs for operators of money transfers. Figure A5 provides a visual representation of the positive relationship between the estimated marginal costs and the volatility of the exchange rate, with markets exposed to greater fluctuations exhibiting higher costs.

Finally, the estimates about fixed costs show that higher barriers to enter a market also contribute to increase operational costs, with a positive coefficient statistically significant at a 90% confidence level.

In figure 6 we propose a decomposition of the total cost of sending a \$200 remittance across world regions based on our model. For each macro-region, we report the average price, the mark-up as a share of price ($\frac{P-MC}{P}$ — which is the theoretical equivalent to the EBIT margin, or operating profits), and the share of the price attributable to currency risk ("FX risk"), computed as $MC-\exp\{\beta_0+\widehat{\omega}_{sry}\}$ and divided by the final price: the first term is the "actual" (estimated via our model) marginal cost, while the second term represents a counterfactual value with no currency risk, where volatility set to 0 — as if the exchange rate was pegged. The results reinforce the view that foreign-exchange risk is a key determinant of remittance pricing, with a contribution comparable in magnitude to the markup component and accounting for approximately 10–25% of the final price. Its role is particularly pronounced in South America and Sub-Saharan Africa, where it represents about 25% and 22% of the final price, respectively, exceeding the corresponding contribution of markups. This pattern may reflect greater currency instability and limited access to effective hedging instruments in these regions. By contrast, the incidence of FX risk is lowest in Eastern Europe, potentially owing to greater exchange-rate stability and the closer integration of several countries with the Euro Area.

Finally, we also look at what fraction of price dispersion can be imputed to heterogeneity in currency risk. We decompose the variance of (log) prices as follows:

$$\begin{aligned}\text{Var}(\ln P_{sry}) =& \text{Var}(\ln MU_{sry}) + \text{Var}(\ln MC_{sry}) + 2\ \text{Cov}(\ln MU_{sry}, \ln MC_{sry}) = \\ =& \text{Var}(\ln MU_{sry}) + \beta_1^2 \text{Var}(Volatility_{sry})\ + 2\beta_1 \text{Cov}(Volatility_{sry},\ \ln MU_{sry}) + \Omega_{sry}\end{aligned} \quad (15)$$

where MU_{sry} is the mark-up, and Ω_{sry} are the residual correlation terms with no currency risk involved. Panel B of Table A5 reports all components of the decomposition, excluding the residual term, and shows that while currency risk explains a non-negligible portion of the disparities in remittance pricing across markets (around 11%), market power plays an important role too (around 15%), and the two components do not seem to be correlated across markets.

Altogether our findings outline a complex landscape for policy intervention. While price transparency and competition remain important levers, the relevant role of currency risk — largely determined by macroeconomic and regulatory conditions — points to a challenging scenario to reduce the cost of remittances globally.

6 Conclusion

This paper investigates the role of currency risk in shaping the pricing and the structure of the international remittance market. Guided by a theoretical framework of imperfect competition and leveraging detailed product-level data on money transfer services, we provide new evidence that imperfections in currency markets are significant drivers of remittance prices, operators profitability, and market structure.

Exploiting the unexpected appreciation of the Swiss franc in early 2015 as a quasi-natural experiment, we isolate the effect of increased currency risk on different market outcomes. The results confirm a meaningful increase in remittance prices, particularly where hedging opportunities are more limited, alongside a decline in firm profitability and market competitiveness. Our structural model estimates suggest that currency risk accounts for a non-negligible share of the final price, comparable in size to mark-ups, highlighting its first-order relevance.

These findings carry important implications for policy. Efforts to reduce remittance costs, as outlined in international targets such as the UN's Sustainable Development Goals, cannot rely solely on increased competition or transparency. Addressing structural sources of currency risk through more stable exchange rate regimes, deeper currency markets, or enhanced hedging mechanisms may be equally crucial. A coordinated policy approach appears necessary to ensure that remittance services become more affordable, especially in vulnerable and high-risk corridors.

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7 Tables

Table 1 – Summary statistics for the full and the CHF shock samples. The analysis is based on three levels of aggregation: the main dataset is at the product (i.e. transfer option) level, and each observation varies at the level of a sender country s, a receiving country r, a firm f and a quarter t. The firm-level sample is at the firm-year level, while the market-level sample is obtained by collapsing the product-level at the corridor level (combination of a sending- and a receiving-country), either quarterly or yearly. In the full sample, $Diversified_f$ is 1 for MTOs that operate transfers in more than one corridor, while in the CHF shock sample is a continuous variable that counts the number of corridor served by MTO f in 2014Q4. The table reports the mean, the standard deviation, the 25th and the 75th percentile.

	Full sample				CHF shock sample			
	Mean	St. Dev	25th	75th	Mean	St. Dev	25th	75th
Panel A: Product-level								
Tot. cost$_{fsrt}$ (%)	7.20	3.81	4.29	9.45	7.03	3.73	4.29	9.09
FX marg.$_{fsrt}$ (%)	2.66	2.30	0.98	3.70	2.44	2.08	0.95	3.39
Var. fee$_{fsrt}$ (%)	3.59	2.95	1.28	5.22	3.20	2.67	1.16	4.56
Fix. fee$_{fsrt}$ (%)	3.61	2.28	2.08	4.73	3.82	2.25	2.28	5.00
Volatility$_{srt}$	0.50	0.32	0.27	0.66				
Volat. shock$_{srt}$	0.09	0.29	0.00	0.00				
Exposed$_s$					0.30	0.46	0.00	1.00
FX vol.$_r$ - $Bn	284.76	1045.19	12.93	89.55	63.35	78.06	12.93	89.55
Diversified$_f$	0.95	0.21	1.00	1.00	181.71	145.55	10.00	338.00
Observations	34,680				18,018			
Panel B: Firm-level								
EBIT$_f$ (%)	9.84	17.98	-0.63	19.37	10.62	14.71	3.14	20.95
Observations	389				76			
Panel C: Market-level								
Quarterly								
N. firms$_{srt}$	3.15	1.77	2.00	4.00	3.39	1.79	2.00	4.00
Observations	11,996				5,557			
Yearly								
Flows$_{sry}$ - $Bn	1.18	2.98	0.11	0.99				
Outfl.$_{sy}$ - $Bn					12.64	15.29	4.33	13.80
Observations	1,652				288			

Table 2 – Swiss franc de-anchoring effects on exposed currencies.

Notes: This table presents estimates for equation 4 using both ordinary least squares (OLS) and Borusyak et al. (2024) imputation method (BJS). The dependent variable is the standard deviation of returns of currency pair p, quoted either against the USD, in columns (1)–(2), or against the relevant payout currency, in columns (3)–(4), in quarter t. The independent variable is the interaction between Exposed$_p$, a treatment dummy, and $2015Q1_t$, a time indicator for 2015Q1. $Post15Q1_t$ is an indicator variable for the subsequent quarters. The table reports the method used for the estimation ("Method"), the unconditional average of the dependent variable (Y mean) and the number of observations (N). Heteroskedasticity-robust and currency-pair level clustered standard errors are reported in parentheses under columns (1) and (2), (3), (4), respectively. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Quarterly volatility of FX returns			
	Currency-level		Pair-level	
	(1)	(2)	(3)	(4)
Exposed$_p$ × 2015Q1$_t$	0.217***	0.217***	0.235***	0.235***
	(0.033)	(0.032)	(0.042)	(0.042)
Exposed$_p$ × Post15Q1$_t$	0.010	0.010	-0.110	-0.110
	(0.018)	(0.024)	(0.189)	(0.186)
Currency pair	✓	✓	✓	✓
Year-Quarter	✓	✓	✓	✓
Method	OLS	BJS	OLS	BJS
Y mean	0.35	0.35	0.74	0.74
N	1061	1061	6961	6961

Table 3 – Remittance prices and currency risk.

Notes: This table presents estimates for equation (5), where the unit of observation is a money transfer option from country s to country r provided by firm f in quarter t. The dependent variable is the total cost of sending a \$200 transfer, as a percentage of the total. Regressors are different proxies for currency risk: $Volatility_{srt}$ is the standardized quarterly standard deviation of returns of the exchange rate, $VolatilityShock_{srt}$ is a binary variable that captures sudden and large shocks to the volatility of the exchange rate between the sending and receiving country, and $Exposed_s$ is an indicator for currencies exposed to the appreciation of the Swiss franc, while $2015Q1_t$ and $Post_t$ are respectively dummies for the first quarter of 2015 and the subsequent quarters. Regressions in columns (1)-(2) are estimated via ordinary least squares (OLS) on the full sample, while that in column (3) is performed on the CHF shock sample using the methodology by Borusyak et al. (2024). The table reports the unconditional average (Y mean) of the dependent variable and the number of observations (N). Standard errors are clustered at the currency pair level in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	Total cost$_{fsrt}$ (%)		
	(1)	(2)	(3)
Volatility$_{srt}$	0.083**		
	(0.041)		
Volatility shock$_{srt}$		0.506***	
		(0.082)	
Exposed$_s$ × 2015Q1$_t$			0.775***
			(0.295)
Exposed$_s$ × Post15Q1$_t$			0.166
			(0.296)
Firm×Year-Quarter	✓	✓	✓
Corridor	✓	✓	✓
Y mean	7.31	7.31	6.96
N	34680	34680	18018

Table 4 – Remittance prices and currency risk, by price component.

