# The Macroeconomics of International Remittance Flows

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**Abstract**

This paper studies the role of international remittance flows in macroeconomic stabilization. We leverage novel transaction-level data from a global Money Transfer Operator to study how individuals send remittances in response to macroeconomic shocks. We document four empirical results. (1) Using a staggered difference-in-differences design, we find that remittance inflows increase by 31% in the week following a natural disaster, consistent with remittances acting as private insurance. (2) Across staggered COVID-19 lockdown reopenings, remittances increased 43% on average over the subsequent ten months, consistent with a labor market recovery. (3) Leveraging the 2021 U.S. stimulus checks as an exogenous income shock, we estimate that remittances rose by 20% in the two weeks following disbursement. (4) The exchange-rate elasticity of sender-currency flows is negative, reaching $-0.20$ at a twenty-week horizon, consistent with the income effect of exchange rate fluctuations dominating the substitution effect.

We then develop a two-country heterogeneous-agent New Keynesian model featuring endogenous remittance flows. Two sufficient statistics — the intertemporal marginal propensity to consume (iMPC) and the intertemporal marginal propensity to remit (iMPR) — govern how income shocks propagate internationally through an international Keynesian cross, amplifying cross-country spillovers and generating co-movement absent in models without family linkages.

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## 1 Introduction

Remittances — flows between individuals in different countries — have increased ten-fold in real terms in the last 30 years. Since the onset of the pandemic, there has been a renewed interest in understanding its role. Figure 1 shows that remittance flows to low-and middle-income countries (LMICs) are both large and stable in comparison to other external flows. Recently, they have represented one of the largest sources of external finance to LMICs, overtaking FDI. Figure 2 shows a map of the main economies involved.[1]

Despite their global significance, the absence of micro data has made it challenging to understand remittance flows at the individual level. This paper asks, 'How do families use remittances to share income risk across countries, and what are the implications for international macroeconomic transmission?' Whilst aggregate remittance data are readily available through the balance of payments accounts, they suffer from coverage issues and low frequency. To investigate these questions, we exploit novel administrative data from a global money transfer operator covering more than 150 million transactions across 65 sender and 157 recipient countries between 2014 and 2023. Despite representing approximately one percent of global remittance flows by the end of the sample, our series tracks official aggregate data closely. Correlations with central bank and World Bank statistics reach 0.94 for Mexico and Kenya, 0.84 for Bangladesh and Romania, 0.77 for the Philippines, and 0.72 for Italy, lending credibility to the dynamics captured in our micro data.

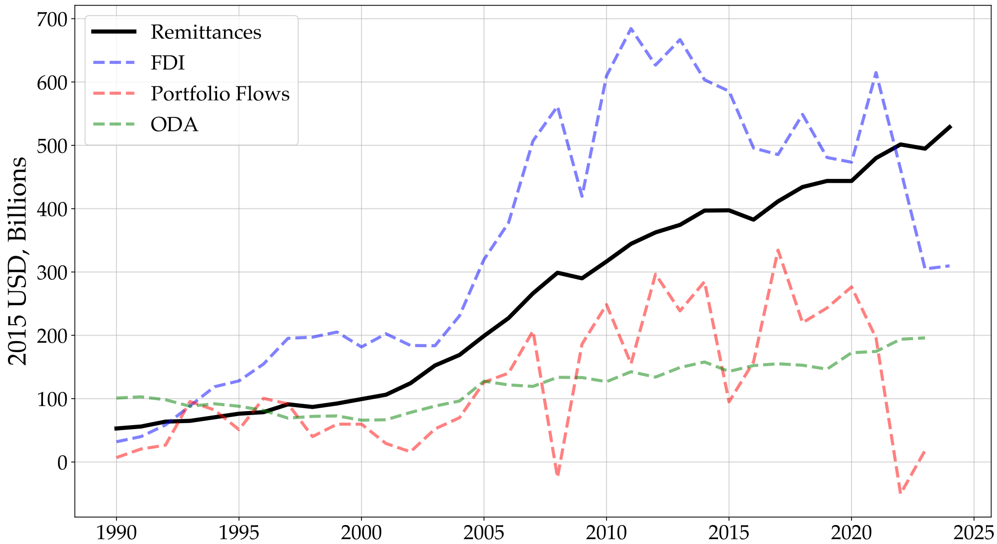
First, we document a key fact about remittance-sending behavior. Transaction amounts cluster at round numbers in the sender's currency — at multiples of \$100 in U.S. outflow corridors and at £100 in the United Kingdom — while no such clustering is visible when amounts are expressed in the recipient's currency. Senders anchor their transfers to a fixed amount of their own income rather than targeting a specific purchasing-power amount for the recipient. This anchoring behavior guides our modeling choice to denominate intra-family transfers in the sender's consumption basket.

Second, we conduct three event studies to examine how economic shocks are transmitted internationally through remittance transfers. We use high-frequency variation in the timing of exogenous shocks to estimate the causal effect of income changes on remittance flows. Pooling major natural disasters across the Philippines, Bangladesh, and Indonesia in a staggered difference-in-differences design following Dube, Girardi, Jorda, and Taylor (2025), we find that remittance flows jump by 31.3% in the first week after a disaster, with the response front-loaded and decaying to approximately 10% above baseline by week four. The surge reflects both an intensive and extensive margin adjustment, while contemporaneous exchange rates remain unaffected, consistent with remittances acting as rapid private insurance when local income and credit markets are disrupted.

We then exploit staggered variation in the timing of lockdown easing during the COVID-19 pandemic across eight advanced economies, using Sweden as a control group. Using the Callaway and Sant'Anna (2021) estimator, we find that easing restrictions raised remittance volumes by 43% on average in the ten months following the change, peaking at approximately 80%. This response operates through a labor-income channel: reopenings restore employment and wages in migrant-intensive sectors, relaxing senders' liquidity constraints and increasing their capacity to remit. The sustained

[1] In 2021, the main net senders as a share of total world remittances were the U.S. (24.8%), Saudi Arabia (6.0%), and the United Arab Emirates (5.8%). The main net receivers were India (10.4%), Mexico (6.5%), and China (6.4%).

Figure 1: Capital Flows to Low-and-Middle-Income Countries

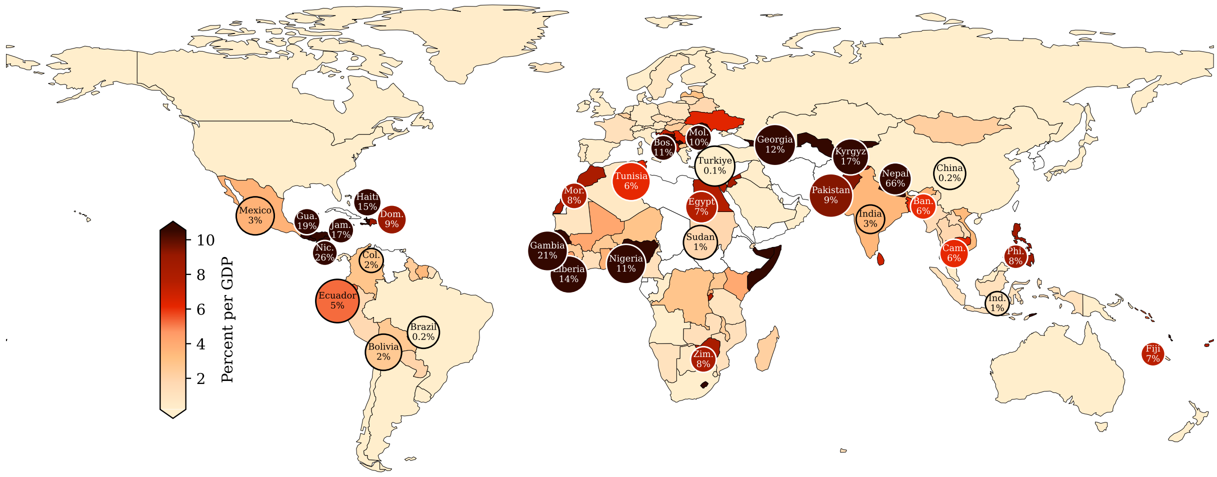



Notes: Data - World Bank–KNOMAD staff; World Development Indicators; IMF Balance of Payments Statistics. FDI = foreign direct investment; ODA = official development assistance.

response reflects the persistent recovery in earnings as economic activity resumes. However, the increase in digitization of remittance transfer during the pandemic – as in-kind transfers were limited due to travel restrictions – represents a concern for our mechanism. To assess the role of channel formalization, we decompose remittances by the tenure of both senders and recipients on the platform, classifying each as existing or new relative to January 2020. While the level of remittance flows is dominated throughout by transactions between existing senders and existing recipients, the growth during 2020 is driven partially by transfers directed toward new recipient accounts, originating from both existing and newly joined senders. Crucially, restricting the estimating sample to senders active on the platform prior to January 2020 leaves the main estimates largely unchanged, indicating that the aggregate response cannot be attributed solely to new entrants switching from informal channels.

In the U.S., cross-state heterogeneity in restriction policies precludes assigning a single treatment date, making the staggered design inappropriate for U.S. corridors. Instead, we exploit the third round of federal Economic Impact Payments under the American Rescue Plan, enacted on March 11, 2021, as a policy-driven income shock. Using the United Kingdom, Australia, and Canada as control senders, and tracing major U.S. outflow corridors to the Philippines, India, Mexico, Ghana, Nigeria, Colombia, Nepal, and Zimbabwe, we find that remittances rose by approximately 20% in the two weeks following disbursement. Total transactions increased by roughly 10% over the same horizon, indicating a response on both the extensive and intensive margins, while bilateral exchange rates exhibited no systematic movement, confirming that the adjustment reflects quantity decisions rather than price incentives. The effect is nonetheless smaller and considerably more transient than the lockdown-easing estimates, dissipating within approximately one month. This contrast reflects the nature of the underlying income shock: a one-time household transfer raises disposable resources temporarily but does not durably alter employment prospects or hours, so the capacity to remit recovers quickly once the transfer is spent, whereas a labor market reopening sustains earnings across sectors over a longer horizon.

Figure 2: Remittance Inflows as Share of GDP in 2024




Notes: Data source - World Bank and KNOMAD, authors' calculations.

Next, we estimate the exchange-rate elasticity of remittances using a distributed-lag specification at weekly frequency across the ten largest corridors. The cumulative elasticity in sender currency grows from $-0.06$ on impact to $-0.20$ at twenty weeks, with the income effect of exchange rate fluctuations dominating the substitution effect at all horizons. A sender-currency appreciation raises the purchasing power of each sender-currency unit in the recipient market, so the sender needs to remit less to deliver the same level of real support — the income effect. The opposing substitution effect — whereby appreciation lowers the relative price of cross-border transfers and encourages larger flows — is present but empirically dominated.

To analyze the effect of remittance flows on the macroeconomy, we develop a two-country New Keynesian model featuring individuals and families. Families are organized into cross-border families, each consisting of a Home and a Foreign member who jointly optimize over consumption and intra-family transfers. The household sector is then integrated into an otherwise standard open economy Heterogeneous Agent New Keynesian (HANK) model. The central theoretical innovation is to characterize the household sector through two objects: the intertemporal marginal propensity to consume (iMPC) (Auclert, Rognlie, and Straub, 2024) and the intertemporal marginal propensity to remit (iMPR). The iMPC captures how a household adjusts consumption across time in response to an income shock, and the iMPR captures the analogous object for remittance flows — how much a family remits, and when, in response to an income change in either country.

In a model of individuals, the iMPC alone is the sufficient statistic for the household block in each country. With cross-border families, a Home income shock also moves the transfer decision of the Home family member — a margin the iMPC has no argument for. The iMPR captures exactly this additional object, and together the pair (iMPC, iMPR) is the minimal sufficient statistic for the household sector for an economy with family linkages.

We show that a simplified, analytically tractable version of the model can match the qualitative patterns in the data. Following a transfer shock, the model predicts that remittances respond immediately, consistent with the near-static pattern we observe in the event studies. The iMPC and iMPR together determine how fiscal shocks propagate internationally through an analogue of the Keynesian cross. We derive a two-country multiplier system in which a government transfer in one country raises income not only for domestic households directly, but also for their family members abroad through remittances, expanding demand in the recipient country and feeding back through trade. The standard Keynesian cross of Auclert, Rognlie, and Straub (2024) — in which the only cross-country transmission operates through trade — is nested as the special case with no remittances and full home-bias in consumption. When remittances are operative, the cross-country multipliers are amplified: the off-diagonal blocks of the multiplier matrix are larger, reflecting the additional income channel through intra-family transfers.

We confirm these predictions by feeding the model with two types of aggregate shocks and comparing the impulse response functions across two extreme calibrations — one in which all households are unconnected individuals, and one in which all households are cross-border families. The model is calibrated to match the empirical moments from the event studies, which document the immediate remittance response to aggregate shocks and the subsequent reversion to baseline.

In response to a positive transfer shock to Foreign, the family calibration generates an immediate increase in remittances of approximately half the size of the transfer, while consumption rises by the same magnitude in both countries. In the individual calibration, by contrast, the consumption and output responses in the two economies are no longer identical, with a larger response in Foreign compared to Home. Moreover, the current account adjustment operates entirely through trade.

The mechanism operates symmetrically for a negative shock. Following a negative productivity shock to Home, the family calibration shares the consumption decline equally across the two economies through an increase in remittance flows, while in the individual calibration, it remains that the Home economy experiences a larger decline in consumption and output relative to Foreign. Taken together, these results suggest that the remittances channel can be a quantitatively important margin for international risk sharing in economies with large remittance flows, complementing the role of financial markets.

Finally, we summarize the risk-sharing role of remittances using the variance of log consumption across countries. Across both the Foreign transfer shock and the Home productivity shock, the variance of log consumption is lower when a larger share of households belong to cross-border families. The mechanism is remittance insurance: when a shock raises income in one country or lowers income in the other, family transfers move resources toward the side with lower relative consumption. The model also shows that the variance of log consumption is higher when households are more home-biased in their spending, because trade transmits less of the shock across borders. The transfer shock generates a substantially larger variance of log consumption than the productivity shock. Thus, remittances reduce international consumption risk in both experiments, but the quantitative importance of the channel depends on the shock, the prevalence of cross-border family links, and the strength of trade integration.

**Related Literature.** This paper is related to three strands of literature. First, there is a literature in development economics that studies the drivers of remittances and is summarized by Yang (2011).[2]

[2]These include Rapoport and Docquier (2006), Yang and Martinez (2005), Yang and Choi (2007), Yang (2008b), Clemens and McKenzie (2018) Bettin, Jallow, and Zazzaro (2023).

Table 1: Personal Remittances Received as percentage of GDP in 2023

| Country | Remittances (% of GDP) | Country | Remittances (% of GDP) |
|---|---|---|---|
| Nepal | 26.2 | India | 3.4 |
| Zimbabwe | 9.2 | Ghana | 3.0 |
| Philippines | 8.9 | Colombia | 2.8 |
| Bangladesh | 5.0 | Indonesia | 1.1 |
| Nigeria | 4.0 | Malaysia | 0.4 |
| Kenya | 3.9 | South Africa | 0.2 |
| Mexico | 3.7 | China | 0.1 |

Notes: Data from the World Bank.

The closest papers to this paper are Joseph, Nyarko, and Wang (2018) and De Arcangelis, Fertig, Liang, Srouji, and Yang (2023). Joseph, Nyarko, and Wang (2018) use data from a money transfer operator in the UAE and find that migrants' earnings affect their remittances through the observability of migrants' incomes. When income shocks are easier to observe, the elasticity of remittance flows to income shocks is higher. De Arcangelis, Fertig, Liang, Srouji, and Yang (2023) combine data from the same money transfer operator and a survey for Filipino migrants in the UAE to measure errors in remittance flows. They find that survey measures of remittance flows tend to be similar to the administrative data for senders of remittances, but are under-reported by recipients. Relative to this literature, this paper is the first to document the behavior of remittance senders from a global money transfer operator that operates over multiple remittance corridors and over a long time horizon.

Second, there is a more limited literature that studies remittance flows at the macroeconomic level. These include Mandelman and Zlate (2012), Mandelman (2013), Acosta, Lartey, and Mandelman (2013), Finkelstein Shapiro and Mandelman (2016) and Bahadir, Chatterjee, and Lebesmuehlbacher (2018). Relative to this literature, we document a series of facts about the behavior of remittance flows at the micro and macro level, which could be used to micro-found and calibrate the macroeconomic models in this literature.

Finally, we contribute to a small but growing literature which studies heterogeneous agents models in a small open economy. These include deFerra, Mitman, and Romei (2020), Auclert, Rognlie, Souchier, and Straub (2021), Guo, Ottonello, and Perez (2023), Guntin, Ottonello, and Perez (2023), Aggarwal, Auclert, Rognlie, and Straub (2023) and Lian, Mukhin, and Wolf (2026). Relative to this literature, which emphasizes the role of incomplete financial assets, we introduce remittance flows as a complementary risk-sharing mechanism.

**Roadmap.** The paper is organized as follows. Section 2 provides an overview of the money transfer operator: the data and its strengths and limitations, comparison with aggregate and survey data, where available, and time series and cross-sectional facts across remittance corridors. Section 3 analyses the effect of two types of shocks on remittance flows: natural disasters and COVID-19. We then introduce the high-frequency exchange-rate elasticity of remittances. Section 4 introduces our model, and Section 5 compares it to our empirical findings. Section 6 concludes.