Notes: This table presents estimates for equation 5, where the unit of observation is a money transfer option from country s to country r provided by firm f in quarter t. The dependent variables are the total cost of sending a \$200 transfer (Total cost$_{fsrt}$), the spread charged by the firm on a benchmark exchange rate (FX margin$_{fsrt}$), the variable component of the price (Variable fee$_{fsrt}$), and the fixed component of the price (Fixed fee$_{fsrt}$) - all as a percentage of a \$200 transaction. We drop observations with missing values for any of the dependent variables. The independent variables are different proxies for currency risk: $Volatility_{srt}$ is the standardized standard deviation of returns of the exchange rate, and $VolatilityShock_{srt}$ is a binary variable that captures sudden and large shocks to the volatility of the exchange rate between the sending and receiving country. $Exposed_s$ is a binary variable that captures the exposure of the sending country's currency to the 2015 Swiss Franc appreciation, and $2015Q1_t$ is a binary variable that takes the value of 1 for 2015Q1. $Post_t$ is an indicator variable for the subsequent quarters. Standard errors are clustered at the currency pair level in parentheses. Panel A reports OLS estimates using the full sample, while Panel B reports the results for the CHF shock sample, estimated following the methodology by Borusyak et al. (2024). The table reports the unconditional average (Y mean) of the dependent variable and the number of observations (N). Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Tot. cost$_{fsrt}$	FX margin$_{fsrt}$	Variable fee$_{fsrt}$	Fixed fee$_{fsrt}$
	(1)	(2)	(3)	(4)
Panel A: Full sample				
Volatility$_{srt}$	0.083**	0.062*	0.082**	0.001
	(0.041)	(0.037)	(0.038)	(0.020)
Volatility shock$_{srt}$	0.506***	0.479***	0.512***	-0.006
	(0.082)	(0.078)	(0.077)	(0.041)
Firm×Year-Quarter	✓	✓	✓	✓
Corridor	✓	✓	✓	✓
Y mean	7.20	2.66	3.59	3.61
N	34680	34680	34680	34680
Panel B: CHF shock event study sample				
Exposed$_s$ × 2015Q1$_t$	0.775***	0.661***	0.676***	0.100
	(0.295)	(0.214)	(0.247)	(0.207)
Exposed$_s$ × Post15Q1$_t$	0.166	0.287	0.358	-0.191
	(0.296)	(0.191)	(0.251)	(0.170)
Firm×Year-Quarter	✓	✓	✓	✓
Corridor	✓	✓	✓	✓
Y mean	7.03	2.44	3.20	3.82
N	18018	18018	18018	18018

Table 5 – Remittance prices, volatility and hedging instruments.

Notes: The unit of observation is a money transfer option from country s to country r provided by firm f in quarter t. The dependent variable is the cost of sending a $200 transfer, as a percentage of the total. Regressors are different proxies for currency risk: $Volatility_{srt}$ is the standardized quarterly standard deviation of FX returns, $VolatilityShock_{srt}$ is a binary variable that captures sudden and large shocks to the volatility of the exchange rate, and $Exposed_s \times 2015Q1_t$ is the interaction between an indicator for being exposed to the appreciation of the Swiss franc and an indicator for the time of the shock. The table also reports the interaction between our currency risk proxies and $FX\ OTC\ volume_r$, the total trading volumes of OTC derivative instruments defined on the payout currency. Regressions in columns (1)-(2) are estimated via OLS on the full sample, while the one in (3) is estimated according to the methodology by Borusyak et al. (2024) on the CHF shock sample. The table reports the unconditional average (Y mean) of the dependent variable and the number of observations (N). Standard errors clustered at the currency pair level in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	Total cost$_{fsrt}$ (%)		
	(1)	(2)	(3)
Volatility$_{srt}$	0.097**		
	(0.043)		
Volatility shock$_{srt}$		0.631***	
		(0.109)	
Exposed$_s$×2015Q1$_t$			1.126***
			(0.353)
Volatility$_{srt}$ × FX OTC volume$_r$	-0.006		
	(0.010)		
Volatility Shock$_{srt}$ × FX OTC volume$_r$		-0.033**	
		(0.013)	
Exposed$_s$×2015Q1$_t$× FX OTC volume$_r$			-0.096**
			(0.044)
Firm×Year-Quarter	✓	✓	✓
Corridor	✓	✓	✓
Y mean	7.31	7.31	6.78
N	32259	32259	13846

Table 6 – Remittance prices, volatility and business diversification.

Notes: The unit of observation is a money transfer option from country s to country r provided by firm f in quarter t. The dependent variable is the cost of sending a \$200 transfer, as a percentage of the total. Regressors are different proxies for currency risk: $Volatility_{rt}$ is the standardized quarterly standard deviation of returns of of the currency of the receiving country, $VolatilityShock_{rt}$ is a binary variable that captures sudden and large shocks to the volatility of the currency of the receiving country, and $Exposed_s \times Post_t$ is the interaction between an indicator for being exposed to the appreciation of the Swiss franc and an indicator variable for the quarters subsequent to the event. All our currency risk proxies are interacted with the variable $Diversified_f$ — cf. section 4.2.2. Regressions in columns (1)-(2) are estimated via OLS on the full sample, while the one in (3) is estimated according to the methodology by Borusyak et al. (2024) on the CHF shock sample. The table reports the unconditional average (Y mean) of the dependent variable and the number of observations (N). Standard errors clustered at the currency pair level in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	Total cost$_{fsrt}$ (%)		
	(1)	(2)	(3)
Volatility$_{rt}$	0.618**		
	(0.270)		
Volatility shock$_{rt}$		2.031***	
		(0.658)	
Exposed$_s$ $\times$ 2015Q1$_t$			1.351***
			(0.349)
Volatility$_{rt}$ $\times$ Diversified$_f$	-0.538*		
	(0.276)		
Volatility shock$_{rt}$ $\times$ Diversified$_f$		-1.431**	
		(0.663)	
Exposed$_s$ $\times$ 2015Q1$_t$ $\times$ Diversified$_f$			-1.499***
			(0.466)
Firm$\times$Year-Quarter	✓	✓	✓
Corridor	✓	✓	✓
Y mean	7.28	7.28	6.78
N	31798	31798	13846

Table 7 – Profitability, market participation and currency risk.

Notes: This table presents estimates for equations (6) and (7). In columns (1)-(3), the unit of observation is a money transfer operator f in year y. The dependent variable is the annual profit margin, computed as operating profits (EBIT) over total revenues. $Volatility_{fy}$ is the standardized firm-level average of the annual standard deviation of exchange rate returns across all currency pairs served by the firm in a given year, $VolatilityShock_{fy}$ is the standardized fraction of corridors that the firm serves that is hit by a volatility shock as defined in section 3.3, and $Exposed_f \times 2015_y$ is the interaction between an indicator for serving at least one corridor exposed to the appreciation of the Swiss franc in 2014 and a time indicator that is 1 for 2015. In columns (4)-(6), the unit of observation is a market, defined as a pair of a sending country s and a receiving country r in quarter t. The dependent variable is the number of firms operating cash-to-cash money transfers in that corridor at that time. $Volatility_{srt}$ is the standardized quarterly standard deviation of returns of the exchange rate, $VolatilityShock_{srt}$ is a binary variable that captures sudden and large shocks to the volatility of the exchange rate between the sending and receiving country, and $Exposed_s$ is an indicator for currencies exposed to the appreciation of the Swiss franc, while $2015Q1_t$ and $Post15Q1_t$ are respectively dummies for the first quarter of 2015 and the subsequent quarters. Regressions in columns (1), (2), (4), (5) are estimated via ordinary least squares (OLS), while the one in column (3) and (6) uses the methodology by Borusyak et al. (2024). The table reports the unconditional average (Y mean) of the dependent variable and the number of observations (N). Standard errors clustered at the firm level, for columns (1)-(3), and currency pair level, for columns (4)-(6), are in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	EBIT margin$_{fy}$ (%)			Number of firms$_{srt}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Volatility$_{fy}$	-1.168					
	(0.888)					
Volatility shock$_{fy}$		-1.698*				
		(0.936)				
Exposed$_f$ $\times$ 2015$_y$			-4.273**			
			(1.869)			
Exposed$_f$ $\times$ Post2015$_y$			-7.135*			
			(3.960)			
Volatility$_{srt}$				-0.074***		
				(0.026)		
Volatility shock$_{srt}$					-0.107**	
					(0.046)	
Exposed$_s$ $\times$ 2015Q1$_t$						-0.213
						(0.198)
Exposed$_s$ $\times$ Post15Q1$_t$						-0.712***
						(0.215)
Year	✓	✓	✓			
Firm	✓	✓	✓			
Year-Quarter				✓	✓	✓
Corridor				✓	✓	✓
Y mean	8.90	8.90	10.62	3.16	3.16	3.39
N	196	196	76	11783	11783	5557

Table 8 – Remittance flows and currency risk.

Notes: This table presents ordinary least squares (OLS) estimates for equation (8). The dependent variable is the logarithm of bilateral remittance volume flowing from country s to country r, for columns (1)-(2), and the logarithm of outgoing remittances from country s, for column (3). Regressors are different proxies for currency risk: $Volatility_{sry}$ is the standardized standard deviation of returns of the exchange rate over year y, $VolatilityShock_{sry}$ is 1 if the exchange rate has experienced a volatility shock — as defined in section 3.3 — during year y, and $Exposed_s \times ShockPeriod_y$ is the interaction between an indicator for being exposed via carry trades to the appreciation of the Swiss franc and a time indicator that is in 2015. $Post_y$ is an indicator variable for the subsequent years. Regressions in columns (1)-(2) are estimated on the full sample, while that in column (3) use the CHF shock sample. The table reports the unconditional average (Y mean) of the dependent variable and the number of observations (N). Heteroskedasticity-robust standard errors are reported in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	Remit. flows$_{sry}$ (log)		Remit. outflows$_{sy}$ (log)
	(1)	(2)	(3)
Volatility$^{FX}_{sry}$	-0.073**		
	(0.030)		
Volatility shock$_{sry}$		0.012	
		(0.033)	
Exposed$_s$ × 2015$_y$			-0.076
			(0.123)
Exposed$_s$ × Post2015$_y$			-0.097
			(0.076)
Year	✓	✓	✓
Corridor	✓	✓	
Sending country			✓
Y mean	5.70	5.70	22.71
N	1646	1646	288

8 Figures

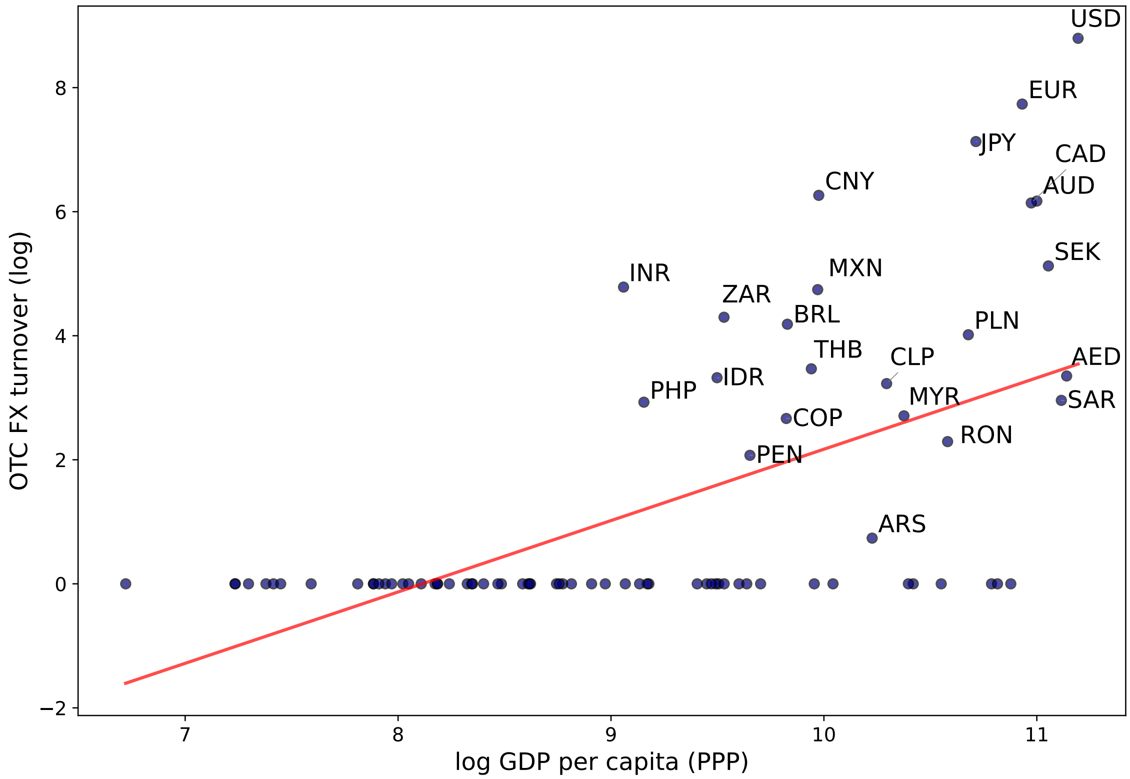


Figure 1 – The figure plots the log daily trading volume of OTC FX instruments for each currency against the log GDP per capita of the corresponding issuing country. Both variables refer to 2022, and the sample is restricted to countries with a population above 10 million. For the euro, GDP per capita is computed as the Euro Area average. The linear fit is also reported in red. *Data sources:* BIS Triennal Survey, World Bank's World Development Indicators.