## 2 Money Transfer Operator Data

In this section, we explore the main features of the transaction data and compare them to aggregate data.

### 2.1 Background

The data is obtained from a Financial Technology company founded in the 2010s. We have access to an anonymized version of the database of all transactions that were sent through the MTO, from 2014 to October 2023. The data covers more than 150 million transactions, amounting to around $40 billion in remittances. Senders in our sample come from 65 countries and transfer remittances to 157 countries around the world.[3]

Customers sign up for an account with the MTO either on the website or the mobile app. There is no possibility of depositing cash in person. Payments are funded through debit cards or bank transfers. The sender is then shown a screen where they choose the amount they would like to send and if available, the currency to be used to fund the transaction, as in Figure 3. Simultaneously, the sender is also shown the amount the recipient would receive and, if available, the set of currencies that can be received.[4] Moreover, the platform also shows the exchange rate that the sender would effectively pay net of any margin taken by the MTO. The transfer fees are also shown along with any opportunities to enter promotion codes.[5]

Finally, the sender chooses the method by which the recipient receives the funds. Examples include bank transfers and cash pickups. The transfer fee and exchange rate may depend on the receiving method and are clearly displayed before finalizing the transaction. In contrast to many other MTOs, our firm operates using both a transaction fee and a foreign exchange margin. This implies that the customer base of our firm skews towards those who send a higher volume of remittances.

Importantly, the sender can choose to fill out either the 'You Send' box or the 'They Receive' box. Figure 3a shows an example of sending 100 U.S. dollars to Mexico.[6] Alternatively, the sender can choose the amount the recipient receives in Mexican Peso, and the app will calculate the amount to be paid in Pounds. Figure 3b shows the possibility of sending the equivalent of 2,000 Mexican Peso.

Our unit of analysis is a transaction between a sender account and a recipient account. Throughout the paper, we refer to a 'sender' as the outflow account of a remittance transaction and a 'recipient' as the inflow account of a remittance transaction. In particular, we observe the exact time of the transaction, the transaction amount, the currency sent by the sender, the currency received by the receiver, the transaction fee paid, the exchange rate at the time of the transaction, and any discounts offered at the time by the platform. We link transactions across senders over time through

[3]The full list of sender and receiver countries is in Table B.1. The largest sending countries in the data are the U.S., the United Kingdom, Australia and Canada. The largest recipient countries in the data are the Philippines (18%), Kenya (10%), Ghana (10%), Nigeria (8.5%), Zimbabwe (6.5%), Uganda (5.5%) and India (4.5%).

[4]For most remittance corridors, there is only one sending currency and one receiving currency available. However, as we document in section B.3, some corridors feature multiple receiving currencies.

[5]While introductory fee promotions are common in this market, repeated exploitation through multiple accounts is constrained by identity verification at sign-up and is not permitted by the platform. Such exploitation is easily detected and usually prohibited.

[6]Note that 100.00 is the default amount shown on the screen.

Figure 3: Example of Screen from the MTO's Mobile App


(a) Sending 100 USD to Mexico from the U.S.

(b) Sending 2,000 MXP to Mexico from the U.S.

Notes: Figures accurate on 10 August 2026, 11:00 ET, using the mobile app. Panel (a) shows the screen when the customer fills in '100.00' in the 'You Send' box. Panel (b) shows the screen when the customer fills in '2,000.00' to the 'They Receive' box.

their unique identification numbers to create a panel at the daily, weekly, and monthly frequencies.

**Strengths.** The data features three key strengths. The first key strength of the data is that it is administrative. Previous work in the international remittances literature typically relies on surveys, where measurement error is a concern.[7] In particular, surveys may suffer from recall bias that favors answering the same number for all previous transactions. Moreover, surveys typically have a short, infrequent panel dimension, which makes it difficult to study questions about the macroeconomy.

A second key strength of our data is the frequency. As we observe transactions, we do not suffer from any aggregation bias. This allows us to observe the exact amount per transaction as opposed to an aggregated statistic. This is important to shed light on the true remittance-sending behavior of individuals.

A third key strength of our data is the scope across remittance corridors. Whereas other papers in the literature have used administrative data from one source country, we observe remittance flows from many sender countries and many recipient countries. This allows us to study the behavior of remittance flows across many different types of remittance corridors and across many different types of exchange rate regimes.

[7] The exception to this is Joseph, Nyarko, and Wang (2018) who leverage data from a large money transfer operator from the United Arab Emirates.

**Limitations.** One limitation of the data is that we only observe transactions that are executed through our firm. A particular concern is whether a sender uses multiple platforms. We would not be able to observe any other transactions the sender makes. Therefore, the sample selection skews towards less price and exchange-rate-sensitive individuals.

A second limitation of the data is that we have limited information on recipients. We only observe the account and the method of reception on the transfer. Therefore, should a recipient change the account they wish to receive remittance flows into, we would not be able to distinguish this from a new recipient. In terms of demographics, we observe the sex of the sender but do not observe other variables such as age. Furthermore, we do not observe other variables of interest, such as income and wealth.

## 2.2 Comparison with Official Remittance Data

As noted above, a key limitation of our data is that we observe only transactions executed through our MTO. Table 2 shows how the coverage of the MTO data has evolved over time for the largest corridors in our sample. While the coverage of our sample expands over time—from roughly 0.09% of global remittance flows in 2014 to just over 1% in 2022 — these figures make clear that our micro data are a small part of global remittance flows.[8] Accordingly, we must consider how external validity and representativeness may be affected.

To assess representativeness, we benchmark our series against aggregates reported by the World Bank and by national central banks. This exercise provides an empirical basis for evaluating how closely the dynamics in our MTO-based data track those in the broader remittance market.

**Comparison within corridors.** High-frequency corridor-level remittance series are rarely available. Therefore, to gauge the relevance of our data, we take as the frame of reference the Bilateral Remittance Matrix, published by KNOMAD/World Bank periodically.[9]

Our coverage rises steadily over the sample, with especially pronounced gains in the United Kingdom–Zimbabwe, Australia–Nepal, and U.S.–Ghana corridors. For Australia–Colombia, our measured flows exceed the World Bank corridor totals (i.e. apparent coverage above 100%), suggesting that the allocation procedure based on migrant stocks and relative PPP incomes understates flows in this corridor. Taken together, these comparisons indicate that our dataset captures a meaningful share of activity in several key corridors and provides high-frequency variation that is largely absent from aggregate sources.

**Comparison with specific countries.** To further establish the relevance of our data, we compare it with publicly available series at a quarterly frequency, where possible. The scope of this exercise is necessarily limited by the small number of official sources that publish high-frequency remittance statistics.

[8] Total global remittance flows are from the World Bank.

[9] These estimates are based on the methodology described in Ratha and Shaw (2007). Inward remittances are allocated to various source countries in proportion to their stock of migrants and per capita PPP income in the destination and origin countries. The Bilateral Migration Matrix is published by the United Nations (UN DESA), Eurostat, national statistical offices, the UNHCR, and the OECD.

Table 2: Largest Corridors – Transactions through MTO as Share of Total Remittances

| | 2016 | 2017 | 2018 | 2021 |
|---|---|---|---|---|
| U.S. – Philippines | 0.2 | 0.4 | 0.8 | 4.8 |
| U.S. – Nigeria | 0.1 | 0.6 | 2.1 | 9.0 |
| Australia – India | 5.4 | 7.8 | 5.0 | 7.3 |
| United Kingdom – Zimbabwe | NA | NA | 8.6 | 45.3 |
| Australia – Nepal | 0.4 | 0.6 | 1.4 | 37.1 |
| U.S. – Ghana | 1.8 | 5.2 | 7.1 | 28.3 |
| Australia – Philippines | 5.6 | 6.9 | 5.9 | 9.6 |
| Canada – Philippines | 1.3 | 1.6 | 1.8 | 3.8 |
| U.S. – Colombia | 0.1 | 0.4 | 1.8 | 6.5 |
| Australia – Colombia | 61.9 | 115.7 | 118.5 | 103.2 |

Notes: MTO data & World Bank Bilateral Remittances Matrix. Author's calculations. N.A. due to missing data in the World Bank Bilateral Remittances Matrix.

We begin with two major recipients, Mexico and Bangladesh, where remittances amounted to roughly 3.7% of GDP and 5.1% of GDP, respectively in 2023. Figures 4a and 4b compare official aggregate inflows with an appropriately aggregated version of our MTO transactions. Despite covering only about 0.001% of total inflows in each case, our series closely co-move with the official data, with correlations coefficients of 0.94 for Mexico and 0.84 for Bangladesh. We also consider Morocco — where remittances peaked at 8.1% of GDP in 2023 — and find similarly strong co-movement (correlation 0.78) despite an average coverage of just 0.55% (Figure 4c).

Further, for the Philippines (Figure 4d) and Kenya (Figure 4e), other two substantial receivers of remittances (at 8.9% and 3.9% of GDP), we obtain high correlations of 0.77 and 0.94, respectively; average coverage is 1.24% for the Philippines and 5.2% for Kenya. Additionally, Figure 4f contrasts our series with Romania's official aggregates, which amounted to 2.8% of GDP in 2023; even with modest coverage (0.09%), the correlation is 0.84.

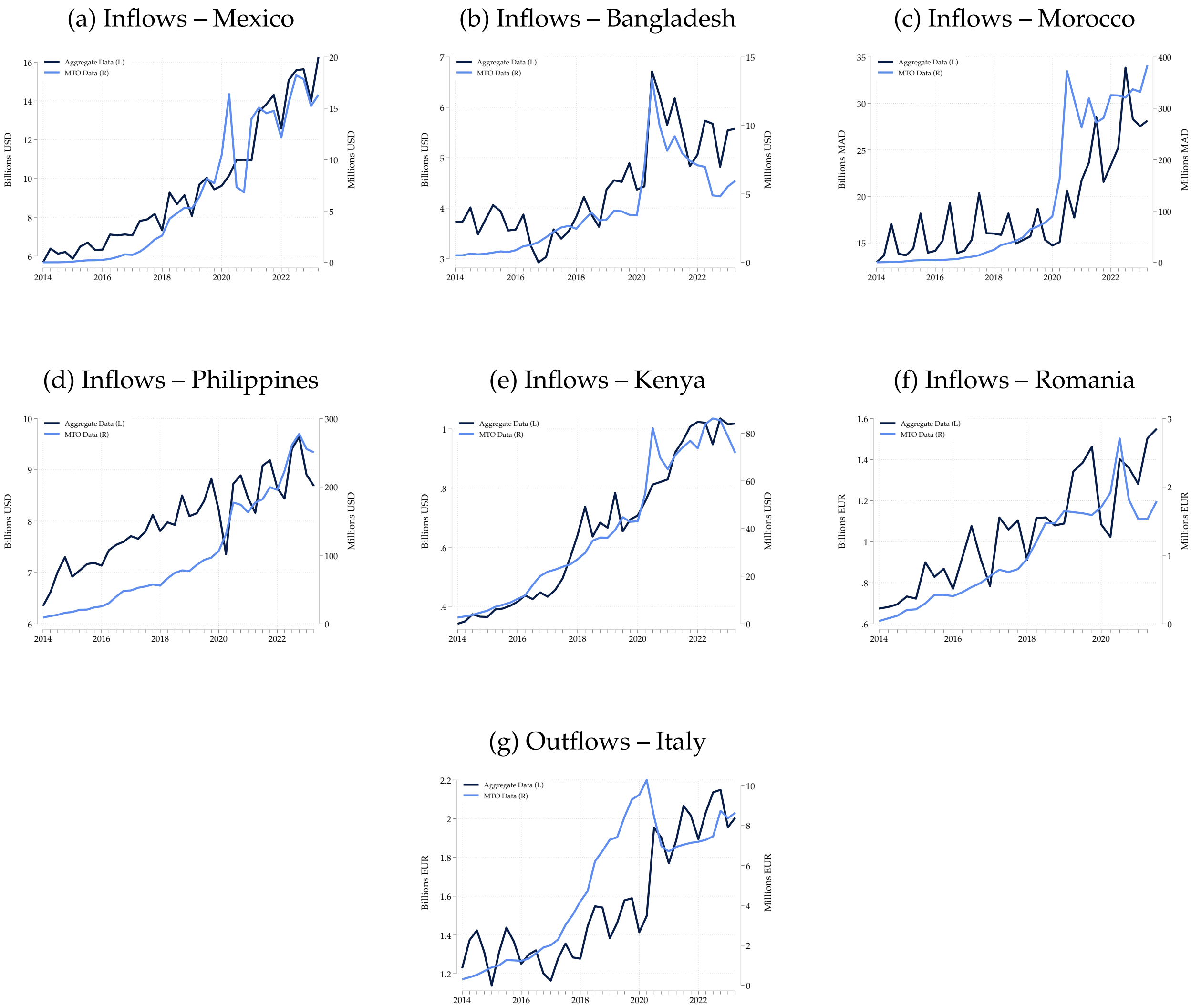
Finally, we compare our data with a sender-country's aggregates. We start from Italy (Figure 4g), a sizable sender within the European Union. At a quarterly frequency, our series tracks official outflows with a correlation of 0.72, though average coverage is just 0.003%.

Taken together, these validations show that—despite limited level coverage in many settings—our high-frequency MTO data reliably capture the temporal dynamics of both remittance inflows and outflows across diverse corridors. Additional comparisons with publicly available household survey data for the Philippines, Bangladesh, and Mexico are reported in Appendix A.2.

### 2.3 MTO Remittance Flows

In this section, we document main summary statistics of our MTO data and some empirical findings regarding the behavior of remittance flows over time.

Figure 4: Comparison Between Official Aggregate Remittances and MTO Data




Notes: Data — MTO, Banco de México, Central Bank of Bangladesh, Office des Changes Maroc, Bangko Sentral ng Pilipinas, Central Bank of Kenya, Banca Naţională a României, Banca d'Italia.

**Summary statistics.** Table 3 reports summary statistics for the ten largest corridors over 2019–2023, where the largest corridors are defined by cumulative transaction value in USD over the period.[10] These ten corridors constitute the main sample for the case studies we analyze throughout the paper. Aggregate volumes span roughly $507 million to $2.2 billion, indicating substantial heterogeneity in market size across corridors. The mean transfer is about $300, and the corresponding standard deviations reported in the table point to considerable dispersion in transaction sizes.

The transaction frequency is moderate. With the exception of the U.S.–Nepal corridor — where the typical sender makes roughly eight transfers per year — most senders remit about once per month. This pattern is consistent with our MTO's client base skewing toward relatively higher-value, less frequent senders.

[10] Analogous statistics for 2014–2018 appear in Table 3.

Fees are generally low on average but vary markedly across corridors; in several African corridors they amount to around 5% of the principal. Such cross-corridor variation reflects differences in market structure, compliance costs, payout networks, and currency conversion frictions. Finally, the gender composition of senders is slightly male-skewed overall (about 55%), with women comprising a majority in U.S.–Nigeria, Canada–Philippines, and U.K.–Zimbabwe.

**The Reference Currency of Remittance Senders.** Which currency do remittance senders use as a frame of reference? We explore this question by documenting the distribution of transaction amounts in a given corridor. A strength of our data is that we observe both the sender's amount and currency and the receiver's amount and currency (net of exchange rate margins). Figure B.1 shows the main results. The grey bars show the distribution of transaction amounts sent in the sender's currency. We find that individuals appear to favor sending round numbers to their receivers. For example, in U.S. outflow corridors, we observe spikes in the distribution of transaction amounts at numbers such as 50, 100, and 200 U.S. dollars. We also observe this pattern across multiple outflow corridors, such as Australia and the United Kingdom, with spikes in the distribution at 100 Australian Dollars or British Pounds.[11]

In Figure B.2, we plot the distribution amount received in the receiver currency. We do not observe spikes around the round numbers in the receiver currency. Instead, the spikes we observe line up with the spikes of the round numbers in the sender currency once we adjust the exchange rate. Therefore, it appears that individuals aim at transferring a given amount set in the currency of the country where they are located rather than in the receiving currency. This can be linked to the fact that individuals aim to send a given amount of their income, which is set in the sender's currency.

The main result is more than 'round-number heuristics' per sé. It's that the 'round-number heuristics' only appear in the sender's currency, which suggests that remittance senders use the sender's currency as the reference currency. In reference to the earlier Figure 3, we see more individuals behaving as in panel (a) as opposed to panel (b).

[11] 'Round-number heuristics' have also been documented in other household decisions such as retirement savings. See for example Benartzi and Thaler (2007).