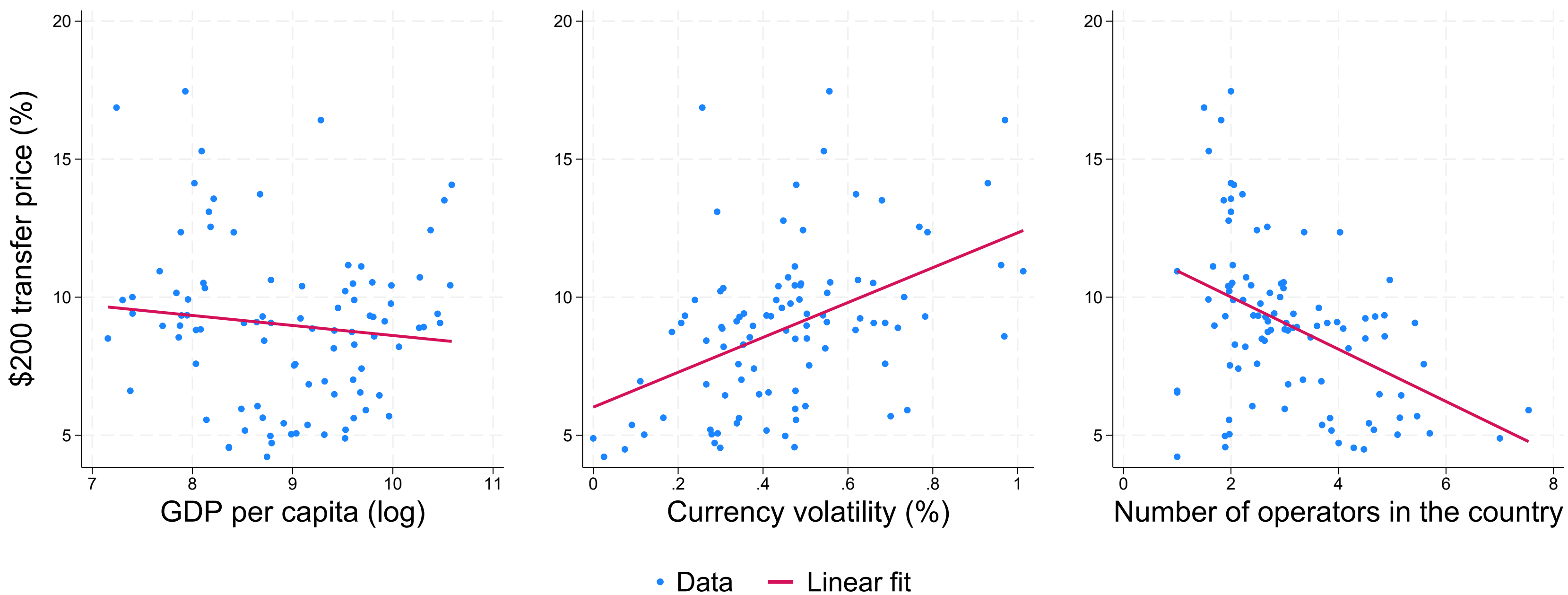
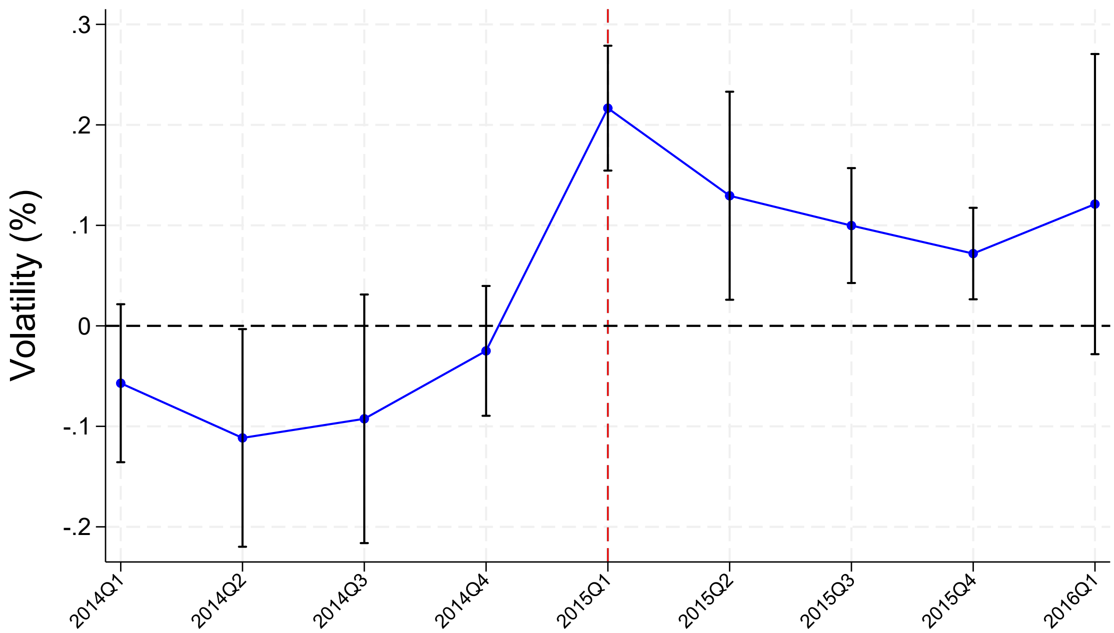
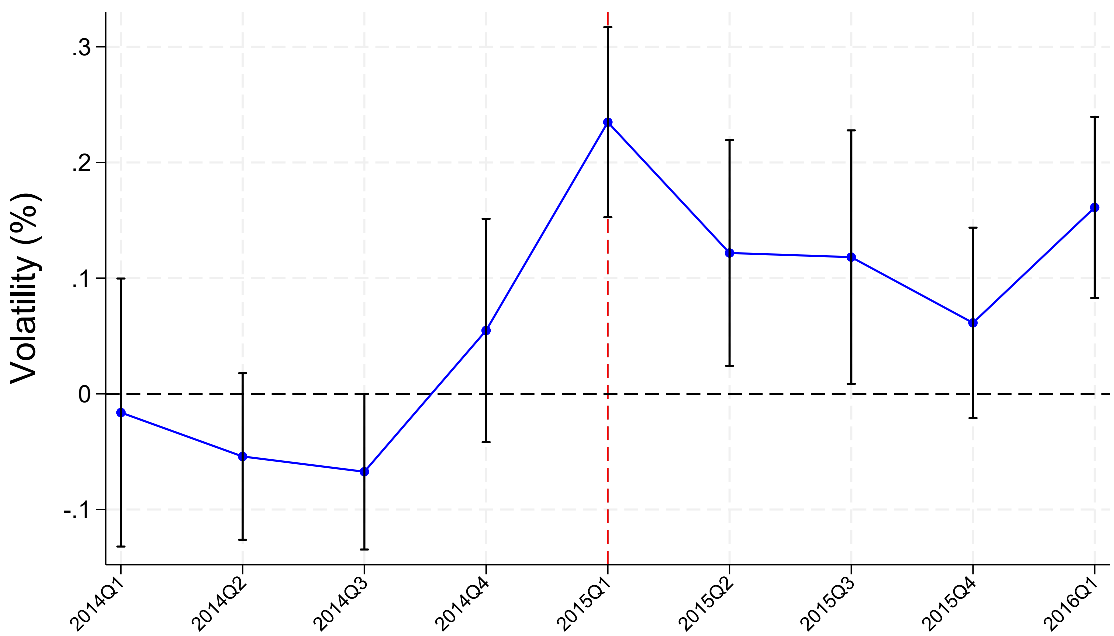


Figure 2 – *Left panel*: the average cost of sending a \$200 trasfer to a receiving country r is contrasted with the (log) GDP per capita, PPP, of that country. Correlation = -0.112, p-value = 0.284. *Center panel*: the average cost of sending a \$200 trasfer to a receiving country r is contrasted with the standard deviation of country r's currency return. Correlation = 0.457, p-value = 0.000. *Right panel*: the average cost of sending a \$200 transfer to a receiving country r is contrasted with the number of firms operating in that country. Correlation = -0.430, p-value = 0.000. *Data sources:* World Bank's Remittance Prices Worldwide database, World Bank's World Development Indicators, Bloomberg.



(a) Currency level



(b) Currency-pair level

Figure 3 – Event study for quarterly volatility of daily FX returns of exposed currencies around the Swiss franc shock — equation (4). Panel (a) reports estimates at the currency level (vs USD), while Panel (b) reports estimates at the currency-pair level. The regression is estimated following the Borusyak et al. (2024). Standard errors are clustered at the currency pair level.

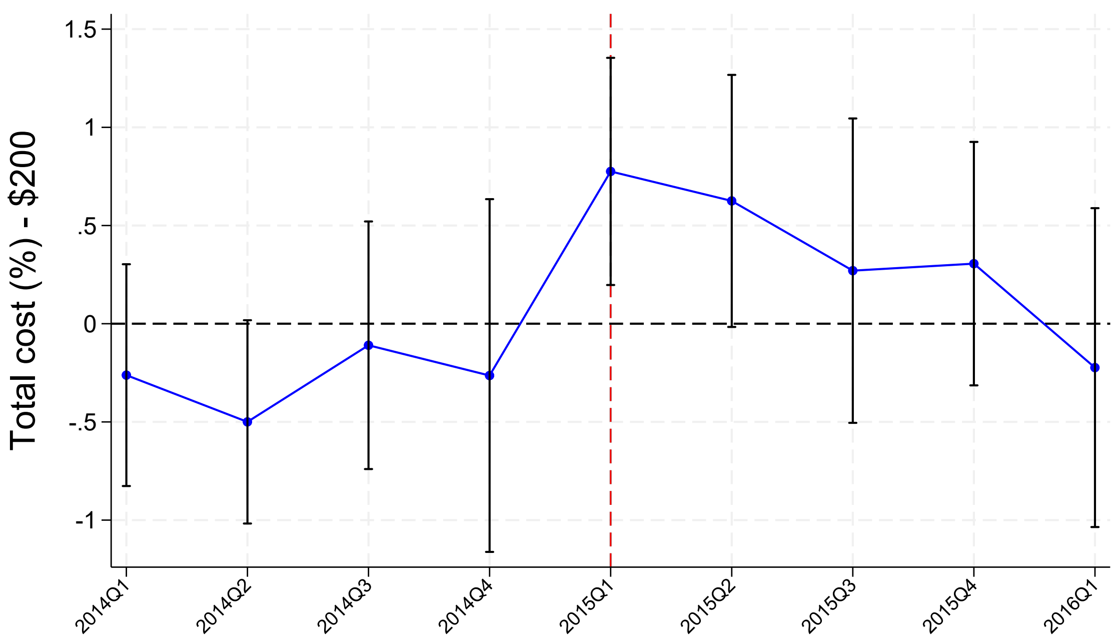
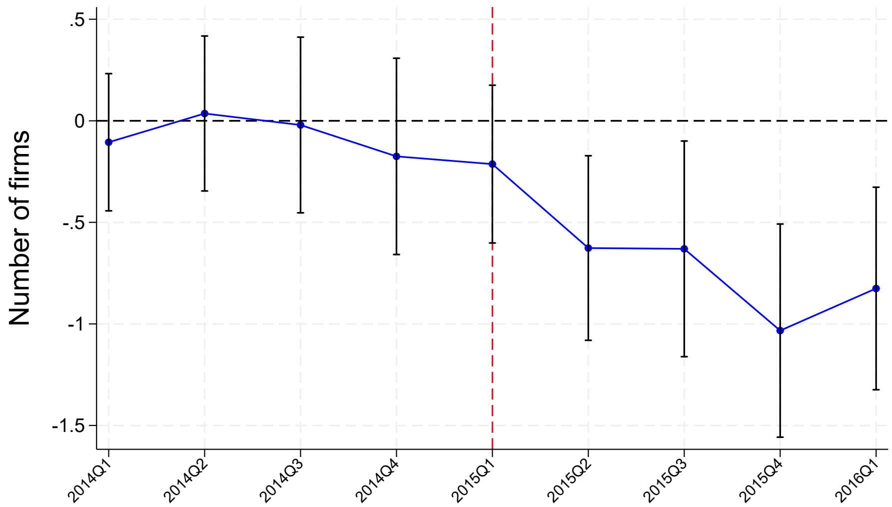
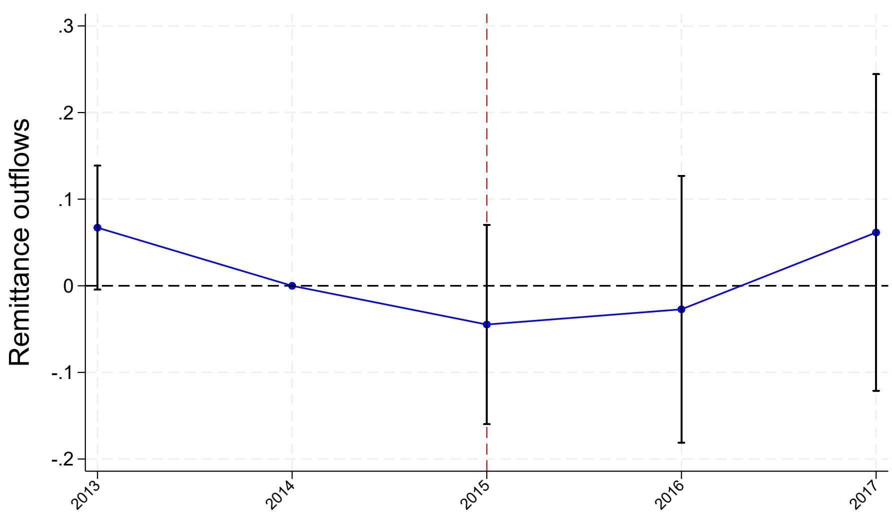


Figure 4 – Event study estimates of the total cost of sending a $200 remittance from country s to country r in quarter t using the service offered by operator f, comparing the evolution of transfers from countries exposed to the Swiss franc shock (treatment group) and transfers in the control group. The regression is specified as the dynamic version of equation (5), and it is estimated following Borusyak et al. (2024). Standard errors are clustered at the currency pair level.



(a) Number of firms



(b) Log remittances paid

Figure 5 – Market-level estimates estimates. Panel (a) shows the estimated coefficients for the number of MTOs operating in market s-r, where s is the sending country and r is the receiving country, relative to the quarter before the shock; the regression is estimated following Borusyak et al. (2024) and includes corridor and quarter fixed effects, with standard errors clustered at the currency pair level. Panel (b) shows OLS estimates for the (log) volume of remittances flowing out of country s for the group of exposed countries, relative to the year before the shock. The regression includes country and year fixed effects, and standard errors are clustered at the currency level.

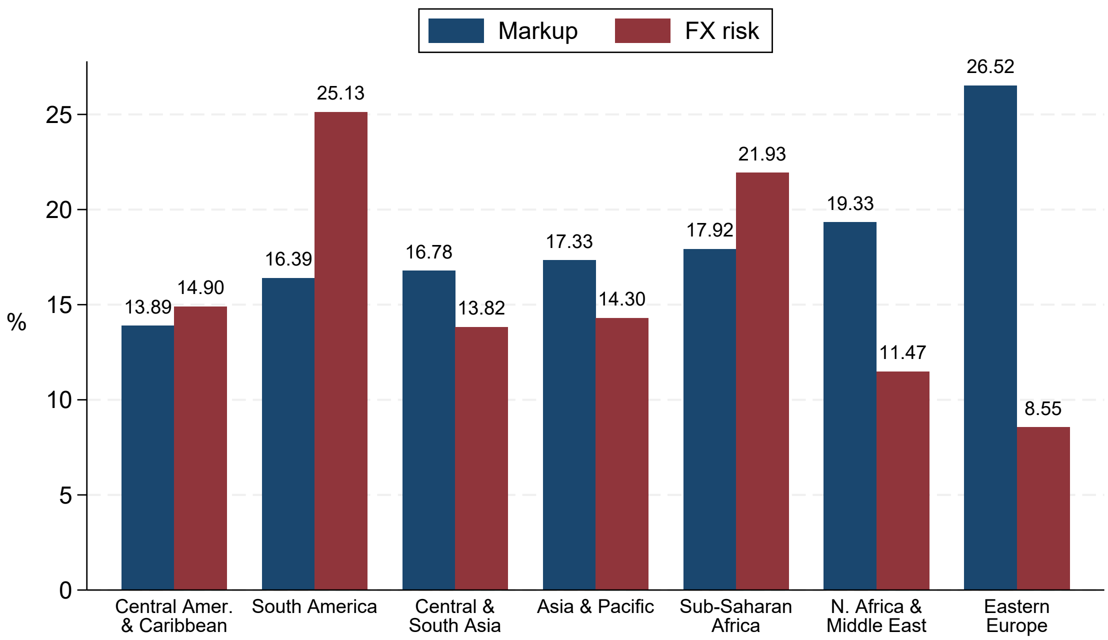


Figure 6 – The figure reports the relative contribution on final price of mark-up ($P - MC$, as a fraction of the price), and currency risk, computed as $(MC_{sry} - \exp\{\beta_0 + \omega_{sry}\})/P$, as estimated from the model of section 5. All reported values are region averages.

A Remittance Prices Worldwide: data preparation

The full dataset, as of our last download, has 234,188 observations, each of which represents an option of sending an international money transfer available in a given quarter within a country, specifying the provider (MTO), the price, the modality (e.g. cash vs digital), the location (e.g. agent vs online), and other product characteristics.

On top of minor cleaning operations, we took two main actions to prepare the data for our analysis:

- We classified the transfers into homogeneous categories that allow us to obtain a sample of comparable products.
- We matched each transfer option to a currency pair, not explicitly recorded in the dataset (only the currency of origination of the transfer is mentioned).

In what follows, we describe the cleaning procedure in detail.

A.1 Basic cleaning

First of all, we standardized country-related information. We harmonized 3-digit ISO country codes where needed and fixed a few inconsistencies in reported codes of the currency in which the transaction is originated (e.g., "CFA" instead of "XAF" for transfers from Cameroon).

We then harmonized firm names to address inconsistent reporting across survey rounds, including commercial name variants (e.g., "Remitly Money Transfer" vs. "Remitly"), typographical errors (e.g., "Dahabshil" vs. "Dahabshiil"), and name changes due to rebranding (e.g., "Transferwise" rebranded as "Wise" in 2021). Because no standardized procedure exists for this task, we combined automated and manual validation. Specifically, we provided the list of company names to an AI agent to generate a Python dictionary mapping candidate variants and rebrandings to a canonical name. Subsequently, we verified each proposed match manually one by one.

Finally, we used the auxiliary variables "note 1" and "note 2"—already included in the dataset—to exclude observations flagged as "not transparent"—either because the provider did not disclose the price or because an account was required to access the service—and those associated with promotions or government subsidies.

A.2 Product classification

Information about the type of service has not been always reported homogeneously, and some observations are associated to more than one product (e.g. they can refer both to cash payments and bank transfers). We considered all products that are associated with multiple characteristics as separate observations, increasing the number of rows in the dataset. After this operation, we harmonised the categories within "product", "sending location", "pick-up method" and "speed" variables, according to the classification reported in Table A6.

A.3 Currency matching

Not all transfers reported in the RPW dataset involve a currency conversion service. Based on this feature, transfers that share the same origin, destination, operator and quarter could be priced in a substantially different way. Unfortunately, the RPW dataset does not explicitly report the currency in which the transfer is paid out, so we had to infer it from the available information. As a baseline, we assumed that the payout currency is the same as the currency of the receiving country. In some cases though, the auxiliary notes explicitly indicate a different possibility (e.g. "USD service" for transfers paid out in US dollars). Consistently with the information in the notes, we assigned the indicated currency as the payout currency for these transfers. We also inferred other cases of no conversion service when the reported exchange rate was equal to 1 or the reported spread was equal to 0%. Yet, a few inconsistencies remain in the dataset at this stage, so we computed cross-rates for all currency pairs that were supposed to be inside the dataset based on the countries of origination and destination of the transfer, and checked that the exchange rate of each currency pair was closer to the actual one than to the rate against the US dollar.

In the final dataset, we only keep transfers that involve currency conversion.

B Non-linear pricing of money transfers

We can compute the two components of the pricing scheme (if any) from the data we have. If the total transaction cost is given by a fixed fee, F, and a variable one, $f \cdot x$ (where x is the amount sent), we have the following:

$$\begin{cases} F + \$200 \cdot f = \$200 \cdot \%TotCost^{\$200} \\ F + \$500 \cdot f = \$500 \cdot \%TotCost^{\$500} \end{cases}$$

and then

$$\begin{cases} f = \frac{\$500 \cdot \%TotCost^{\$500} - \$200 \cdot \%TotCost^{\$200}}{\$300} \\ F = \$200 \cdot \%TotCost^{\$200} - \$200 \cdot f \end{cases} .$$

In our analysis, we take both as percentage of the transaction amount, that is we consider f as the variable fee and $\frac{F}{\$200}$ as the fixed fee.