Table 3: Summary Statistics: 2019–2023

| | | Total | | | | Transaction | | | | | per Sender/Year | | per Dyad/Year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Corridor** | **Female** | **Trans.** | **Volume** | **Senders** | **Dyads** | **Mean** | **Median** | **St. Dev.** | **Avg Fee ($)** | **Avg Fee %** | **Trans.** | **Avg. Days** | **Trans.** | **Avg. Days** |
| U.S. – Philippines | 45% | 8m | 2.2bn | 194.1k | 1.1m | 275 | 105 | 465 | 2.9 | 4.6% | 20 | 8 | 5 | 17 |
| U.S. – Nigeria | 53% | 5m | 2bn | 225.7k | 940.6k | 409 | 145 | 712 | 6.1 | 5.5% | 12 | 11 | 4 | 19 |
| Australia – India | 32% | 2.7m | 1.3b | 103.9k | 424.7k | 559 | 233 | 900 | 1.9 | 3.5% | 10 | 19 | 4 | 31 |
| United Kingdom – Zimbabwe | 58% | 4.8m | 987m | 102.8k | 1m | 205 | 103 | 425 | 4.2 | 6.2% | 19 | 11 | 3 | 29 |
| Australia – Nepal | 40% | 1.8m | 821m | 95.5k | 491.8k | 459 | 171 | 812 | 1.5 | 2.6% | 8 | 21 | 3 | 36 |
| U.S. – Ghana | 37% | 5.3m | 859m | 159.4k | 898.3k | 160 | 100 | 246 | 0.82 | 1.3% | 20 | 7 | 5 | 15 |
| Australia – Philippines | 42% | 3.6m | 739m | 70.5k | 471.6k | 201 | 92 | 385 | 2 | 3.7% | 25 | 8 | 6 | 16 |
| U.S. – Colombia | 46% | 1.9m | 600m | 76.9k | 229.8k | 321 | 140 | 493 | 2.9 | 5.10% | 13 | 12 | 6 | 18 |
| Canada – Philippines | 55% | 3.8m | 573m | 78.7k | 489.1k | 202 | 107 | 262 | 3.4 | 5.2% | 17 | 11 | 4 | 22 |
| Australia – Colombia | 49% | 1.5m | 508m | 46.9k | 155.2k | 247 | 128 | 319 | 1.3 | 1.9% | 12 | 17 | 6 | 24 |

*Notes:* Trans. = Transactions; Avg. Days = Average days between transactions. All the volumes are in USD.

## 3 The Transmission of International Shocks

In this section, we assess the role of remittances as an insurance mechanism in the face of asymmetric cross-border shocks. First, we study recipient-side income shocks generated by natural disasters. Second, we examine sender-side income shocks associated with the COVID-19 pandemic. Throughout, we focus on the timing and magnitude of the response at high frequency, using event-study dynamic difference-in-differences (DiD) specifications around shock onsets. Third, we study the elasticity of remittances to the exchange rate over time.

### 3.1 Natural Disasters

Figure B.9 documents a sustained increase in the number of natural disasters since 1990, driven largely by weather-related events — storms, floods, droughts, heat waves, and tropical cyclones. Due to their geographical location, the economic burden of these shocks is disproportionately borne by low-and-middle-income countries. Relative to income, damages are larger, private insurance adoption is low, and public safety nets and fiscal space are limited. In such episodes, remittances can function as rapid, private insurance providing liquidity to affected households when local income and credit markets are disrupted. Our central question in this section is, 'How quickly, and by how much do remittances respond to a natural disaster?'

Our MTO data is well-suited to address this question. Transactions can be routed to digital accounts, enabling payouts even when cash pickup networks are impaired, and the high frequency of the data allows us to trace the timing of responses around shock onsets. To identify salient events affecting countries in our sample, we rely on EM-DAT, the global database of natural and technological disasters maintained by CRED, which has cataloged more than 26,000 disasters since 1900. This comprehensive dataset includes metrics such as the total number of people affected and total damages in USD, allowing us to pinpoint relatively large disasters with substantial socioeconomic impacts.

The literature has already examined the response of remittances, as well as other financial flows such as foreign aid, to natural disasters, yielding varied findings. Yang (2008), for instance, studies the effect of hurricanes and finds that while foreign aid universally increases following hurricane exposure, remittances respond positively primarily for the poorest home countries. Similarly, Mohapatra, Joseph, and Ratha (2012) show that remittance flows rise in response to meteorological, climatological, and geophysical disasters across a large sample of 129 countries, with the strongest effects observed in countries with substantial migrant stocks abroad. Additionally, Ebeke and Combes (2013) highlight the stabilizing role remittances play in reducing the adverse effects of natural disasters on output volatility.

Our contribution is to leverage high-frequency transaction data to implement an event-study design that precisely isolates short-run remittance responses around sharply dated shocks. Relative to quarterly or annual aggregates, this approach attenuates confounding factors from slow-moving trends, seasonality, and macro developments, yielding a cleaner identification of timing and magnitude. A second contribution is the breadth of country-corridor coverage: this allows us to create a multi-country panel in which we pool many disasters and treat them as staggered events, increasing our statistical power.

Our panel covers nine receiving countries: Bangladesh, China, Indonesia, India, Malaysia, Nepal, the Philippines, Pakistan, and Thailand, and the four major sending countries in our sample: the U.S., the United Kingdom, Australia, and Canada. We focus on three salient recipient-side shocks: a major typhoon in the Philippines (December 2021), a severe tropical cyclone affecting Bangladesh (October 2022), and a large earthquake in Indonesia (November 2022). These episodes define our treated country–time cells.

For identification, we construct event windows around each disaster and pool them in a staggered design. The control group includes other receiving countries in the same broad region that do not experience overlapping disasters within the event window. By selecting unaffected neighbors with similar economic and migration profiles, we sharpen the counterfactual and limit bias from regional trends and seasonality.

Methodologically, we follow Dube, Girardi, Jorda, and Taylor (2025) to estimate dynamic treatment effects in a staggered setting while avoiding the "forbidden comparisons" problem emphasized by recent work (see Roth, Sant'Anna, Bilinski, and Poe (2023)). Natural disasters provide a particularly compelling quasi-experimental environment as they are plausibly unanticipated and orthogonal to remittance decisions in both origin and destination countries. This setting thus permits a sharp assessment of the timing and magnitude of the remittance response.

Our main specification is the following:

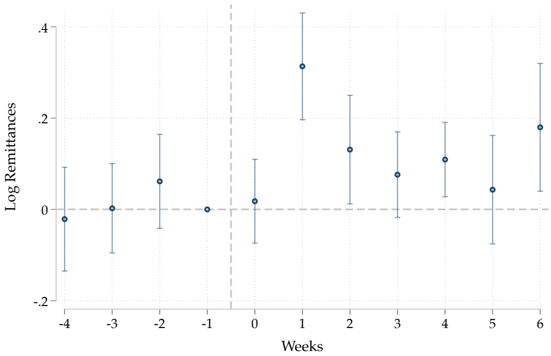
$$\Delta_h y_{ijt} = \delta_t^h + \beta^h \Delta D_{jt} + u_{ijt}^h \quad \text{for } h = -4, \ldots, 6\,, \tag{1}$$

where $\delta_t$ are time-fixed effects. $\Delta_h y_{ijt}$ is a h-periods forward long difference, defined as $\Delta_h y_{ijt} = y_{ij,t+h} - y_{ij,t-1}$; Our dependent variable, $y_{ijt}$, includes various measures such as (the logarithm of) remittances in USD, number of transactions and foreign exchange from sender country $i$ to receiver country $j$. The $\beta$ terms are regression coefficients that captures the dynamic impact of the disaster on remittances from four weeks before to six weeks after the event, and $e$ is an error term. $D_{jt} \in \{0, 1\}$ is our treatment, i.e. the natural disaster.

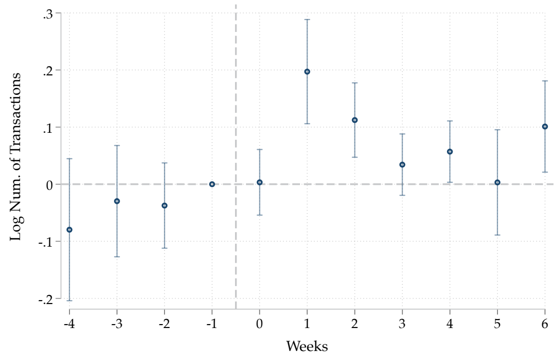
The results are reported in Figure 5. Figure 5a plots dynamic coefficients for remittance flows (in USD) from sender to receiver countries relative to the control group. In the month leading up to each disaster, treatment and control series move in parallel: pre-event coefficients are small and statistically indistinguishable from zero, supporting both the parallel-trends and no-anticipation assumptions. In other words, catastrophic events appear largely unanticipated — remittances do not rise in advance but react only once the shock materializes. Following the disaster, remittances jump sharply. In the first week after the event, flows increase by 31.3% (s.e. 0.05). The impulse is front-loaded — most of the surge occurs within week 1 — and then attenuates: point estimates remain about 10% above baseline through week 4, albeit with only weak statistical significance by that horizon. On the margin of adjustment, the total number of transactions also rises, indicating an extensive-margin response (Figure 5b). By contrast, contemporaneous movements in the weekly exchange rate are economically negligible; we find only a statistically significant appreciation of 0.01 in week 1, with no meaningful effects thereafter (Figure 5c).

Overall, the response of remittance flows suggests that remittances act as rapid yet substantial insurance buffer in the immediate aftermath of natural disasters. This countercyclical function highlights the role of remittances in stabilizing the receiving country's economy during periods of extreme disruption. Appendix B.5 reports country-specific results for Bangladesh, India and Indonesia.

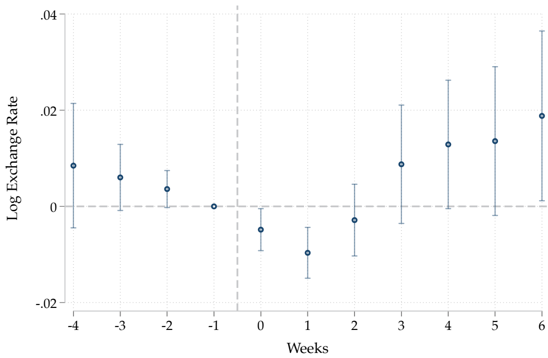
Figure 5: Event Study — Staggered Natural Disasters




(a) (Log) Amount Sent in USD.




(b) (Log) Total Transactions.




(c) (Log) Exchange Rate

Notes: Panel (a)-(c) MTO data. Author's calculations. We aggregate daily data into weekly to deal with seasonality.

### 3.2 The COVID-19 Pandemic

At the onset of the COVID-19 pandemic in March 2020, global remittances were projected to decline by 20% year-on-year, according to the World Bank's estimates (World Bank (2020)). The anticipated decline was attributed to expected reductions in wages and employment among migrant workers in remittance-sending countries. However, defying initial expectations, global remittances only fell by 1.6% for the year — a decrease smaller than what was witnessed during the 2009 global financial crisis (4.8%). Remarkably, some regions even experienced an increase in remittance inflows, with Latin America and the Caribbean experiencing a 6.5% rise, South Asia a 5.2% increase, and the Middle East and North Africa a 2.3% increase. Conversely, remittance flows decreased in East Asia and the Pacific (7.9%), Europe and Central Asia (9.7%), and Sub-Saharan Africa (12.5%). Notably, the decline in Sub-Saharan Africa was almost entirely driven by a 28% reduction in remittance flows to Nigeria. Excluding Nigeria, remittances to Sub-Saharan Africa actually increased by 2.3%, showcasing a degree of resilience that is mirrored in our data.

Several factors may have contributed to the resilience of remittance flows during the pandemic. One significant factor could be the labor market policies and fiscal stimulus measures implemented in sender countries, which likely helped sustain the incomes of remittance senders and mitigated the potential negative impact of economic contractions. Labor market interventions, such as furlough

Table 4: Lockdown Dates

| Country | Start First Lockdown | End First Lockdown |
|---|---|---|
| Canada | March 18, 2020 | May 2020 |
| Australia | March 23, 2020 | May 2020 |
| Italy | March 9, 2020 | May 2020 |
| Germany | March 22, 2020 | May 2020 |
| France | March 17, 2020 | May 2020 |
| United Kingdom | March 23, 2020 | June 2020 |
| New Zealand | March 25, 2020 | June 2020 |
| Ireland | March 27, 2020 | June 2020 |
| Sweden | No formal lockdown | N/A |

schemes, were designed to support regular employees who had been employed at their jobs for a certain period. However, these schemes might not have extended support to irregular migrants or individuals who had only recently gained employment, suggesting that the overall impact might have been uneven.

Another mechanism underpinning this resilience is a compositional shift in remittance channels — from cash to digital, and from informal to formal. Travel restrictions and the temporary closure of retail agents curtailed in-person cash transfers, prompting senders committed to supporting foreign households to adopt online platforms and formal money-transfer operators.[12] As borders closed, carrying cash or using *hawala* networks became less feasible, accelerating the transition towards traceable, electronic transfers.[13]

We examine how the easing of lockdowns in selected European economies, Canada, New Zealand, and Australia, and the U.S. stimulus payments affected remittance inflows. Our objective is to quantify the international spillovers of the reopenings and of these income-support policies in the aftermath of the pandemic and to shed light on why remittances declined far less than initially forecasted. Although the pandemic was global, the largest fiscal transfers to households and firms were concentrated in advanced economies, predominantly in the Northern Hemisphere. We exploit cross-country and temporal variation in the timing and scale of these measures using an event-study difference-in-differences framework.

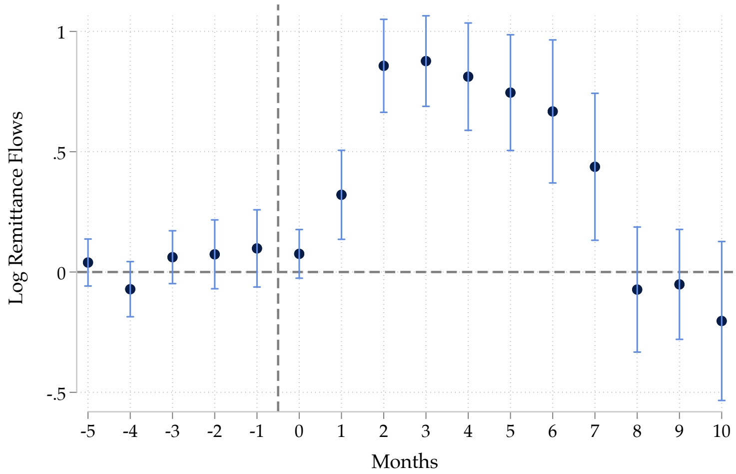
**Easing of Lockdown Restrictions** Our analysis focuses on a selected group of sender countries: United Kingdom, Canada, New Zealand, Ireland, France, Italy, Germany, and Australia. They implemented systematic lockdowns during the pandemic, providing a robust basis for comparative analysis. Sweden serves as a control group given its distinctive choice not to impose formal lockdowns. On the recipient side, we study the largest corridors in our data: Nigeria, Colombia, Zimbabwe, Nepal, the Philippines, Ghana, India, and Kenya.

To estimate the spillover of easing lockdown restrictions from sender to recipient country through

[12] Dinarte-Diaz, Jaume, Medina-Cortina, and Winkler (2022) document a pronounced rise in formal remittances in the U.S.–Mexico corridor.

[13] *Hawala* denotes an informal value-transfer network operating outside the banking system.

Figure 6: Event Study — Staggered Easing of Lockdown Restrictions




Notes: MTO data. Author's calculations. Not-yet-treated control group.

remittances sent from the North to the South, we implement a staggered difference-in-differences estimator following Callaway and Sant'Anna (2021). This estimator is particularly useful in this set-up for two reasons. First, it properly accommodates cohort-specific treatment timing and avoids problematic comparisons between already-treated and later-treated units that can bias two-way fixed-effects estimates, the so-called forbidden comparison problem.[14] Second, beyond standard treated vs never-treated contrasts, it allows for 'not-yet-treated' comparisons, which may be informative when never-treated units differ systematically from treated corridors, making the soon-to-be-treated units the more appropriate counterfactual.

Our identification exploits cross-country variation in the timing of lockdown easing. Conditional on time and corridor fixed effects, the timing at which a sender country re-opened is as good as random with respect to short-run trends in corridor-level remittances. Further, we also know by looking at lockdown-measures, cases and deaths, that during the first lockdown, the sender-countries in the sample had similar timing of the initial pandemic shock and comparable first-wave conditions — namely the degree of lockdown stringency and the epidemiological severity of the situation. By aggregating our data from daily to monthly intervals, we can exploit the time variation of the treatment, i.e., the easing of lockdown restrictions (Table 4). We use data from July 2019 to March 2021 to estimate:

$$\log \mathrm{Remit}_{ijt}^{\mathrm{USD}} = \alpha_t + \alpha_{ij} + \sum_{k=-10}^{-1} \delta_k \cdot D_{it}^k + \sum_{k=0}^{12} \beta_k \cdot D_{it}^k + v_{ikt} \,. \tag{2}$$

Where $i$ represents a sender country, $j$ represents the receiving country, $D_{it}^k = \mathbb{1}\{t - G_i = k\}$ is an indicator for unit $i$ being $k$ periods away from initial treatment at time $t$, and $G_i$ as the time period when unit $i$ is first treated, $\alpha_t$ is the time fixed effect, and $\alpha_{ij}$ the sender-receiver corridor fixed effect. Figure 6 reports the event-study coefficients. We find that, upon easing, senders increase remittance volumes relative to their own lockdown period and relative to corridors linked to countries that were

[14] i.e., it rules out comparisons that mix treatment effects across cohorts in ways that induce negative or non-convex weights Borusyak and Jaravel (2018).

not in lockdown. At the peak, easing raises remittance flows to recipient countries by roughly 80%; the average treatment effect over the estimation window is 43% (Table B.4). Appendix B.6.1 reports ATT estimates by recipient country. Pre-treatment coefficients are statistically indistinguishable from zero, supporting parallel trends between soon-to-reopen and comparison units. The dynamics show a gradual ramp-up as restrictions are loosened, followed by mean reversion toward zero as new lockdowns were introduced in 2021.