C Currency crises in the CHF shock sample

To mitigate concerns about confounding effects arising from concurrent country-specific factors and pre-trends, we examine the exchange rate dynamics of all pay-out currencies in our sample in the year preceding the shock, so as to verify their comparability in terms of price behaviour immediately before the event of interest. Specifically, we exclude currencies whose exchange rate exhibits an absolute change greater than 50% between the beginning of 2014 and the date of the shock, and this restriction only excludes one currency from the sample. Figure A4 plots, for each currency, an index normalised to 100 at the start of 2014. While most currencies in the sample remain within a band of approximately ±10% around their starting value throughout the year, the Ghanaian cedi (GHS) stands out as a clear outlier. This stark contrast reflects a well-documented currency crisis that unfolded in Ghana over the course of 2014, driven by a combination of large fiscal and current account deficits, high inflation, and the sharp decline in international oil prices[17]. As a robustness check, Table A3 reports estimates obtained when the full sample is used instead. Reassuringly, our results remain statistically significant and quantitatively similar.

[17] Cf. IMF staff report and Bloomberg article.

D Theoretical framework for a model of the remittance industry

The model is structured as a two-stage game where money transfer operators first decide whether to enter a market, defined as a pair of a sending country s and a receiving country r in year y, and then–conditional on such decision–choose the quantity to supply in that market.

Firm's problem and equilibrium First, firms need to decide whether to enter market sry. We assume that firms are risk-neutral and maximize expected profits:

$$\max_{q_{fsry}} \mathbb{E}[\pi|\lambda_f] = P(Q_{sry})\ q_{fsry} - C(q_{fsry}) - F_{sry}, \tag{16}$$

where $P(Q_{sry})$ is a continuously differentiable inverse demand function, Q_{sry} and q_{fsry} are the quantity of foreign currency supplied respectively by all operators and by firm f in market sry, $\lambda_f = \frac{\partial Q_{sry}}{\partial q_{fsry}}$ is the firm's belief about post-entry competitive behavior, $C(q_{fsry})$ is the variable cost of supplying that quantity, with a stochastic component that is not known ex ante, and F is the market-specific fixed entry cost. In our baseline specification, we assume $\lambda_f = 1$, equivalent to a Cournot competition scenario.

We assume ex-ante symmetry before entry across firms: the realised value of the firm-specific marginal cost is not known ex-ante, and to compute first-stage expected profits firms use expected marginal costs $\overline{MC}_{sry}$, given by

$$MC_{fsry} = \overline{MC}_{sry} + \nu_{fsry}.$$

Given this symmetry, the market share $s_{fsry} \equiv q_{fsry}/Q_{sry}$ in expectation is the same for all firms in market sry, that is $\frac{1}{N_{sry}}$, where N_{sry} is the number of firms in market sry.

Define $\eta_{sry} \equiv -\left(\frac{\partial P_{sry}}{\partial Q_{sry}}\ \frac{Q_{sry}}{P_{sry}}\right)^{-1}$ as the price elasticity of demand, and by backward induction (computing FOC on the expected profits in the second stage of the game), we get an expression for the expected profits in market sry as a function of the (expected) number of firms N_{sry}. The entry condition is:

$$\pi_{sry}(N_{sry}) \geq 0 > \pi_{sry}(N_{sry}+1) \tag{17}$$

meaning that in equilibrium, N_{sry} firms in the market make a non-negative profit, while $N_{sry}+1$ firms would not. As we shall see, currency imperfections are impacting profitability negatively, in turn hindering market competition.

Equilibrium mark-up is defined as the ratio of price to marginal cost:

$$M_{fsry} \equiv \frac{P(Q_{sry})}{MC_{fsry}} = \frac{\eta_{sry}}{\eta_{sry} - s_{fsry}} = \frac{\eta_{sry} N_{sry}}{\eta_{sry} N_{sry} - 1} \tag{18}$$

which is clearly decreasing in the elasticity of demand η_{sry} and the number of competitors N_{sry}. We will base our estimates of average mark-ups on this expression.

Currency imperfections In the model, we posit that firms face exchange rate risk when selling foreign currency, and this enters the objective function as a marginal cost component. In our empirical specification, we assume a linear functional form for marginal costs, so that we can directly compute the "currency imperfection" component of the price simply as the product between proxies for currency imperfections (volatility of the exchange rate and bid-ask spread of the payout currency) and their estimated coefficients.

E Auxiliary tables and figures

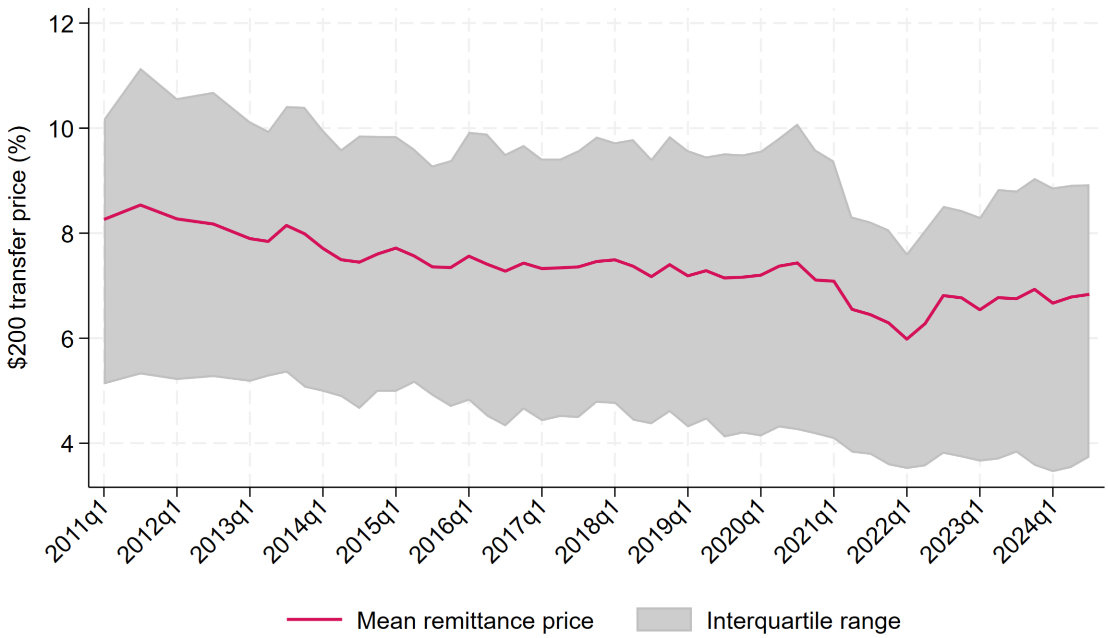


Figure A1 – Average price of sending a cash-to-cash $200 transfer from a physical location, by quarter. *Data source:* World Bank's Remittance Prices Worldwide database.

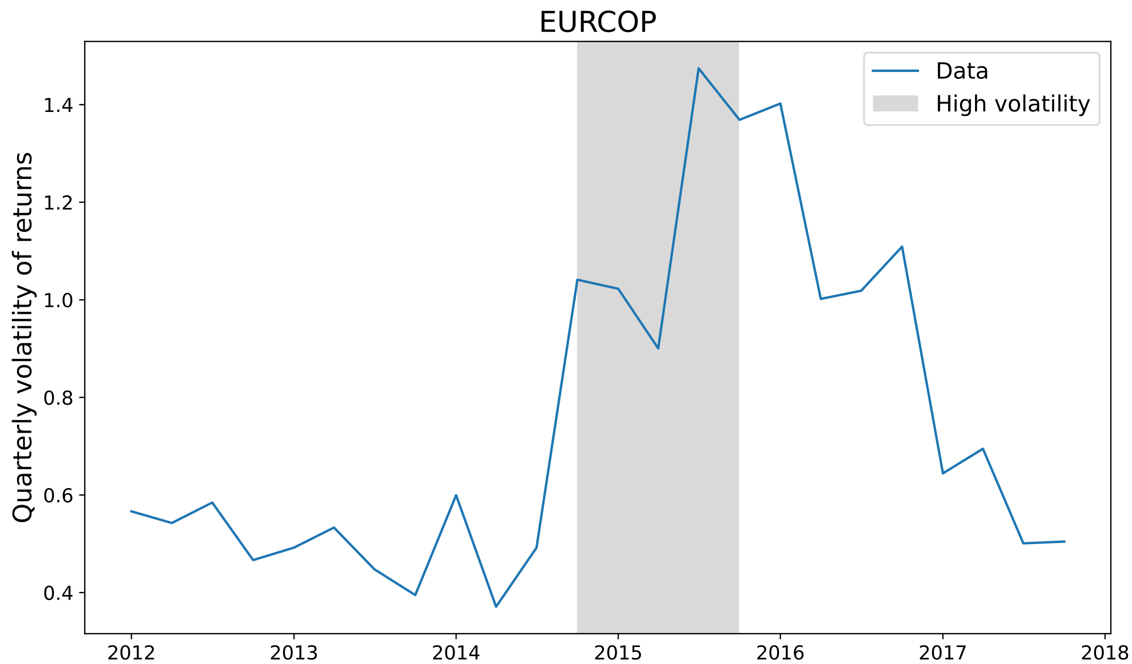


Figure A2 – Example of a "volatility shock" in our sample. The grey shaded area indicates quarters for which the dummy $VolatilityShock_{srt}$ is equal to 1 for all corridors where the currency of the sending country is the Euro and the receiving country is Colombia.

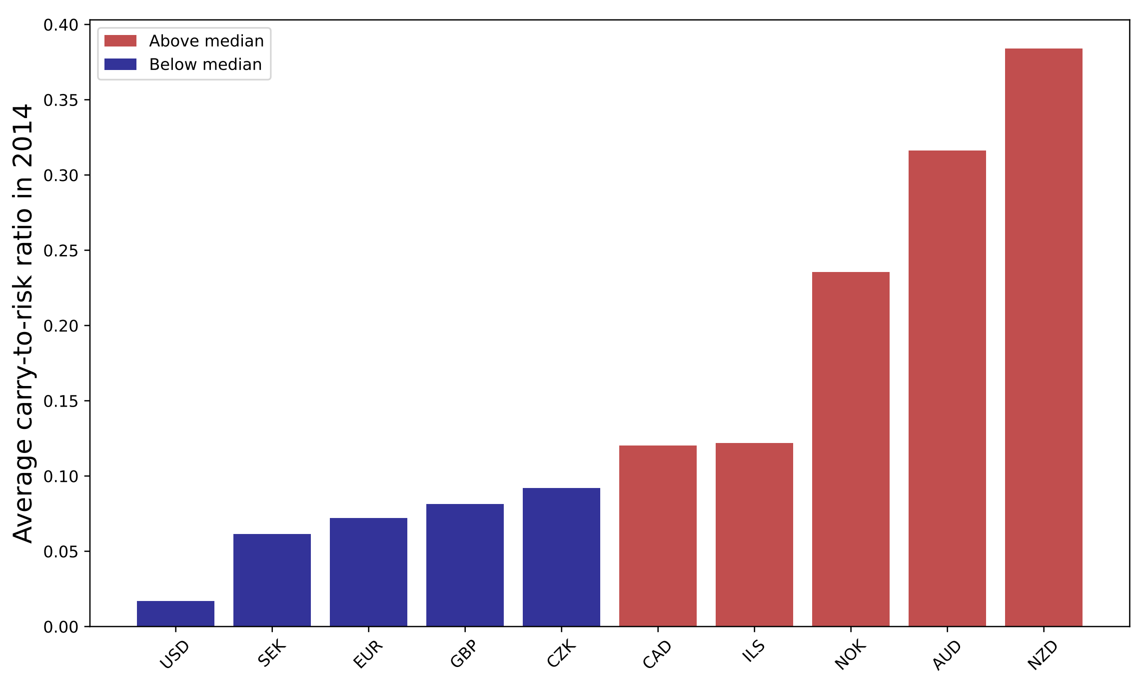


Figure A3 – 2014 average carry-to-risk for currencies with available data in our sample.

Table A1 – The table reports the first 30 countries by number of observations associated with a volatility shock - as defined in section 3.3 - in our sample. The first column reports the country name, the second column reports the fraction of observations associated with a volatility shock in the sample, and the third column reports the cumulative percentage.

Receiving country	% obs.	Cumulative distribution
Nigeria	7.58%	7.58%
Ghana	6.76%	14.33%
India	6.36%	20.70%
Brazil	5.91%	26.60%
Philippines	5.71%	32.32%
Pakistan	5.03%	37.35%
Colombia	3.93%	41.28%
Samoa	3.87%	45.15%
Bangladesh	3.48%	48.63%
Indonesia	3.36%	51.99%
Sri Lanka	3.25%	55.24%
Turkey	3.11%	58.35%
Vietnam	2.91%	61.27%
Tonga	2.63%	63.90%
Rwanda	2.46%	66.36%
Fiji	2.18%	68.53%
Kenya	2.06%	70.60%
Uganda	1.84%	72.43%
Egypt, Arab Rep.	1.70%	74.13%
Ethiopia	1.39%	75.52%
Mexico	1.36%	76.87%
Peru	1.33%	78.20%
Jamaica	1.24%	79.45%
Dominican Republic	1.13%	80.58%
Nepal	1.10%	81.68%
China	1.10%	82.78%
South Africa	0.90%	83.69%
Haiti	0.90%	84.59%
Myanmar	0.79%	85.38%
Afghanistan	0.79%	86.17%

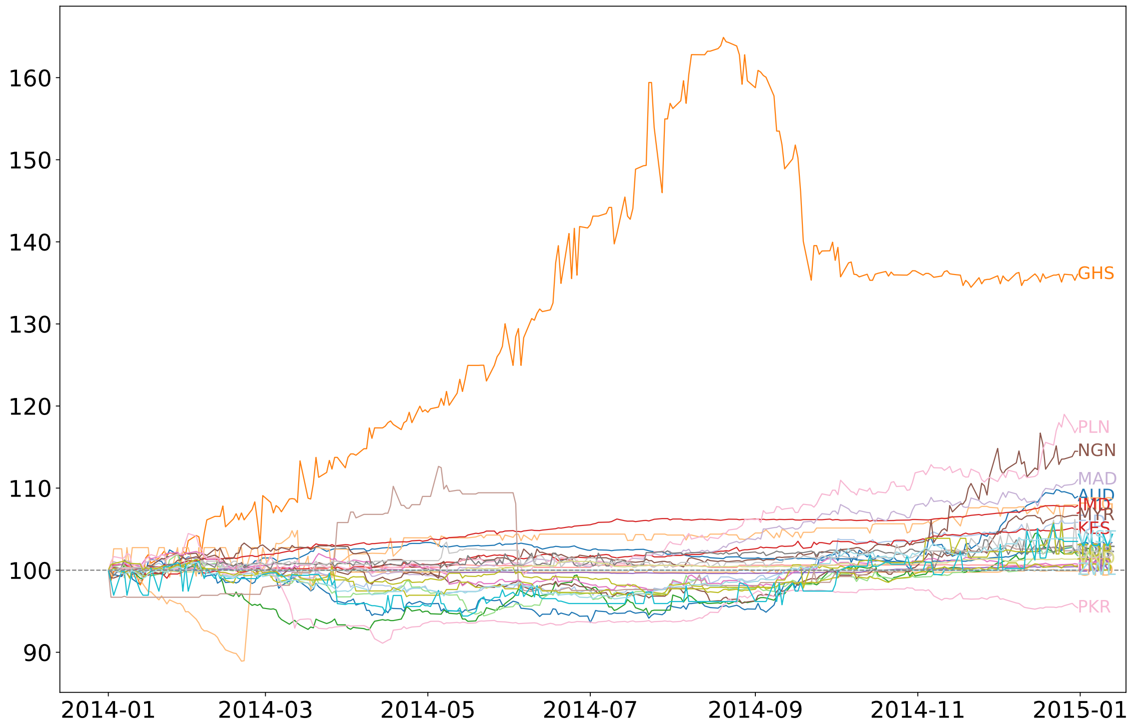


Figure A4 – Destination currencies within CHF shock sample in 2014. Each currency is quoted against the USD as base currency, and the start of the series is normalized to 100.

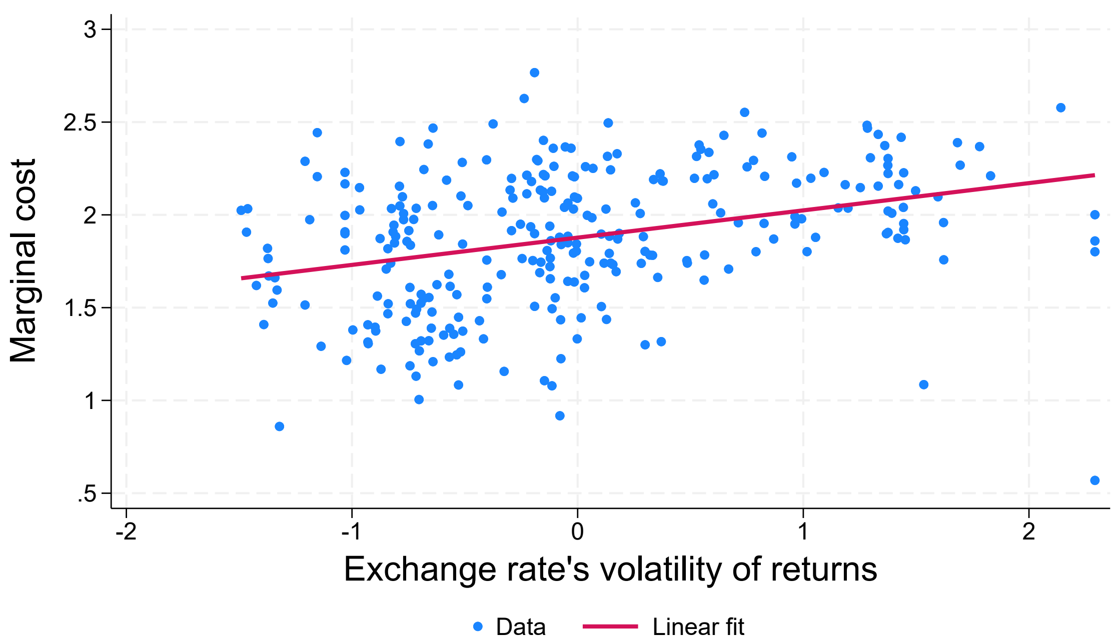


Figure A5 – The figure shows marginal costs as estimated from the model (cf. section 5), contrasted with the (standardized) volatility of the exchange rate. All values are averaged at the corridor level.