Interpreted through a risk-sharing lens, remittances behave as state-contingent transfers within cross-border family networks. When sending economies re-open and migrants' earnings recover, households reallocate resources toward relatives abroad who remain liquidity constrained or face slower recoveries, thereby smoothing consumption across borders. The operative channel is a labor income channel: re-openings restore hours and wages in migrant-intensive sectors, relaxing senders' liquidity constraints and enabling a temporary, front-loaded increase in transfers that fades as conditions normalize or new restrictions arrive.

However, as noted above, a plausible explanation for the observed increase in remittances is formalization of sending behaviors — the disruption of face-to-face channels during the COVID-19 pandemic pushed transactions onto regulated digital platforms. To examine this margin, we classify senders into those who joined the platform before January 1, 2020 ('existing senders') and those who joined thereafter ('new senders'). Recipients are analogously partitioned into existing and new categories. Figure B.5 displays in black the volume (Figure B.5a) and transactions of remittance flows (Figure B.5b) for the corridors in this event study, from 2018 to 2023. We decompose these transactions into three categories: remittances from existing senders to existing recipients (navy bars), existing senders to new recipients (blue bars), and new senders to new recipients (grey bars). Notably, there were minimal transactions from new senders to existing recipients across all corridors.

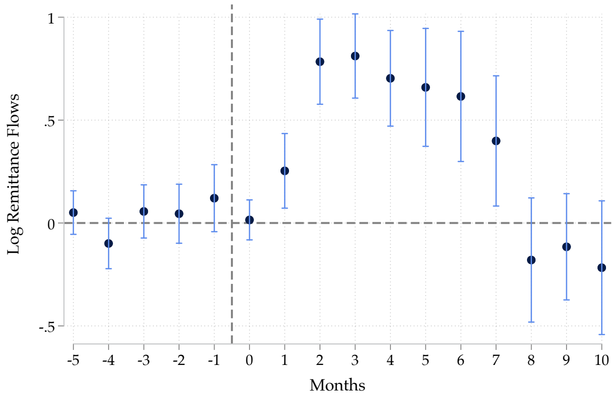
The key takeaway from these figures is that the volume of remittance flows increased temporarily during the latter half of 2020 before stabilizing at a level that is higher than before the pandemic. Looking into the composition of transactions, we find that at the onset of the pandemic, the majority of the level of remittance flows is attributed to transactions between existing senders and existing recipients, and the majority of the growth in the remittance flows during the pandemic is attributed to transactions to existing senders.

One should be careful in interpreting transactions between new senders to new recipients as evidence of the formalization of remittance flows as we do not have any prior information on the method of sending remittance flows between these individuals prior to the pandemic. Therefore, it is difficult to disentangle a story of formalization as opposed to an increase in the market share of a given MTO. Appendix B.4 shows a similar pattern for individual corridors.

While the increase in the number of new remitters during the pandemic is notable, it alone does not comprehensively account for the observed rise in remittance volumes. Indeed, as a robustness check, we run our specification (equation (2)) restricting the sample only to senders that joined the platform before January 1, 2020. As Figure 7 shows, the results are broadly unchanged, supporting the idea that the increase in the number of remitters was not the driving force behind our conclusion.

**The 2021 U.S. Stimulus Check** The U.S. is excluded from the sender cluster analyzed above for two reasons. First, our MTO partner reported a product disruption specific to U.S. corridors around

Figure 7: Event Study — Staggered Easing of Lockdown Restrictions — Existing Senders




Notes: MTO data. Author's calculations. Not-yet-treated control group.

May 2020 (no further details were disclosed), compromising measurement comparability with other senders. Second, the U.S. did not implement a uniform national lockdown and exhibited substantial cross-state heterogeneity in restrictions, undermining the single-treatment timing required for our staggered DiD design.

However, at the same time, the U.S. provides a distinct, policy-driven experiment through the federal Economic Impact Payments (EIPs) in three legislated rounds: CARES (March 27, 2020), the Consolidated Appropriations Act's COVID-Related Tax Relief (December 27, 2020), and the American Rescue Plan (March 11, 2021), were delivered as advances on refundable tax credits. Round 1 deposits began in mid-April 2020; Round 2 was executed around December 28–30, 2020–January 15, 2021; Round 3 commenced immediately after enactment, with first deposits dated March 12, 2021 and subsequent weekly tranches.

We exploit the third tranche. We aggregate the data at a weekly frequency, as the transfers were more targeted and directly into the pockets of the households, rather than the lockdown easing that involved a more slow-moving adjustment of the whole economy. The treated sender is the U.S.; control senders are the United Kingdom, Australia, and Canada. Recipient countries trace major corridors in our data: the Philippines, India, Mexico, Ghana, Nigeria, Colombia, Nepal, and Zimbabwe. Therefore, we can exploit the exogeneity of the timing once more.

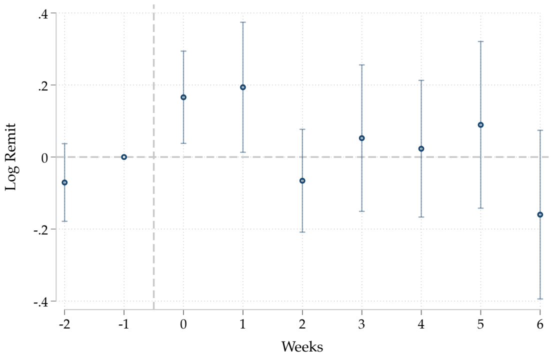
Our main specification is the following:

$$\Delta_h y_{ijt} = \delta_t^h + \beta^h \Delta D_{it} + \nu_{ijt}^h , \quad \text{for } h = -2, \ldots, 6 , \tag{3}$$

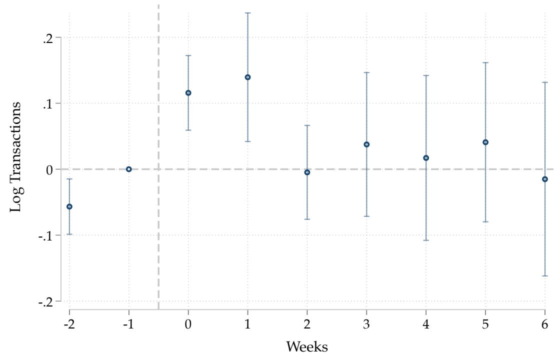
where $\Delta_h y_{ijt} \equiv y_{ij,t+h} - y_{ij,t-1}$ is an $h$-period forward at weekly frequency for sender $i$ and recipient $j$, $y_{ijt}$ includes (log) remittances in USD, number of transactions, and foreign-exchange volume along corridor $(i, j)$. The indicator $D_{it} \in 0, 1$ marks the event week for sender $i$ (for the U.S., the week of March 12, 2021). Common week effects are $\delta_t$, $X_i$ collects sender-specific controls (including pay-cycle/pay-date dummies to absorb seasonality), and $\varepsilon_{ijt}^h$ is an error term. The coefficients $\beta^h$ trace dynamic responses from two weeks pre-event to six weeks post-event. Figure 8 reports the dynamic effects around EIP-3.[15] We find that remittances rise by approximately 20% in the two weeks fol-

[15]The results by receiver country are presented in Appendix B.6.2.

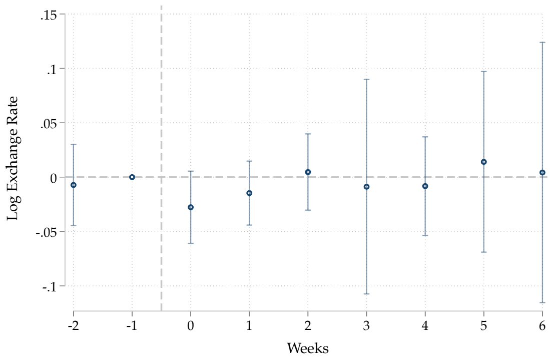
Figure 8: Event Study — U.S. Stimulus Check




(a) Log Amount Sent in USD.




(b) Log Total Transactions.




(c) Log Exchange Rate

Notes: Panel (a)-(c) MTO data. Author's calculations. We aggregate daily data into weekly data to deal with seasonality.

lowing disbursement, relative to the pre-event baseline and relative to control senders with no contemporaneous transfer, with the effect dissipating quickly thereafter. Overall transactions increase by roughly 10% over the same horizon, while we detect no systematic movement in the quoted exchange rate for these corridors. The short half-life of the impulse is consistent with a one-off income shock rather than a persistent shift in earnings or remitting behavior.

U.S. households experienced abrupt earnings and hours volatility during COVID-19, with uneven sectoral exposure and intermittent workplace closures. EIP-3 temporarily raised disposable resources, enabling remitters to both restart transfers and modestly scale up amounts sent abroad. Its rapid delivery, and its salience likely increased the marginal propensity to support relatives overseas, producing a short, sharp rise on both the extensive margin (more transactions) and the intensive margin (higher average amount), while the absence of movements in corridor exchange rates indicates that the response reflects quantity choices rather than price incentives. The effect is smaller and more transient than the reopening results because a one-off household transfer does not durably alter employment prospects or hours, whereas reopening broadens and sustains labor income across sectors; moreover, relative to jurisdictions that backstopped payrolls, U.S. support to workers during this phase was comparatively limited in duration and scope, so the boost to disposable income—and thus the capacity to remit—faded quickly, returning remittances to baseline within roughly a month.

### 3.3 The Exchange-Rate Elasticity of Remittances

In the last section of our empirical analysis, we study how remittances adjust to weekly movements in bilateral exchange rates. For each corridor $(i, j)$, where $i$ and $j$ index the sender and receiver country respectively, we aggregate remittance flows to weekly frequency and estimate a distributed-lag specification in first differences with corridor fixed effects:

$$\Delta \mathrm{y}_{ijt} = \alpha_{ij} + \sum_{k=0}^{n} \beta_k \Delta e_{ij,t-k} + \epsilon_{ijt} \, . \tag{4}$$

$\Delta$y is the average weekly log remittance change in the sender's (and receiver's) currency. $\Delta e$ is the average weekly log nominal exchange rate (sender per unit of receiver currency) change, and $n$ is the number of lags, ranging from 0 to 25. The exchange rate is taken from the MTO's weekly rate, which closely tracks the spot market, and is the relevant exchange rate for the remitter. We estimate specification (4) for the full panel made of the 10 largest corridors in the sample, as well as a corridor-by-corridor estimation – see Appendix B.7 for more detail.

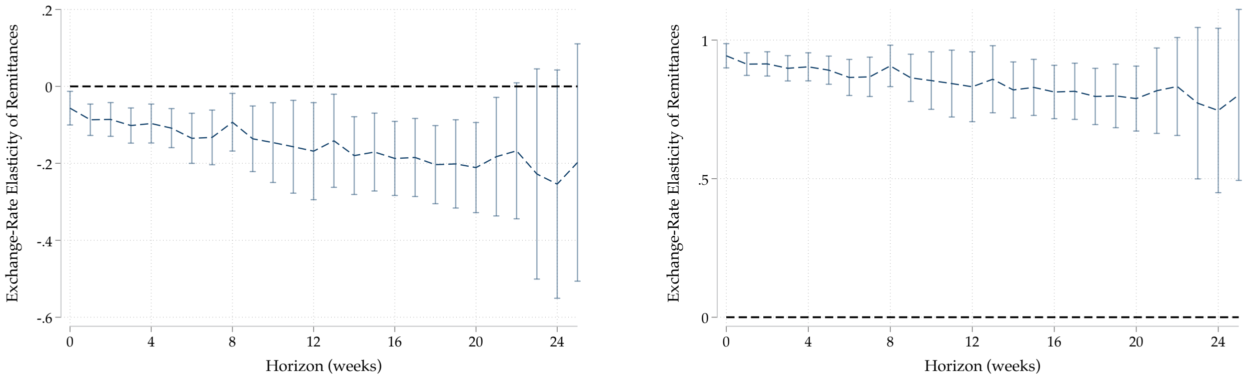
The statistic of interest is the sum of the coefficients on the nominal exchange rate: $\beta(n) \equiv \sum_{k=0}^{n} \beta_j$. These coefficients reflect the impact that the current change in the exchange rate has on the (nominal) quantity of remittances over time. In this sense, we can interpret $\beta(n)$ as the reduced-form elasticity of remittances to the exchange rate.

Figure 9 shows the pass-through coefficients from estimating a panel regression of all corridors against the number of lags, $n$. The line in the middle is the average elasticity. The bands represent the 95% confidence interval around the point estimate for each lag specification. Figure 9a shows the results for remittances sent in sender currency, whilst Figure 9b in receiver currency. Given that we take the sender currency as the remitter's numeraire (section 2.3), we focus on results expressed in that currency.

We find that the measure of elasticity ranges from $-0.06$ on impact to $-0.2$ at 20 lags, and levels off after that. This means, on average, a 1% appreciation of the sender's currency is associated with approximately a 20% decrease in remittance flows in the sender's currency. This suggests that the initial adjustment is quick yet contained, followed by further decrease as we include lags. Panel (b) shows that the response of remittances in the receiver currency follows a similar pattern.

A negative exchange-rate elasticity reflects the income effects dominating substitution effects at high frequency. A sender-currency appreciation raises the purchasing power of each sender-currency unit in the recipient market — an income effect. If remitters care about the recipient's real consumption or obligations, then an appreciation relaxes the short-run cost of achieving a given real transfer. Holding preferences and the receiver's needs fixed, the remitter can attain the same recipient-side real support with fewer sender-currency units — pushing nominal remittances in the sender's currency down. The same appreciation, however, makes the recipient's consumption basket cheaper in terms of the sender's currency — a substitution effect. When the exchange rate appreciates, cross-border transfers become cheaper for the remitter; a lower relative price tends to increase the quantity remitted (other things equal), increasing remittance flows. When estimating the elasticity on our panel, we find that, on average, the income effect dominates.

Figure 9: Exchange Rate Elasticity — Ten Largest Corridors




(a) Sender Currency - Post 2019

(b) Receiver Currency - Post 2019

Notes: MTO data. Author's calculations. The figure reports cumulative distributed-lag coefficients from weekly first-difference regressions of log remittances on log bilateral exchange-rate changes for the ten largest corridors by cumulative USD volume over 2019–2023. Panel (a) uses remittances measured in sender currency; Panel (b) uses remittances measured in receiver currency. The nominal exchange rate is the MTO's weekly quoted rate, defined as sender-currency units per unit of receiver currency. The x-axis is the maximum lag $n$, and the plotted coefficient is $\sum_{k=0}^{n} \beta_k$ from equation (4). Bands report 95% confidence intervals. The sample uses post-2019 observations through October 2023, with U.S. corridors restricted to the post-2020 window.

# 4 A Macroeconomic Model of International Remittance Flows

In this section, we develop a New-Keynesian model to analyze the macroeconomic implications of remittances. Whereas sections 2 and 3 focus on the effect of shocks on remittance flows, this section focuses on how remittance flows transmit to the remainder of the macroeconomy.

Our main innovation lies in the household block and the modeling of remittance flows as a risk-sharing mechanism. Time is discrete. The model economy consists of two countries, Home $H$ and Foreign $F$. Each country consists of households, firms, unions, financial markets, and a government. We first present the household block, followed by the remaining blocks that close the model. This is followed by a discussion of model choices and assumptions.

## 4.1 Households: Families and Individuals

There are two countries, Home $H$ and Foreign $F$. Asset markets are segmented by countries, and markets are incomplete within and across countries.

**Preferences.** Preferences are identical across types of households and are such that aggregate consumption consists of Home and Foreign varieties,

$$c_t = \left( \int_0^1 [(1-\gamma)^{\frac{1}{\theta}} c_{Ht}(k)^{\frac{\theta-1}{\theta}} + \gamma^{\frac{1}{\theta}} c_{Ft}(k)^{\frac{\theta-1}{\theta}}] dk \right)^{\frac{\theta}{\theta-1}}, \tag{5}$$

where $\theta$ is the elasticity of substitution between Home and Foreign goods and $1-\gamma$ captures home bias. Expenditure minimization results in the demand functions

$$c_{Ht}(k) = (1-\gamma)\left(\frac{P_{Ht}(k)}{P_t}\right)^{-\theta} c_t \ \text{ and } \ c_{Ft}(k) = \gamma \left(\frac{P_{Ft}(k)}{P_t}\right)^{-\theta} c_t\ , \tag{6}$$

with the ideal price index

$$P_t = \left(\int_0^1 [(1-\gamma)P_{Ht}(k)^{1-\theta} + \gamma P_{Ft}(k)^{1-\theta}]dk\right)^{\frac{1}{1-\theta}}\ , \tag{7}$$

such that $P_t c_t = P_{Ht} c_{Ht} + P_{Ft} c_{Ft}$. A symmetric set of expressions holds for Foreign households,

$$c_t^* = \left(\int_0^1 [(1-\gamma^*)^{\frac{1}{\theta}} c_{Ft}^*(k)^{\frac{\theta-1}{\theta}} + (\gamma^*)^{\frac{1}{\theta}} c_{Ht}^*(k)^{\frac{\theta-1}{\theta}}]dk\right)^{\frac{\theta}{\theta-1}}\ , \tag{8}$$

$$c_{Ht}^*(k) = \gamma^* \left(\frac{P_{Ht}^*(k)}{P_t^*}\right)^{-\theta} c_t^* \ \text{ and } \ c_{Ft}^*(k) = (1-\gamma^*)\left(\frac{P_{Ft}^*(k)}{P_t^*}\right)^{-\theta} c_t^*\ , \tag{9}$$

$$P_t^* = \left(\int_0^1 [(1-\gamma^*)P_{Ft}^*(k)^{1-\theta} + \gamma^* P_{Ht}^*(k)^{1-\theta}]dk\right)^{\frac{1}{1-\theta}}\ . \tag{10}$$

**Individuals.** There are two types of households – individuals and families. Individuals solve a standard problem featured in HANK models. Home individuals solve

$$\max_{\{c_{it}, a_{it}\}_{t=0}^{\infty}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \{u(c_{it}) - v(\ell_{it})\} \tag{11}$$

s.t.

$$c_{it} + a_{it} = (1 + r_{t-1})a_{it-1} + w_t z_{it} \ell_{it} - \frac{P_{Ht}}{P_t} T_{it}, \quad a_{it} \geq \underline{a}\ , \tag{12}$$

where they can save in shares of a mutual fund, $a_{it}$. Additionally, labor supply is intermediated by a labor union, which ration hours such that all workers supply identical hours (explained in section 4.2). Individuals face uninsurable income risk ($z_{it}$), receives a wage per efficiency unit $w_t$ and pay taxes $T_{it}$.

Foreign individuals solve a symmetric problem

$$\max_{\{c_{it}^*, a_{it}^*\}_{t=0}^{\infty}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \{u(c_{it}^*) - v(\ell_{it}^*)\} \tag{13}$$

s.t.

$$c_{it}^* + a_{it}^* = (1 + r_{t-1}^*)a_{it-1}^* + w_t^* z_{it}^* \ell_{it}^* - \frac{P_{Ft}^*}{P_t^*} T_{it}^*, \quad a_{it}^* \geq \underline{a}^*\ . \tag{14}$$

**Families.** Our innovation lies in the modeling of Families. Families consist of a member who lives at Home and a member who lives in Foreign. They solve a joint problem where they maximize the Pareto-weighted sum of utility flows subject to each member's budget and borrowing constraints,

$$\max_{\{c_{it}, a_{it}, c_{it}^*, a_{it}^*, \omega_{it}^*\}_{t=0}^{\infty}} \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t \left\{(1-\eta)\{u(c_{it}^*) - v(\ell_{it}^*)\} + \eta\{u(c_{it}) - v(\ell_{it})\}\right\}\right] \tag{15}$$

subject to a budget constraint for the Foreign and Home members respectively

$$c_{it} + a_{it} = (1 + r_{t-1})a_{it-1} + w_t z_{it}\ell_t - \frac{P_{Ht}}{P_t}T_{it} + Q_t\omega^*_{it} , \quad a_{it} \geq \underline{a} , \tag{16}$$

$$c^*_{it} + a^*_{it} + \omega^*_{it} = (1 + r^*_{t-1})a^*_{it-1} + w^*_t z^*_{it}\ell^*_t - \frac{P^*_{Ft}}{P^*_t}T^*_{it} , \quad a^*_{it} \geq \underline{a}^* . \tag{17}$$

An additional choice that the Family makes relative to individuals is how many transfers are made between the two members ($\omega^*_{it}$). We call these transfers 'remittances' or 'remittance flows'. In the exposition below, we use a convention of net remittance flows between household members. A positive remittance flow is defined to be a net transfer from the Foreign to the Home member. A remittance flow from Foreign to Home is an expenditure on the side of the Foreign member, in units of the Foreign numeráire, and enters as income in the Home member's budget constraint, multiplied by the real exchange rate, $Q_t = \frac{\mathcal{E}_t P^*_t}{P_t}$, where $\mathcal{E}_t$ is the nominal exchange rate.

We highlight the optimality condition for remittance flows, which we call the family risk-sharing condition

$$\frac{1-\eta}{\eta}\frac{u'(c^*_{it})}{u'(c_{it})} = Q_t . \tag{18}$$

This equation states that the optimal remittance transfers within households equate the Pareto-weighted marginal utilities of consumption of the members of the family to the marginal cost of sending remittance flows, which consists of the relative exchange rate between the two countries, net of remittance costs. Two things are of note. First, the family risk-sharing condition resembles the Backus-Smith condition. However, the differences are that it holds for family consumption, as opposed to aggregate consumption, and it's a result of family members sending inter-vivos transfers to one another, as opposed to trading international bonds.

Second, as with any relative price change, the mechanism introduces income and substitution effects, in this case, of the real exchange rate fluctuations on remittance flows. Suppose there is a depreciation of Home currency relative to Foreign currency (an increase in $Q_t$). The substitution effect leads to an increase in remittances as the relative price of the Home consumption good has decreased relative to the Foreign consumption good. The income effect depends on the initial direction of the remittance flow. If the initial flow is from Foreign to Home, then the depreciation of Home currency expands the budget set of the Home member. The income effect pushes the family to consume more of both Home and Foreign consumption baskets, and as a result, can lead to a reduction of remittance flows. Note that the usual effects of exchange fluctuations through trade, such as expenditure switching and expenditure reducing effects, are still present.

**Aggregation.** Aggregate variables in each country are defined as weighted averages of individuals and families across their distributions. For Home, aggregate consumption and asset holdings

$$C_t = \mu C^{\text{indiv}}_t + (1-\mu)C^{\text{fam}}_t , \tag{19}$$
$$A_t = \mu A^{\text{indiv}}_t + (1-\mu)A^{\text{fam}}_t , \tag{20}$$

where $\mu$ is the mass of individuals at Home, $C^{\text{indiv}}_t = \int c^{\text{indiv}}_t(a,z)dG^{\text{indiv}}(a,z)$ is the total consumption of individuals, and $C^{\text{fam}}_t = \int c^{\text{fam}}_t(a,a^*,z,z^*)dG^{\text{fam}}(a,,a^*,z,z^*)$ is the total consumption of families. In Foreign, aggregate variables are defined similarly,

$$C_t^* = \mu^* C_t^{*\text{indiv}} + (1-\mu^*) C_t^{*\text{fam}}, \tag{21}$$

$$A_t^* = \mu^* A_t^{*\text{indiv}} + (1-\mu^*) A_t^{*\text{fam}}\ , \tag{22}$$

with the addition of remittance flows, which consists only of families. That is,

$$\omega_t^* = (1-\mu^*) \int \omega_{it}^*(a, a^*, z, z^*) dG^{\text{fam}}(a, a^*, z, z^*)\ , \tag{23}$$

where $\mu^*$ is the mass of individuals in Foreign.

## 4.2 Closing the Model: Firms, Unions, and Policy

The remaining blocks of the model follows the canonical HANK literature. In particular, we largely follow the setup of Aggarwal, Auclert, Rognlie, and Straub (2023).

**Production and Prices.** Firms produce using an identical, linear production technology in labor and are subject to TFP shocks,

$$Y_t = \Theta_t \ell_t, \quad \text{and } Y_t^* = \Theta_t^* \ell_t^*\ , \tag{24}$$

where aggregate labor supply is $\ell_t \equiv \int_i \ell_{it} di$ and $\ell_t^* = \int_i \ell_{it}^* di$. Prices are flexible, and there is no pricing to market. As such, firms maximize their dividends,

$$d_t(k) = \frac{(P_{Ht}(k) - MC_t)}{P_t}(c_{Ht}(k) + g_t(k)) + \frac{(\mathcal{E}_t P_{Ht}^*(k) - MC_t)}{P_t} c_{Ht}^*(k)\ , \tag{25}$$

subject to the demand constraints (6) and (9). The optimal price is then

$$\frac{P_{Ht}}{P_t} = \mathcal{M} \frac{W_t}{P_t \Theta_t}\ , \tag{26}$$

where $\mathcal{M} = \frac{\theta}{\theta - 1}$ is the gross markup, and the law of one price holds for each good such that

$$P_{Ht} = \mathcal{E}_t P_{Ht}^*\ . \tag{27}$$

Dividends are aggregated across firms, $d_t = \int_0^1 d_t(k) dk$, and are distributed as a lump sum to the financial intermediary. Foreign firms solve a symmetric problem where they maximize:

$$d_t^*(k) = \frac{(P_{Ft}^*(k) - MC_t^*)}{P_t^*}(c_{Ft}^*(k) + g_t^*(k)) + \frac{(\mathcal{E}_t^{-1} P_{Ft}^*(k) - MC_t^*)}{P_t^*} c_{Ft}(k)\ , \tag{28}$$

subject to (6) and (9). This results in the optimal pricing equation,

$$\frac{P_{Ft}^*}{P_t^*} = \mathcal{M}^* \frac{W_t^*}{P_t^* \Theta_t^*}\ . \tag{29}$$

**Unions.** Following Auclert, Rognlie, and Straub (2024), labor supply is intermediated by unions. There is no sorting between cohorts and unions, and unions impose the same hours on each worker. The real wage is $w_t \equiv \frac{W_t}{P_t}$, $w_t^* \equiv \frac{W_t^*}{P_t^*}$, and nominal wage inflation is $1 + \pi_t^w = \frac{w_t}{w_{t-1}}(1+\pi_t)$, $1 + \pi_t^{w*} =$

$\frac{w_t^*}{w_{t-1}^*}(1+\pi_t^*)$. Changing nominal wages incurs an adjustment cost as in Rotemberg (1982). This results in a wage-Phillips Curve,

$$\pi_t^w(1+\pi_t^w) = \frac{\epsilon}{\psi}\left(\ell_t v'(\ell_t) - \frac{\epsilon-1}{\epsilon}Z_t u'(C_t)\right) + \beta\pi_{t+1}^w(1+\pi_{t+1}^w)\,, \tag{30}$$

$$\pi_t^{w*}(1+\pi_t^{w*}) = \frac{\epsilon}{\psi}\left(\ell_t^* v'(\ell_t^*) - \frac{\epsilon-1}{\epsilon}Z_t^* u'(C_t^*)\right) + \beta\pi_{t+1}^{w*}(1+\pi_{t+1}^{w*})\,. \tag{31}$$

where $Z_t$ and $Z_t^*$ are aggregate real incomes.

**Financial intermediary.** The financial intermediary receives funds from households and invests the funds into government bonds and equity. As assets are segmented by countries, the financial intermediary is the agent that performs the carry trade. By no-arbitrage, the returns in Home and Foreign must satisfy,

$$1+r_t = \frac{p_{t+1}+d_{t+1}}{p_t}, \quad \text{and} \quad 1+r_t^* = \frac{p_{t+1}^*+d_{t+1}^*}{p_t^*}\,, \tag{32}$$

The real UIP condition is

$$1+r_t = \frac{Q_{t+1}}{Q_t}(1+r_t^*)\,, \tag{33}$$

and the Fisher equation is

$$1+r_t = \frac{1+i_t}{1+\pi_{t+1}}\,. \tag{34}$$

**Policy.** The policy block consists of a monetary and fiscal rule for each country. In the baseline model, Monetary policy sets a 'neutral' real interest rate rule in each country,

$$r_t = \bar{r}\,, \quad \text{and} \quad r_t^* = \bar{r}^*\,. \tag{35}$$

In each country, the government collects taxes, issues debt, and disburses transfers to households. We assume that there is no government consumption. The government budget constraint for the Home economy (in real terms) is,

$$B_t + \frac{P_{Ht}}{P_t}T_t = \frac{P_{Ht}}{P_t}G_t + \frac{1+i_{t-1}}{1+\pi_t}B_{t-1}\,. \tag{36}$$

where $T_t = \tau_\ell \frac{W_t}{P_t}\ell_t - \tau_t$ are tax revenues net of transfers, with the no-Ponzi condition $\lim_{t\to\infty} B_t = \overline{B}$. The government budget constraint for the Foreign economy differs only with the addition of tax revenues on remittances,

$$B_t^* + \frac{P_{Ft}^*}{P_t^*}T_t^* = \frac{P_{Ft}^*}{P_t^*}G_t^* + \frac{1+i_{t-1}^*}{1+\pi_t^*}B_{t-1}^*\,. \tag{37}$$

with the no-Ponzi condition $\lim_{t\to\infty} B_t^* = \overline{B}^*$.

We now specify a fiscal rule for each economy. Government debt follows a mean-reverting (AR(1)) process with parameters $\rho_b$, $\rho_b^* \in (0,1)$, which captures the speed at which debt returns to its steady state level. We specify

$$B_t - \overline{B} = \rho_b(B_{t-1}-\overline{B}) - \tau_\ell\frac{W_t}{P_t}\ell_t + \frac{P_{Ht}}{P_t}\tau_t^x\,, \tag{38}$$

$$B_t^* - \overline{B}^* = \rho_b^*(B_{t-1}^* - \overline{B}^*) - \tau_\ell^* \frac{W_t^*}{P_t^*}\ell_t^* + \frac{P_{Ft}^*}{P_t^*}\tau_t^{x*} \ . \tag{39}$$

Negative lump-sum tax shocks (or stimulus checks) are captured by $\tau_t^x$ and $\tau_t^{x*}$, which we specify the paths for. In our baseline model, we specify that government spending remains at its steady state level.

**Market clearing and equilibrium.** There are five market clearing conditions. Two for the goods market, two for the labor market, and the world asset market clearing condition. The goods market clearing conditions are,

$$Y_t = C_{Ht} + C_{Ht}^* + G_t \ , \tag{40}$$

$$Y_t^* = C_{Ft} + C_{Ft}^* + G_t^* \ . \tag{41}$$

We combine the household's budget constraint with the government's budget constraint, and the goods market clearing conditions to get the Home country's budget constraint (or current account surplus) in real terms

$$(A_t - B_t) - \frac{1+i_{t-1}}{1+\pi_t}(A_{t-1} - B_{t-1}) = NX_t + Q_t\omega_t^* \ ,$$

where $NX_t \equiv \frac{\mathcal{E}_t P_{Ht}^* C_{Ht}^*}{P_t} - \frac{P_{Ft}C_{Ft}}{P_t}$ are real net exports of Home. The Home intermediary's balance sheet is

$$A_t = B_t + \text{nfa}_t \ . \tag{42}$$

Hence, the previous equation can be rewritten in terms of the net foreign asset position

$$\text{nfa}_t - (1 + r_{t-1})\text{nfa}_{t-1} = NX_t + Q_t\omega_t^* \ .$$

Note that the model assumes that the net foreign assets are a residual of households' assets and government debt. Defining the current account as $ca_t \equiv \text{nfa}_t - \text{nfa}_{t-1}$, we can rewrite the previous equation as

$$ca_t = r_{t-1}\text{nfa}_{t-1} + NX_t + Q_t\omega_t^* \ . \tag{43}$$

The Foreign country budget constraint (or current account surplus) in real terms is,

$$(A_t^* - B_t^*) - \frac{1+i_{t-1}^*}{1+\pi_t^*}(A_{t-1}^* - B_{t-1}^*) = NX_t^* - \omega_t^* \ ,$$

where $NX_t^* \equiv \frac{\mathcal{E}_t^{-1} P_{Ft} C_{Ft}}{P_t^*} - \frac{P_{Ht}^* C_{Ht}^*}{P_t^*}$. Using the Foreign intermediary's balance sheet, we can rewrite the previous equation in terms of the net foreign asset

$$\text{nfa}_t^* = A_t^* - B_t^* \ , \tag{44}$$

to get

$$\text{nfa}_t^* - (1 + r_{t-1}^*)\text{nfa}_{t-1}^* = NX_t^* - \omega_t^* \ ,$$

and defining the Foreign current account, $ca_t^* \equiv \text{nfa}_t^* - \text{nfa}_{t-1}^*$, we have

$$ca_t^* = r_{t-1}^*\text{nfa}_{t-1}^* + NX_t^* - \omega_t^* \ . \tag{45}$$

Much like net exports, remittance flows enter the current account and sum to zero in the aggregate world economy. If $\omega_t^* > 0$, this represents a net remittance outflow from the Foreign economy and a net remittance inflow for the Home economy. This enters as a current account deficit for the Foreign economy and a current account surplus for the Home economy. The world asset market clearing equation is

$$\text{nfa}_t + Q_t \text{nfa}_t^* = 0 \,. \tag{46}$$

**Definition** (Competitive Equilibrium). *Let* $\boldsymbol{u} \equiv \{u_t\}_{t=0}^{\infty}$. *A (sequential) competitive equilibrium is defined as a set of policies* $\{\boldsymbol{\tau}, \boldsymbol{\tau}^*, \boldsymbol{i}, \boldsymbol{i}^*, \boldsymbol{B}, \boldsymbol{B}^*, \boldsymbol{G}, \boldsymbol{G}^*\}$, *prices* $\{\boldsymbol{\pi}, \boldsymbol{\pi}^*, \boldsymbol{\pi}^{W}, \boldsymbol{\pi}^{W*}, \boldsymbol{p_H}, \boldsymbol{p_H^*}, \boldsymbol{p_F}, \boldsymbol{p_F^*}, \boldsymbol{\mathcal{E}}, \boldsymbol{\mathcal{Q}}, \boldsymbol{r}, \boldsymbol{r}^*\}$ *and quantities* $\{\boldsymbol{\omega}^*, \boldsymbol{Y}, \boldsymbol{Y}^*, \boldsymbol{C}, \boldsymbol{C}^*, \boldsymbol{C_H}, \boldsymbol{C_H^*}, \boldsymbol{C_F}, \boldsymbol{C_F^*}, \boldsymbol{\ell}, \boldsymbol{\ell}^*, \boldsymbol{d}, \boldsymbol{d}^*, \boldsymbol{A}, \boldsymbol{A}^*, \boldsymbol{nfa}, \boldsymbol{nfa}^*\}$ *such that:*

1. Households: Given prices and incomes, $\{\boldsymbol{C}, \boldsymbol{C}^*, \boldsymbol{A}, \boldsymbol{A}^*, \boldsymbol{\omega}^*\}$ solves the household's problems.
2. Unions: $\{\boldsymbol{\pi}^{W}, \boldsymbol{\pi}^{W*}\}$ are consistent with the wage-Phillips curves (132) and (133).
3. Firms: $\{\boldsymbol{p_H}, \boldsymbol{p_F^*}, \boldsymbol{Y}, \boldsymbol{Y}^*, \boldsymbol{d}, \boldsymbol{d}^*\}$ solve the firm's problem, and $\{\boldsymbol{p_H^*}, \boldsymbol{p_F}\}$ are consistent with PCP.
4. Financial intermediaries: The real UIP condition (140) holds.
5. Policies: Given inflation, nominal interest rates $\{\boldsymbol{i}, \boldsymbol{i}^*\}$ are consistent with monetary policy rules (141). $\{\boldsymbol{\tau}, \boldsymbol{B}, \boldsymbol{G}\}$ and $\{\boldsymbol{\tau}^*, \boldsymbol{B}^*, \boldsymbol{G}^*\}$ are consistent with the fiscal rules and government budget constraints in Home and Foreign, respectively.
6. Market clearing: The goods market clearing (146) and (147) holds, the labor market clears such that $\{\boldsymbol{\ell}, \boldsymbol{\ell}^*\}$ are consistent with the production technologies (134) and (135) and the wage NKPCs (132), (133). The world asset market (151) clears.