Table A2 – Balance table for the CHF shock sample. We compare sending countries whose currencies were popular investing currencies in carry trades ("Treatment" group) to those whose currencies were not exposed to the 2015 CHF appreciation ("Control" group). For the treatment group, we use data only for the pre-shock period (that is, until 2014). The table shows group means (Mean) and standard deviations (St.Dev.), as well as the result of a conditional t-test to compare whether the two means are statistically different across the two groups (t-stat). In particular, the latter is the ratio between the estimated coefficient and standard error of an OLS regression of the variable of interest on a "treatment" indicator, with the inclusion of year fixed effects and standard errors clustered at the currency level. The variables, sourced from the World Bank's World Development Indicators, are GDP per capita at purchasing power parity (in log units - "GDP per capita, PPP (constant 2021 international $"), its growth rate, population (in log units "Population, total"), its growth rate, the CPI inflation rate (growth rate of the consumer price index - "Inflation, consumer prices (annual %)"), employment rate (the ratio between employed and total population - "Employment to population ratio, 15+, total (%) (modeled ILO estimate)"), and unemployment rate (the ratio between unemployed population and labor force - "Unemployment, total (% of total labor force) (modeled ILO estimate)"). Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

	Treatment		Control		Difference	
	Mean	St.Dev.	Mean	St.Dev.	t-stat	N.obs.
GDP (log)	10.988	0.304	10.954	0.251	-0.168	253
ΔGDP (%)	0.659	3.444	1.232	0.732	0.982	253
Population (log)	16.951	1.410	16.264	0.937	-1.620	254
ΔPopulation (%)	1.198	2.220	1.197	0.352	-0.458	254
Inflation (%)	2.149	2.228	1.929	0.927	-0.441	253
Employment share (%)	60.853	10.437	62.628	1.185	1.316	254
Unemploym. rate (%)	5.411	4.297	5.573	1.552	-0.870	254

Table A3 – Robustness check for CHF shock event study.

Notes: The table reports the results from estimating specifications (5) and (7) for our event study, extending the sample to include the countries excluded from the main analysis due to the occurrence of currency crises (see Section C). The unit of observation is a money transfer option from country s to country r provided by firm f in quarter t. The dependent variable is the cost of sending a \$200 transfer, as a percentage of the total. The table reports the unconditional average (Y mean) of the dependent variable and the number of observations (N). Standard errors clustered at the currency pair level in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	Total cost$_{fsrt}$ (%)	Number of firms$_{srt}$
	(1)	(2)
Exposed$_s$ $\times$ 2015Q1$_t$	0.571*	-0.169
	(0.343)	(0.203)
Exposed$_s$ $\times$ Post$_t$	0.218	-0.666***
	(0.281)	(0.217)
Firm$\times$Year-Quarter	✓	
Corridor	✓	✓
Year-Quarter		✓
Y mean	7.16	3.42
N	17544	5538

Table A4 – 2SLS estimates for equation (10). Column (1) reports 1st stage estimates: the dependent variable is the (log) median price of sending a \$200 money transfer from country s to country r in year y, $Z_{sry\text{-}1}$ is the average price of sending money from country s in year $y-1$, removing transfers directed to destination r, $GDP_{ry\text{-}1}$ is the per-capita real GDP of country r lagged by one year, GDP_{sy} is the per-capita real GDP of country s, $Migrant\ stock_{sr}$ is a time-invariant measure of migrant population in country s, $FX\ return_{sry}$ is the average return of the exchange rate between country s and country r in year y. Column (2) reports estimates for the 2nd stage regression, where the independent variable is the (log) volume of remittances sent from country s to country r in year y. Heteroskedasticity-robust standard errors are reported in parenthesis.

	Total cost$_{sry}$	Remit. flows$_{sry}$
	(1)	(2)
$Z_{sry\text{-}1}$	0.684***	
	(0.025)	
Total cost$_{sry}$		-1.824***
		(0.158)
GDP$_{ry\text{-}1}$	0.057***	0.405***
	(0.012)	(0.059)
GDP$_{sy}$	-0.028*	0.891***
	(0.016)	(0.075)
Migrant stock$_{sr}$	-0.019***	0.283***
	(0.004)	(0.024)
Population$_{sy}$	0.025***	0.293***
	(0.006)	(0.031)
Population$_{ry}$ (log)	-0.024***	0.243***
	(0.004)	(0.017)
FX return$_{sry}$	0.010	-0.066***
	(0.010)	(0.011)
Constant	0.677***	-16.047***
	(0.205)	(0.993)
Kleibergen-Paap F-stat	735.65	215.26
N	1389	1389

Table A5 – Model estimation.

Notes: Panel A reports the parameter estimates of the model from section 5. The model is estimated using the full sample already described in section 3.1 aggregated at the corridor-year level. The table reports the estimated parameters for all the equations of the model, along with the standard errors and p-values. The sample size is reported at the bottom of the table. Panel B reports the variance decomposition of the total cost of sending a $200 transfer - cf. equation (15). It reports the variance of the logarithm of the price, the variance of the logarithm of mark-up, the variance of the FX components of marginal costs, and the covariance between the two. The second row shows the share of the variance explained by each component.

Panel A: Parameter estimates

	Point estimate	Standard Error	p-value
Demand			
Total Cost$_{sry}$	-1.823	0.158	0.000
GDP$_{r,y-1}$	0.407	0.059	0.000
GDP$_{s,y}$	0.890	0.075	0.000
Population$_{r,y}$	0.243	0.017	0.000
Population$_{s,y}$	0.293	0.031	0.000
Migrant population$_{sr}$	0.282	0.024	0.000
FX return$_{sry}$	-0.045	0.015	0.002
Constant - demand	-16.054	0.994	0.000
Marginal cost			
FX volatility$_{sry}$	0.137	0.010	0.000
Constant - supply	1.885	0.024	0.000
Fixed cost			
Entry regulation$_r$	0.113	0.063	0.072
Constant - fixed costs	4.500	0.097	0.000
σ	1.903	0.040	0.000
N. obs.	1389		

Panel B: Variance decomposition

Var(log P)	Var(log MU)	Var($X\beta$)	Cov(log $MU, X\beta$)
0.16	0.02	0.02	-0.00
	14.52%	11.45%	-0.53%

Table A6 – Harmonisation of product characteristics. “Harmonised category” is the label we have created, while “Included categories” are the original values grouped under the new label.

	Harmonised category	Number of observations	Included categories
Product	Cash	90,290	Cash, Cash to cash, Cash to account, Door to door, Cash to account (same bank)
	Bank transfer	97,768	Bank account, Bank account transfer, Account to account, Account to cash, Account to account (same bank), Account to account (other bank), Account
	Card / mobile	81,912	Debit/credit card, Credit/debit card service, Card, Debit card, Prepaid card, Card, Credit card, Credit Card, Online service, Online transfer, Mobile money, Mobile
	Missing or unclassified	323	*No value reported or* USD service, EUR service, JPY service, GBP service, LCU service, Home delivery
Pick-up method	Cash	150,887	ATM, ATM Network, Cash, Home Delivery, Home delivery
	Bank account	110,710	Bank Account, Bank account, Own/partner bank account, Bank account (same/partner bank), Own/Partner bank account, Own/partner Bank Account, Own/partner Bank account, own/partner Bank Account
	Card / mobile	8,696	Mobile, Mobile wallet, Mobile Wallet, Debit card
	Missing or unclassified	0	
Sending location	Agent	111,122	*Whatever is not “Online”* and *the provider is not a bank.* Agent, Call Center, Post Office, Post Office branch, at Branch, Bank branch

	Online	115,789	Internet, On-line, Mobile phone
	Bank	43,382	*Whatever is not "Online"* and *the provider is a bank.* Agent, Call Center, Post Office, Post Office branch, at Branch, Bank branch
	Missing or unclassified	0	
Transfer speed	Same day	157,708	Less than one hour, Same day
	1-3 days	65,643	Next day, 1-3 days, 2 days
	More than 3 days	46,933	3-5 days, 6 days or more
	Missing or unclassified	9	*No value reported*