### 4.3 Model Discussion

The household block abstracts from a number of factors that could be important in practice. We discuss each in turn.

*Time-varying Pareto weights.* The family's problem is formulated with Pareto weights $\eta$ and $1 - \eta$ that are held constant over time. Relaxing this assumption would considerably complicate the model, as the Pareto weights enter directly into the family risk-sharing condition (equation 18), which equates the ratio of Pareto-weighted marginal utilities of consumption to the cost of sending remittances. In the family economics literature, time-varying Pareto weights typically arise when a household member's participation constraint becomes binding — see, for example, Doepke and Tertilt (2016) and the broader limited-commitment literature originating with Ligon, Thomas, and Worrall (2002). When a participation constraint binds, the Pareto weight $\eta_t$ of the constrained member shifts upward to retain their cooperation, and efficient risk-sharing requires compensating them with a larger share of household resources. In our context, this would introduce a time-varying wedge into the family risk-sharing condition. Rather than the ratio of marginal utilities being equated to the exchange rate $Q_t$ at every date, it would instead be equated to $Q_t \cdot \frac{\eta_t}{1-\eta_t}$, where $\eta_t$ moves endogenously in response to outside options. Empirically, such a mechanism could be relevant if, for example, a sufficiently large positive income shock in the origin country raises the value of autarky for the Home member, weakening the incentive to remit. Identifying this channel would require data on the distribution of bargaining power within transnational families, which is generally unobservable. We leave this extension and the associated empirical identification challenge, for future research.

*Endogenous migration.* The model treats the mass parameters $\mu$ and $\mu^*$ — the fractions of individuals in each country — as fixed. This abstracts from the possibility that migration decisions respond endogenously to the same macroeconomic fluctuations we study. In a richer model, a positive productivity shock in the destination country could both increase remittances sent by existing migrants and attract new migrants, amplifying the aggregate remittance response. Such an extension would require embedding a discrete migration choice into the household problem, with the migration decision governed by a comparison of the present discounted value of wages in each country net of migration costs. Our abstraction from endogenous migration is motivated by the focus on short-run cyclical fluctuations, over which the stock of migrants adjusts relatively little. The fixed costs of migration — legal, financial, and social — imply that the extensive margin responds primarily to persistent income differentials rather than the transitory shocks we study. That said, the model can accommodate changes in the steady-state composition of the population through comparative statics in $\mu$ and $\mu^*$: these trace out how the macroeconomic transmission of remittances changes as diaspora communities grow or shrink over longer horizons.

*The two-country restriction and international capital markets.* The analytical model is cast as a closed two-country world economy in which the only international financial instrument is the nominal bond traded between Home and Foreign financial intermediaries. This means that remittance flows $\omega_t^*$ and cross-border bond holdings — summarized by net foreign assets $\text{nfa}_t$ — are the two channels through which resources are transferred internationally, and their interaction is transparent. However, the two-country restriction has an important implication: it overstates the degree to which remittances and international borrowing substitute for one another.

In a multi-country world, the Home country can smooth income shocks by borrowing from third countries, reducing the role that remittances must play as an insurance mechanism. Conversely, if international capital markets are thin or closed — as is empirically plausible for low-income remittance-receiving countries, where sovereign spreads are high and access to external finance is limited — the substitutability between $\omega_t^*$ and $\text{nfa}_t$ is itself limited, and the two-country abstraction is less consequential. We are actively exploring an extension of the model which addresses this limitation by embedding the two-country family structure within a larger multi-country world economy, where the rest of the world provides an additional borrowing and lending margin. This extension also permits us to study how the transmission of remittances varies with the degree of financial openness.

*Non-risk-sharing motives for remittances.* The theoretical framework models remittances as the outcome of intra-family risk-sharing, formalized through the family's joint optimization problem. In practice, however, remittances are sent for a variety of reasons that extend beyond insurance. A well-documented motive is the servicing of informal migration debt: migrants may remit in repayment of loans that financed their migration, giving rise to a front-loaded remittance profile that unwinds as debts are repaid (Rapoport and Docquier, 2006). In this case, remittances respond to debt balances rather than to income differentials, and the mapping between income shocks and remittance flows need not have the sign implied by the risk-sharing first-order condition.

A second motive is investment in the origin household's productive assets — housing, education, or small-business capital — which would generate remittance flows driven by expected returns rather than current consumption gaps. Our empirical strategy is partially robust to these alternative motives by construction: the event-study design identifies remittance responses to well-defined exogenous shocks — natural disasters, labour market reopenings and U.S. stimulus checks. At these horizons, debt-repayment dynamics and investment returns are plausibly less active than the immediate insurance motive, and the estimated responses are therefore more cleanly attributable to the risk-sharing channel. Nevertheless, a more complete structural treatment would augment the family problem with an additional motive — for example, a bequest or investment term in the utility function, or an explicit debt-repayment constraint linking remittance flows to the stock of migrant debt — and derive the implied remittance response under each. We leave this extension for future work.

## 5 Remittance Flows and Risk Sharing

In this section, we delve further into how remittance flows contribute towards risk-sharing across countries. First, under some assumptions on monetary policy, we introduce an analytical framework to show how consumption and output behave in response to aggregate income shocks. Then, we compare the partial equilibrium sequence space Jacobians from our family model to the event study exercise conducted in section 3.2. Finally, we feed the model with two types of aggregates shocks — a positive Foreign transfer shock, to imitate a U.S. stimulus check, and a negative Home productivity shock to imitate a natural disaster.

### 5.1 The Marginal Propensity to Remit

In this section, we work with the limiting case whereby the economy consists only of families. We defer the mixed-household case to Appendix C.2. For simplicity, we work with the special case where firms are competitive and make zero profits and households have CRRA utility, $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$. Monetary policy is 'neutral' in the sense that it keeps real interest rates constant. That is, $r_t = r$ and $r_t^* = \bar{r}^* \ \forall t$, with $\bar{r} = \bar{r}^*$. Furthermore, government spending remains at the steady state level. From the UIP condition, this results in the real exchange rate remaining at steady state ($d\mathbf{Q} = 0$), implying that there are no valuation effects or expenditure switching. Moreover, labor income and dividend income are scaled versions of the real income in each country. Therefore, the only relevant aggregate sequences for the aggregate policy functions are those of real incomes. The consumption and remittance policy functions are

$$C_t = \widetilde{C}_t\left(\left\{\frac{P_{Hs}}{P_s}(Y_s - T_s)\right\}_s, \left\{\frac{P^*_{Fs}}{P^*_s}(Y^*_s - T^*_s)\right\}_s\right), \quad C^*_t = \widetilde{C}^*_t\left(\left\{\frac{P_{Hs}}{P_s}(Y_s - T_s)\right\}_s, \left\{\frac{P^*_{Fs}}{P^*_s}(Y^*_s - T^*_s)\right\}_s\right),$$

$$\omega^*_t = \Omega^*_t\left(\left\{\frac{P_{Hs}}{P_s}(Y_s - T_s)\right\}_s, \left\{\frac{P^*_{Fs}}{P^*_s}(Y^*_s - T^*_s)\right\}_s\right).$$

Using the budget constraint for each member of the family, we can rewrite the consumption functions such that another family member's income enters only through remittances:

$$C_t = \mathcal{C}_t \left( \left\{ \frac{P_{Hs}}{P_s}(Y_s - T_s) + Q_s \Omega^*_s \left( \left\{ \frac{P_{Hk}}{P_k}(Y_k - T_k) \right\}_k, \left\{ \frac{P^*_{Fk}}{P^*_k}(Y^*_k - T^*_k) \right\}_k \right) \right\}_s \right) ,$$

$$C^*_t = \mathcal{C}^*_t \left( \left\{ \frac{P^*_{Fs}}{P^*_s}(Y^*_s - T^*_s) - \Omega^*_s \left( \left\{ \frac{P_{Hk}}{P_k}(Y_k - T_k) \right\}_k, \left\{ \frac{P^*_{Fk}}{P^*_k}(Y^*_k - T^*_k) \right\}_k \right) \right\}_s \right) .$$

Let $\widetilde{Z}_s = \frac{P_{Hs}}{P_s}(Y_s - T_s) + Q_s \omega^*_s$ and $\widetilde{Z}^*_s = \frac{P^*_{Fs}}{P^*_s}(Y^*_s - T^*_s) - \omega^*_s$ be the sequences of disposable incomes inclusive of remittance flows. Totally differentiating the consumption functions, we get

$$dC_t = \sum_s \frac{\partial C_t}{\partial \widetilde{Z}_s} \left( d\left( \frac{P_{Hs}}{P_s}(Y_s - T_s) \right) + \overline{\omega}^* dQ_s + \overline{Q} \left[ \sum_k \frac{\partial \Omega^*_s}{\partial Z_k} d\left( \frac{P_{Hk}}{P_k}(Y_k - T_k) \right) + \sum_k \frac{\partial \Omega^*_s}{\partial Z^*_k} d\left( \frac{P^*_{Fk}}{P^*_k}(Y^*_k - T^*_k) \right) \right] \right)$$

$$dC^*_t = \sum_s \frac{\partial C^*_t}{\partial \widetilde{Z}^*_s} \left( d\left( \frac{P^*_{Fs}}{P^*_s}(Y^*_s - T^*_s) \right) - \left[ \sum_k \frac{\partial \Omega^*_s}{\partial Z_k} d\left( \frac{P_{Hk}}{P_k}(Y_k - T_k) \right) + \sum_k \frac{\partial \Omega^*_s}{\partial Z^*_k} d\left( \frac{P^*_{Fk}}{P^*_k}(Y^*_k - T^*_k) \right) \right] \right) .$$

Let $d\mathbf{Z} = d\left( \frac{\mathbf{P_H}}{\mathbf{P}}(\mathbf{Y} - \mathbf{T}) \right)$ and $d\mathbf{Z}^* = d\left( \frac{\mathbf{P^*_F}}{\mathbf{P^*}}(\mathbf{Y}^* - \mathbf{T}^*) \right)$ denote Home and Foreign real incomes respectively. Stacking over time, we get the impulse for consumption and summarize the findings in Proposition 1.

Because relative prices remain at their steady-state levels in this analytical exercise, we express output, taxes, and government spending in units of the local consumption basket. In particular, define

$$d\widetilde{\mathbf{Y}} \equiv \frac{\overline{P}_H}{\overline{P}} d\mathbf{Y}, \qquad d\widetilde{\mathbf{T}} \equiv \frac{\overline{P}_H}{\overline{P}} d\mathbf{T}, \qquad d\widetilde{\mathbf{G}} \equiv \frac{\overline{P}_H}{\overline{P}} d\mathbf{G},$$

$$d\widetilde{\mathbf{Y}}^* \equiv \frac{\overline{P}^*_F}{\overline{P}^*} d\mathbf{Y}^*, \qquad d\widetilde{\mathbf{T}}^* \equiv \frac{\overline{P}^*_F}{\overline{P}^*} d\mathbf{T}^*, \qquad d\widetilde{\mathbf{G}}^* \equiv \frac{\overline{P}^*_F}{\overline{P}^*} d\mathbf{G}^*.$$

To simplify notation, we suppress the tildes throughout the analytical results below. Thus, $d\mathbf{Y}$ and $d\mathbf{Y}^*$ denote output changes valued in units of the corresponding local consumption basket.

**Proposition 1.** (Impulse of Consumption and Remittances). *Suppose the economy consists of only families ($\mu, \mu^* \to 0$), and monetary policy is neutral in both countries such that $d\mathbf{r} = \mathbf{0}$ and $d\mathbf{r}^* = \mathbf{0}$. Let $\chi = \ell_\infty$ denote the space of bounded sequences. Suppose aggregate consumption and remittance policy functions $\mathcal{C}, \mathcal{C}^* : \chi \to \chi$, $\mathbf{\Omega}^* : \chi \times \chi \to \chi$ are Fréchet differentiable around the steady state. For all sequences of disposable incomes, $d\mathbf{Z}, d\mathbf{Z}^* \in \chi$, the impulse for Home and Foreign consumption can be written as*

$$d\mathbf{C} = \mathbf{M}\left(\mathbf{I} + \overline{Q}\mathbf{\Omega}^*_Z\right) d\mathbf{Z} + \overline{Q}\mathbf{M}\mathbf{\Omega}^*_{Z^*} d\mathbf{Z}^*, \tag{47}$$

$$d\mathbf{C}^* = \mathbf{M}^*\left(\mathbf{I} - \mathbf{\Omega}^*_{Z^*}\right) d\mathbf{Z}^* - \mathbf{M}^*\mathbf{\Omega}^*_Z d\mathbf{Z}. \tag{48}$$

*where, under the value-unit convention above, $d\mathbf{Z} \equiv d\mathbf{Y} - d\mathbf{T}$ and $d\mathbf{Z}^* \equiv d\mathbf{Y}^* - d\mathbf{T}^*$. Moreover, the risk-sharing condition*

$$d\mathbf{C} = \kappa \, d\mathbf{C}^*$$

*where $\kappa \equiv \frac{\overline{C}}{\overline{C}^*} = \left( \frac{\eta \overline{Q}}{1-\eta} \right)^{1/\sigma}$, implies the remittance equation*

$$\left(\overline{Q}\mathbf{M} + \kappa \mathbf{M}^*\right) d\boldsymbol{\omega}^* = \kappa \mathbf{M}^* d\mathbf{Z}^* - \mathbf{M} d\mathbf{Z}, \tag{49}$$

*and the iMPR operators satisfy*

$$\left(\overline{Q}\mathbf{M}+\kappa\mathbf{M}^*\right)\boldsymbol{\Omega}^*_Z=-\mathbf{M},\qquad \left(\overline{Q}\mathbf{M}+\kappa\mathbf{M}^*\right)\boldsymbol{\Omega}^*_{Z^*}=\kappa\mathbf{M}^*. \tag{50}$$

The proof is contained in Appendix C.1. The entries of $\mathbf{M}$ and $\mathbf{M}^*$ are $M_{t,s}=\frac{\partial \mathcal{C}_t}{\partial \widetilde{Z}_s}$ and $M^*_{t,s}=\frac{\partial \mathcal{C}^*_t}{\partial \widetilde{Z}^*_s}$ represent the intertemporal Marginal Propensities to consume out of income, and $\Omega^*_{Z,t,s}=\frac{\partial \Omega^*_t}{\partial Z_s}$ and $\Omega^*_{Z^*,t,s}=\frac{\partial \Omega^*_t}{\partial Z^*_s}$ are the intertemporal marginal propensities to remit out of Home and Foreign income respectively. Intuitively, the impulse for consumption consists of the usual marginal propensity to consume out of income, which is now adjusted by the ability of households to transfer remittances between one another. The latter term is captured by the intertemporal propensity to remit (iMPR). In general, we have that the derivative of remittances with respect to Foreign income is positive, and the derivative of remittances with respect to Home income is negative. Consumption risk-sharing then determines the optimal amount of remittances sent between households.

**Corollary 1.** *Suppose, in addition, that $\overline{Q}\mathbf{M}+\kappa\mathbf{M}^*$ is boundedly invertible on $\chi$. Then the remittance impulse has a unique bounded solution*

$$d\omega^*=\left(\overline{Q}\mathbf{M}+\kappa\mathbf{M}^*\right)^{-1}\left(\kappa\mathbf{M}^*d\mathbf{Z}^*-\mathbf{M}d\mathbf{Z}\right), \tag{51}$$

*and the iMPR operators admit the closed-form representations*

$$\boldsymbol{\Omega}^*_Z=-\left(\overline{Q}\mathbf{M}+\kappa\mathbf{M}^*\right)^{-1}\mathbf{M},\qquad \boldsymbol{\Omega}^*_{Z^*}=\left(\overline{Q}\mathbf{M}+\kappa\mathbf{M}^*\right)^{-1}\kappa\mathbf{M}^*. \tag{52}$$

The proof follows immediately from inverting $\overline{Q}\mathbf{M}+\kappa\mathbf{M}^*$.[16] Intuitively, the optimal remittance flow is an iMPC-weighted average of the consumption differential. Put differently, under the assumptions underlying Proposition 1, the iMPR out of Home and Foreign disposable income is a weighted average of the iMPC matrices between family members. Note that the closed-form representation of the iMPR (52) is pinned down by the risk-sharing condition.

We can substitute in the expressions for the iMPR operators to get an expression of the consumption impulses in terms of impulses to disposable income,

$$d\mathbf{C}=\kappa\mathbf{M}\left(\overline{Q}\mathbf{M}+\kappa\mathbf{M}^*\right)^{-1}\mathbf{M}^*\left(d\mathbf{Z}+\overline{Q}d\mathbf{Z}^*\right). \tag{53}$$

Similarly,

$$d\mathbf{C}^*=\mathbf{M}^*\left(\overline{Q}\mathbf{M}+\kappa\mathbf{M}^*\right)^{-1}\mathbf{M}\left(d\mathbf{Z}+\overline{Q}d\mathbf{Z}^*\right). \tag{54}$$

Under the maintained condition, a special case arises when the Home and Foreign families are symmetric.

[16] Note that, for finite-horizon approximations, the bounded-invertibility condition reduces to nonsingularity. It is distinct from the non-invertibility of $\mathbf{I}-\mathbf{M}$ in Auclert, Rognlie, and Straub (2024). The iMPC adding-up condition implies $\mathbf{p}'\mathbf{M}=\mathbf{p}'$ and $\mathbf{p}'\mathbf{M}^*=\mathbf{p}'$, where $\mathbf{p}$ is the vector of present-value weights, and therefore $\mathbf{p}'(\mathbf{I}-\mathbf{M})=0$. By contrast, under the common present-value weights used here, $\mathbf{p}'(\overline{Q}\mathbf{M}+\kappa\mathbf{M}^*)=(\overline{Q}+\kappa)\mathbf{p}'$. Thus, the adding-up condition does not generate a left null vector for $\overline{Q}\mathbf{M}+\kappa\mathbf{M}^*$. This restriction does not establish bounded invertibility; it only implies that any null direction of this operator must have zero present value.

**Corollary 2** (Symmetric Families). *Suppose, in addition to the conditions in Corollary 1, that Home and Foreign families are symmetric, so that*

$$\overline{Q} = 1, \qquad \kappa = 1, \qquad \mathbf{M} = \mathbf{M}^*.$$

*Then the remittance impulse is*

$$d\boldsymbol{\omega}^* = \frac{1}{2}\left(d\mathbf{Z}^* - d\mathbf{Z}\right), \tag{55}$$

*and the iMPR operators are*

$$\boldsymbol{\Omega}^*_Z = -\frac{1}{2}\mathbf{I}, \qquad \boldsymbol{\Omega}^*_{Z^*} = \frac{1}{2}\mathbf{I}. \tag{56}$$

That is, the iMPR operators become diagonal. Thus, under symmetry, the remittance response is purely static: the family immediately transfers one-half of the difference between Foreign and Home disposable income. The intuition behind this result is straightforward. When the economy is symmetric, any income differences must be immediately remitted such that the risk-sharing condition maintains equal consumption. There are no differences in the iMPCs to generate an early or delayed reaction of risk-sharing.[17]

Next, we investigate how fiscal shocks affect output through their impact on remittance flows. Let $\alpha$ and $\alpha^*$ denote the steady-state import expenditure shares of Home and Foreign households, respectively:

$$\alpha \equiv \gamma \left(\frac{\overline{P}_F}{\overline{P}}\right)^{1-\theta}, \qquad \alpha^* \equiv \gamma^* \left(\frac{\overline{P}^*_H}{\overline{P}^*}\right)^{1-\theta}. \tag{57}$$

The CES price-index identities imply

$$1-\alpha = (1-\gamma)\left(\frac{\overline{P}_H}{\overline{P}}\right)^{1-\theta}, \qquad 1-\alpha^* = (1-\gamma^*)\left(\frac{\overline{P}^*_F}{\overline{P}^*}\right)^{1-\theta}. \tag{58}$$

Thus, with relative prices and government spending remaining at their steady-state levels, goods-market clearing in local consumption-basket units is

$$d\mathbf{Y} = (1-\alpha)d\mathbf{C} + \overline{Q}\alpha^* d\mathbf{C}^*, \tag{59}$$

and

$$d\mathbf{Y}^* = \overline{Q}^{-1}\alpha d\mathbf{C} + (1-\alpha^*)d\mathbf{C}^*. \tag{60}$$

We can substitute in the expressions for the consumption impulses from Proposition 1 to get the following proposition.

**Proposition 2** (Remittances and the International Keynesian Cross). *Suppose the economy consists only of families, so that $\mu, \mu^* \to 0$, households have CRRA utility, and monetary policy is neutral in both countries, so that $d\mathbf{r} = d\mathbf{r}^* = \mathbf{0}$ and $d\mathbf{Q} = \mathbf{0}$. Let $\chi = \ell_\infty$ denote the space of bounded sequences. Suppose the aggregate consumption and remittance policy functions $\mathcal{C}, \mathcal{C}^* : \chi \to \chi$ and $\boldsymbol{\Omega}^* : \chi \times \chi \to \chi$ are Fréchet differentiable around the steady state. Suppose government spending remains at its steady-state level, so that*

[17] In this setup, the static MPR is equal to $\frac{1}{2}$. This is simply because we model the family as consisting of two members.

$d\mathbf{G} = d\mathbf{G}^* = \mathbf{0}$, *and consider bounded tax shocks* $d\mathbf{T}, d\mathbf{T}^* \in \chi$. *Then any bounded solution* $d\mathbf{Y}, d\mathbf{Y}^* \in \chi$ *must satisfy the following international Keynesian cross:*

$$\begin{pmatrix} d\mathbf{Y} \\ d\mathbf{Y}^* \end{pmatrix} = \mathbf{\Phi} \begin{pmatrix} d\mathbf{Y} - d\mathbf{T} \\ d\mathbf{Y}^* - d\mathbf{T}^* \end{pmatrix}, \qquad \mathbf{\Phi} \equiv \begin{pmatrix} \Phi_{11} & \Phi_{12} \\ \Phi_{21} & \Phi_{22} \end{pmatrix}, \tag{61}$$

*where*

$$\begin{aligned}
\Phi_{11} &= (1-\alpha)\mathbf{M}\left(\mathbf{I} + \overline{Q}\mathbf{\Omega}_Z^*\right) - \overline{Q}\alpha^*\mathbf{M}^*\mathbf{\Omega}_Z^*, \\
\Phi_{12} &= (1-\alpha)\overline{Q}\mathbf{M}\mathbf{\Omega}_{Z^*}^* + \overline{Q}\alpha^*\mathbf{M}^*\left(\mathbf{I} - \mathbf{\Omega}_{Z^*}^*\right), \\
\Phi_{21} &= \overline{Q}^{-1}\alpha\mathbf{M}\left(\mathbf{I} + \overline{Q}\mathbf{\Omega}_Z^*\right) - (1-\alpha^*)\mathbf{M}^*\mathbf{\Omega}_Z^*, \\
\Phi_{22} &= \alpha\mathbf{M}\mathbf{\Omega}_{Z^*}^* + (1-\alpha^*)\mathbf{M}^*\left(\mathbf{I} - \mathbf{\Omega}_{Z^*}^*\right).
\end{aligned}$$

The proof is contained in Appendix C.1. Note that this nests the case of the International Keynesian Cross with only individuals, which is captured by taking the limit of iMPR matrices $\mathbf{\Omega}_Z^*$ and $\mathbf{\Omega}_{Z^*}^*$ to $\mathbf{0}$. Following the discussion in Auclert, Rognlie, and Straub (2024), in Proposition 3, we discuss under which conditions a solution to the Keynesian Cross exists.

**Proposition 3** (Solving the International Keynesian Cross). *Suppose* $\bar{r} > 0$ *and the operator* $\mathbf{A} \equiv \overline{Q}\mathbf{M} + \kappa\mathbf{M}^*$ *is boundedly invertible on* $\chi = \ell_\infty$. *Define*

$$\mathbf{H} \equiv \mathbf{M}^*\mathbf{A}^{-1}\mathbf{M}, \qquad b_H \equiv (1-\alpha)\kappa + \overline{Q}\alpha^*, \qquad b_F \equiv \overline{Q}^{-1}\alpha\kappa + (1-\alpha^*),$$
$$\lambda_W \equiv b_H + \overline{Q}b_F = \kappa + \overline{Q}, \qquad \mathbf{M}^W \equiv \lambda_W\mathbf{H}.$$

*Let*

$$d\mathbf{X} \equiv d\mathbf{Y} + \overline{Q}d\mathbf{Y}^*, \qquad d\boldsymbol{\tau}^W \equiv d\mathbf{T} + \overline{Q}d\mathbf{T}^*.$$

*world output and tax shocks. Then the international Keynesian cross in Proposition 2 is equivalent to*

$$\left(\mathbf{I} - \mathbf{M}^W\right) d\mathbf{X} = -\mathbf{M}^W d\boldsymbol{\tau}^W, \qquad b_F d\mathbf{Y} - b_H d\mathbf{Y}^* = \mathbf{0}. \tag{62}$$

*Let* $\mathbf{p}$ *denote the present-value weights, with* $p_t = (1+\bar{r})^{-t}$. *If* $\mathbf{p}'\mathbf{M} = \mathbf{p}'$, *and* $\mathbf{p}'\mathbf{M}^* = \mathbf{p}'$, *then* $\mathbf{p}'\mathbf{M}^W = \mathbf{p}'$. *Consequently, neither* $\mathbf{I} - \mathbf{M}^W$ *nor* $\mathbf{I}_2 - \mathbf{\Phi}$ *is boundedly invertible, where* $\mathbf{I}_2$ *denotes the identity operator on* $\chi \times \chi$. *Let* $\mathbf{F}$ *denote the lead operator,* $(\mathbf{F}\mathbf{x})_t = x_{t+1}$, *and define*

$$\mathbf{K} \equiv -\sum_{j=1}^{\infty}(1+\bar{r})^{-j}\mathbf{F}^j.$$

*For any fiscally feasible tax shock satisfying*

$$\mathbf{p}'d\boldsymbol{\tau}^W = 0,$$

*if* $\mathbf{K}(\mathbf{I} - \mathbf{M}^W)$ *is boundedly invertible, the international Keynesian cross has a unique bounded solution given by*

$$d\mathbf{X} = -\left[\mathbf{K}(\mathbf{I} - \mathbf{M}^W)\right]^{-1}\mathbf{K}\mathbf{M}^W d\boldsymbol{\tau}^W, \tag{63}$$

$$d\mathbf{Y} = \frac{b_H}{\lambda_W}d\mathbf{X}, \qquad d\mathbf{Y}^* = \frac{b_F}{\lambda_W}d\mathbf{X}. \tag{64}$$

Due to the risk-sharing condition, remittance flows act as an amplifier of the international Keynesian cross, whereby a change in disposable income in one country is directly shared by families with members in the other country. Note that the mechanism is symmetric and works similarly for negative changes to disposable income.

## 5.2 The Marginal Propensity to Remit: Model vs Data

In this section, we work with a special case of the model featuring perpetual-youth OLG households in the spirit of Blanchard (1985), recently featured in Angeletos, Lian, and Wolf (2024) and Wolf (2025). Throughout, we will work with a linearized version of the model. The goal of this section is to show that a simplified, analytical version of the household sector can reasonably match the qualitative patterns in the data.

**Perpetual-Youth OLG.** Types are indexed by $i$ and $j$ denotes a household. We make the simplifying assumption that family members have a common death rate, $\phi_i$. Relative to the model in section 4.2, we add a tax on remittances. The tax captures the cost of sending remittance flows, capturing the wedge between the amount sent and received in the data.[18] Families maximize the joint utility function

$$\max_{\{c_{jit}, b_{jit}, c^*_{jit}, b^*_{jit}, \omega^*_{jit}\}_{t=0}^{\infty}} \mathbb{E}_0 \left[ \sum_{t=0}^{\infty} (\beta\phi_i)^t \left\{ (1-\eta)\{u(c^*_{jit}) - v(\ell^*_{jit})\} + \eta\{u(c_{jit}) - v(\ell_{jit})\} \right\} \right] \tag{65}$$

subject to a budget constraint for the Foreign and Home member respectively

$$c^*_{jit} + a^*_{jit} + (1+\tau^*_{\omega})\omega^*_{jit} = x^*_{jit} + \frac{1+i^*_{t-1}}{(1+\pi^*_t)\cdot\phi_i} a^*_{jit-1}\,, \tag{66}$$

$$c_{jit} + a_{jit} = x_{jit} + \frac{1+i_{t-1}}{(1+\pi_t)\cdot\phi_i} a_{jit-1} + Q_t\omega^*_{jit}\,, \tag{67}$$

where $x^*_{jit} \equiv (1-\tau^*_{\ell})w^*_t\ell^*_{jit} + d^*_{jit} + \tau^*_{jit} + z^*_{jit}$, is the Foreign member's cash-on-hand, $x_{jit} \equiv (1-\tau_{\ell})w_t\ell_{jit} + d_{jit} + \tau_{jit} + z_{jit}$ is the Home member's cash-on-hand (excluding remittances), and $\omega^*_{jit}$ are remittance flows. As in Wolf (2025), $z_{jit}$ are transfers within each type across generations. The two assumptions result in households having identical income and wealth within a type, and as such, we do not need to track the distribution of wealth or age. Individuals solve a standard problem and can be thought of as a special case of the Family problem with Pareto weights equal to either zero or one and no remittances. The full statement of the individual's problem is contained in Appendix C.

From this point onward, we work with the linearized version of the model and use standard utility functions $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$ and $v(\ell) = \frac{\ell^{1+\varphi}}{1+\varphi}$. Furthermore, we work with the case where $\beta(1+\bar{r}) = 1$ and $\beta(1+\bar{r}^*) = 1$. We can show that the linearized consumption function for the Foreign member of the family is

$$\widehat{c}^*_{it} = (1-\beta\phi_i) \left\{ \widehat{x}^*_{it} + \sum_{k=1}^{\infty} (\beta\phi_i)^k \widehat{e}^*_{it+k} - \underbrace{(1+\tau^*_{\omega}) \sum_{k=0}^{\infty} (\beta\phi_i)^k \widehat{\omega}^*_{it+k}}_{\text{remittance outflows}} \right\} - \nu^*_i \sum_{k=0}^{\infty} (\beta\phi_i)^k (\widehat{i}^*_{b,t+k} - \widehat{\pi}^*_{t+1+k})\,, \tag{68}$$

[18] Our motivation for modeling the remittance cost as a tax lies in part due to the discussion of remittance taxes in the One Big Beautiful Bill Act (OBBBA).

where $\nu_i^* \equiv \left(\beta\phi_i\sigma^{-1} - (1-\beta\phi_i)\frac{\overline{A}_i^*}{\overline{C}_i^*}\right)\beta$, $\widehat{\omega}_{it}^* = \frac{\omega_{it}^* - \overline{\omega}_i^*}{\overline{Y}^*}$, $\widehat{i}_t^* = di_t^*$ and $\widehat{\pi}_t^* = d\pi_t^*$. The linearized consumption function for the Home member is

$$\widehat{c}_{it} = (1-\beta\phi_i)\left\{\widehat{x}_{it} + \sum_{k=1}^{\infty}(\beta\phi_i)^k\widehat{e}_{it+k} + \underbrace{\frac{\overline{Q}\overline{\omega}_i^*}{\overline{C}_i}\sum_{k=0}^{\infty}(\beta\phi_i)^k\widehat{q}_{t+k} + \frac{\overline{QY}^*}{\overline{C}_i}\sum_{k=0}^{\infty}(\beta\phi_i)^k\widehat{\omega}_{it+k}^*}_{\text{remittance inflows}}\right\} - \nu_i\sum_{k=0}^{\infty}(\beta\phi_i)^k\left(\widehat{i}_{b,t+k} - \widehat{\pi}_{t+1+k}\right), \tag{69}$$

where $\nu_i \equiv \left(\beta\phi_i\sigma^{-1} - (1-\beta\phi_i)\frac{\overline{A}_i}{\overline{C}_i}\right)\beta$.

In (68) and (69), the first term captures the consumption response out of disposable income, which is a product of the baseline MPC, $(1-\beta\phi_i)$, and the current and future NPV of income. As a result of the common death rate assumption, the baseline MPC out of net worth is symmetric across household members. Remittance flows from Foreign to Home reduces the net present value of the Foreign member while simultaneously increasing the NPV of income for the Home member. Moreover, remittance flows enter (69) with a real exchange rate term to adjust for the units of the Home consumption basket. If remittance flows were non-zero in the steady state, then there is an additional valuation effect coming from real exchange rate fluctuations. The second term captures intertemporal substitution.

We simplify the distribution of households to include OLG and hand-to-mouth individuals and families. To do this, we vary the death rate parameter $\phi_i$. Similar to equation (19), aggregate variables are now defined as a weighted average across families and individuals, and within those households, OLG and hand-to-mouth types. For example, aggregate consumption is defined as

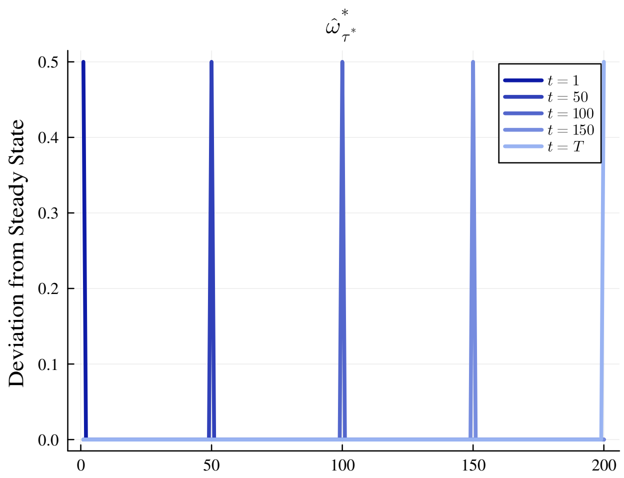
$$C_t = \mu\sum_i C_{it}^{\text{indiv}} + (1-\mu)\sum_i C_{it}^{\text{fam}}, \quad i \in \{\text{OLG}, \text{HtM}\}.$$

**Comparing Model and Data.** With the setup in hand, we can characterize some features of the model. As a result of the symmetry assumption, from (55), the iMPR out of Foreign and Home transfers are $\frac{1}{2}\mathbf{I}$ and $-\frac{1}{2}\mathbf{I}$ respectively. The iMPCs resemble that of standard models and are shown in Figure C.1 of Appendix C.

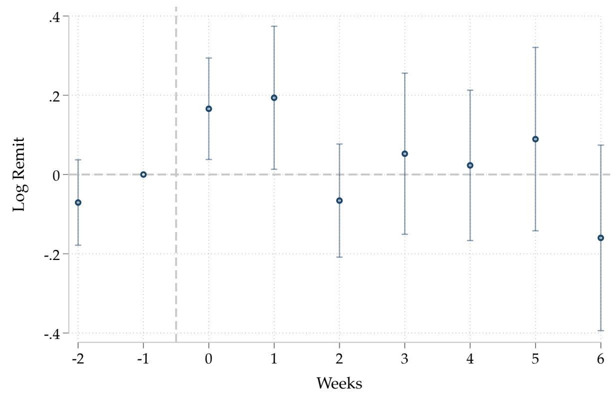
Figure 10 shows a comparison of the Sequence-space Jacobians of remittance flows with respect to transfer income. Comparing to the earlier Figure 8a (reprinted here for convenience), we find that the increase in remittance flows from the U.S. stimulus checks is positive, and large for a short window of time (two weeks) after the disbursement of the checks. Panel (a) shows the columns of the sequence space Jacobian of remittance flows with respect to Foreign transfers, announced in period $t$. The figure shows a spike only in the date of the announcement of the transfer, with no increase prior to, or after date $t$. Hence, the dynamics essentially match the near-static mechanism in the model with symmetric families.

However, this simple model does not match the quantitative magnitude of the event study. This is a result of the symmetry assumption that was made to give analytical tractability, which restricts the marginal propensity to remit to 0.5. In ongoing work, we solve the more general HANK version of the model to match the (intertemporal) marginal propensity to remit more closely.

Figure 10: Marginal Propensity to Remit: Model vs Data




(a) Model




(b) Data

Notes: Panel (a) — sequence space Jacobian of remittance flows with respect to Foreign transfers. Panel (b) — event study of aggregate remittance outflows to the 2021 U.S. stimulus check.

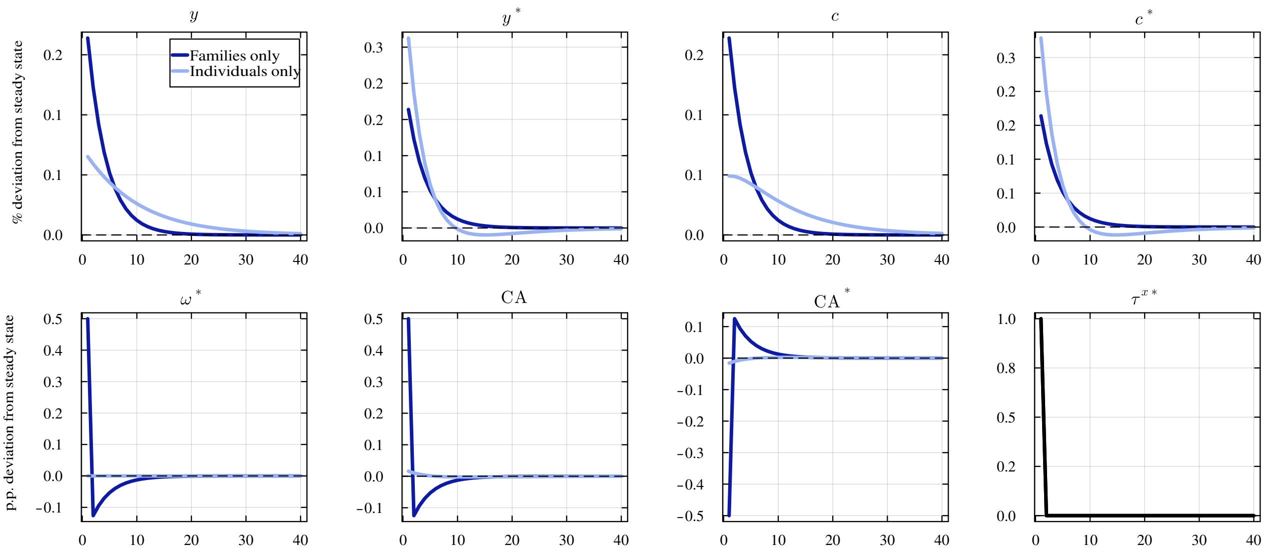
### 5.3 Risk-Sharing in General Equilibrium

In this section, we feed exogenous shocks into our model and solve for the impulse response functions. We study two shocks: a positive Foreign transfer shock, intended to capture the macroeconomic effects of a U.S. stimulus check on remittance-sending households, and a negative Home productivity shock, intended to capture the effects of a natural disaster in the origin country. These two experiments are chosen to mirror the empirical event studies in Section 3, and together span the two directions of the risk-sharing mechanism — a windfall in the sending country and a loss in the receiving country. For each shock, we compare impulse response functions across two extreme calibrations of the household sector: one in which all households are unconnected individuals, and one in which all households are cross-border families. The comparison isolates the contribution of the family channel to international macroeconomic transmission.

**Foreign Transfer Shock.** We explore the impact of a stimulus check shock on the aggregate economy. To do so, we shock the economy with a 1 p.p. increase in transfers to Foreign and solve for the impulse response functions. As in previous sections, monetary policy in both countries is neutral. This implies that all relative prices, including real wages and the real exchange rate, remain at steady state, thereby shutting down expenditure switching effects. The operative channels include the income effect of the transfer on household consumption and remittance decisions, and in general equilibrium, the effect of inflation on real assets in both countries.

We take two extreme calibrations of the mass parameters — one where the economy consists of only families, and one where the economy consists of only individuals. Figure 11 shows the impulse response functions for key aggregate variables. The key difference between the two calibrations is the role of remittance flows. In the family calibration, remittances increase on impact to exactly half the size of the transfer shock. This follows directly from the analytical result in Section 5.2:

Figure 11: Impulse Response Functions — Foreign Transfer Shock



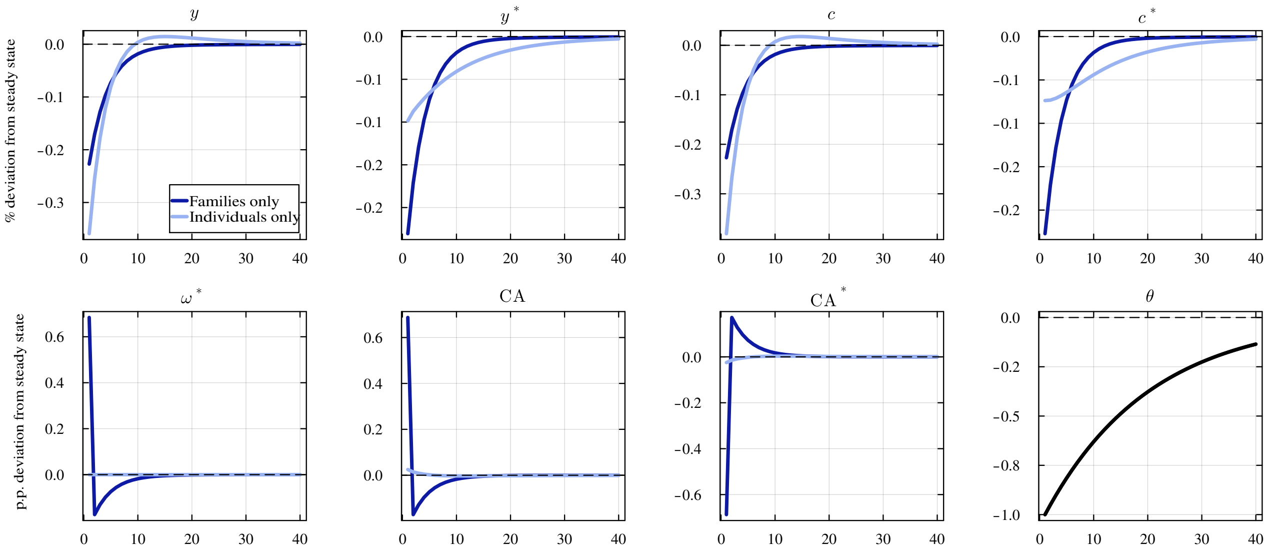

Notes: Model-generated impulse responses from the linearized sequence-space equilibrium. The shock is a 1 p.p. increase in Foreign transfers, $\hat{\tau}_1^{x*} = 0.01$. Panels plot the first 40 periods after the shock. Unstarred variables are Home variables and starred variables are Foreign variables; $\omega^*$ denotes remittances from Foreign to Home and CA denotes the current account. Lines compare the families-only calibration, $\mu = \mu^* = 0$, to the individuals-only calibration, $\mu = \mu^* = 1$, with all other parameters at the baseline calibration and neutral monetary policy. Responses are multiplied by 100; remittances and current accounts are expressed relative to steady-state GDP.

under the symmetric calibration, the marginal propensity to remit is one-half, so the Foreign family member immediately shares half of the windfall with the Home member. The on-impact magnitude of the remittance response is therefore pinned down by theory, complementing the empirical pattern documented in Section 5.2.

The first row of Figure 11 shows the dynamic responses of output and consumption. In the individual calibration, the transfer raises consumption and output in Foreign more than in Home. The only channel through which the transfer affects the Home economy is through trade in goods, which is modest given the home bias in consumption. In the family calibration, by contrast, the consumption responses are equal across the two countries. The remittance transfer raises Home disposable income immediately, supporting Home consumption and output alongside Foreign. As a result, aggregate consumption and output are more correlated across countries in the family calibration than in the individual calibration.

The current account dynamics also differ sharply across the two calibrations. In the individual calibration, the current account adjustment operates entirely through the trade balance: higher Foreign income raises demand for Home exports, generating a modest current account surplus for Home. In the family calibration, the current account reflects both the remittance flow and the trade balance. The remittance component dominates quantitatively, so the overall current account is of similar order of magnitude to the remittance response itself. This illustrates a broader point: in economies with large family networks, remittance flows can be a major driver of current account dynamics, even in response to shocks that originate as domestic fiscal transfers. We show in the next section that the same mechanism operates symmetrically for negative shocks.

Figure 12: Impulse Response Functions: Home Productivity Shock



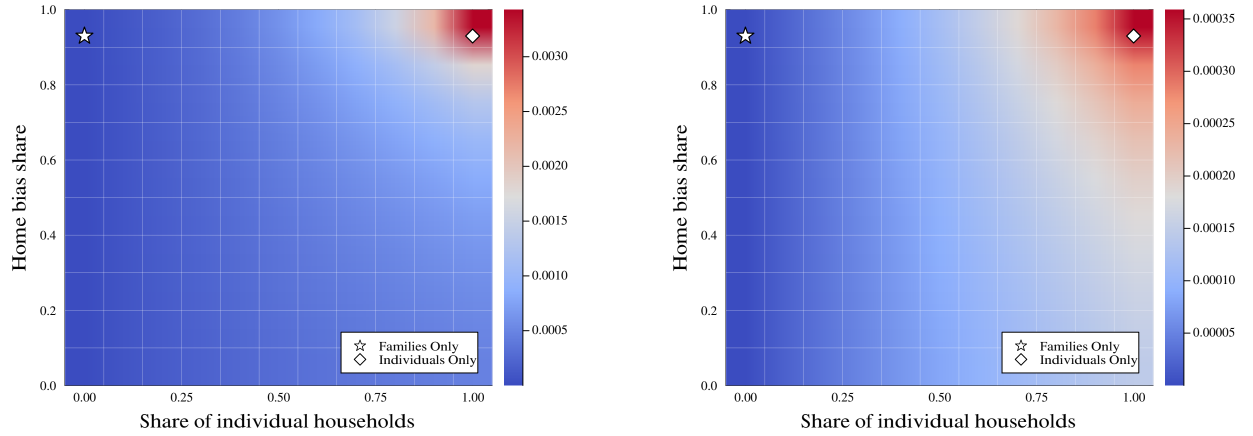

Notes: Model-generated impulse responses from the linearized sequence-space equilibrium. The shock is a 1 p.p. decline in Home productivity, $\hat{\theta}_1 = -0.01$, with AR(1) persistence 0.95. Panels plot the first 40 periods after the shock. Unstarred variables are Home variables and starred variables are Foreign variables; $\omega^*$ denotes remittances from Foreign to Home and CA denotes the current account. Lines compare the families-only calibration, $\mu = \mu^* = 0$, to the individuals-only calibration, $\mu = \mu^* = 1$, with all other parameters at the baseline calibration and neutral monetary policy. Responses are multiplied by 100; remittances and current accounts are expressed relative to steady-state GDP.

**Natural Disasters.** We now analyze the macroeconomic effects of natural disasters. Since our model does not feature capital, we model natural disasters through a negative Home productivity shock. Similar to the previous section, we impose that monetary policy in each country maintains a 'neutral' interest rate as the benchmark.

In the individual calibration, the Home economy suffers a large decline in output and consumption, whereas the Foreign economy is less affected by the shock, as the fall in output and consumption is quantitatively smaller. As with the previous shock, the current account adjustment in this calibration operates entirely through trade. In the family calibration, the decline in consumption is shared equally across the two economies. The mechanism operates through remittances: faced with a fall in Home income, the Foreign family member increases transfers to Home, partially offsetting the income loss. It is this increase in remittance flows — from Foreign to Home — that equalizes consumption across the two economies, absorbing a portion of the shock that would otherwise fall entirely on the Home economy. Thus, the current account dynamics in the family calibration reflect both the remittance response and the trade balance, much as in the transfer shock experiment in the previous section.

Comparing the two experiments reveals that the risk-sharing mechanism functions symmetrically across shock types. In the transfer shock, remittances rise because Foreign income rises and the family optimally shares the windfall. In the productivity shock, remittances rise because Home income falls and the family optimally insures the loss. The direction of the remittance flow is the same in both cases — Foreign to Home — but the trigger differs: income improvement in one experi-

Figure 13: Variance of Log Consumption.




(a) Foreign Transfer Shock

(b) Home Productivity Shock

Notes: Model-generated heatmaps of cross-country log-consumption dispersion. The horizontal axis is the share of individual households, $\mu = \mu^*$; the mass of cross-border families is $1 - \mu$. The vertical axis is the home-bias share, $1 - \gamma = 1 - \gamma^*$. The plotted statistic is the root mean squared cross-country standard deviation of aggregate log consumption over periods 1–40, $\sqrt{40^{-1} \sum_{t=1}^{40} (\hat{c}_t - \hat{c}_t^*)^2 / 4}$, computed conditional on each shock. Panel (a) uses the positive Foreign transfer shock, $\hat{\tau}_1^{x*} = 0.01$; Panel (b) uses the negative Home productivity shock, $\hat{\theta}_1 = -0.01$; both shocks have AR(1) persistence 0.95. The star marks the families-only calibration, $\mu = 0$, and the diamond marks the individuals-only calibration, $\mu = 1$, both at the baseline home-bias share $1 - \gamma = 0.93$. Color scales are panel-specific; higher values indicate less risk sharing. In variance units, the transfer-shock heatmap is roughly an order of magnitude larger than the productivity-shock heatmap.

ment, income deterioration in the other. That the family mechanism responds in the same stabilizing direction regardless of the source of the income differential is a direct implication of the family risk-sharing condition and is consistent with the empirical patterns documented in section 3.

**Variance of Consumption.** To summarize the degree of risk sharing across the parameter space, we compute the cross-country dispersion of aggregate log consumption along each impulse response. This statistic therefore provides a direct measure of risk sharing in the model. At date $t$, this statistic is

$$\mathrm{Var}_t(\log C, \log C^\star) = \frac{(\hat{c}_t - \hat{c}_t^\star)^2}{4}.$$

The heatmaps report the root mean squared cross-country standard deviation over the first 40 periods. This object is conditional on the shock experiment: we compute it separately for the positive Foreign transfer shock and for the negative Home productivity shock, rather than interpreting it as an unconditional variance of consumption.

Figure 13 reports the results. The left panel shows the Foreign transfer shock, and the right panel shows the Home productivity shock. In both panels, dispersion is increasing in the share of individual households, $\mu$, and therefore decreasing in the mass of cross-border families, $1 - \mu$. When the economy consists mostly of families, remittances absorb the cross-country income gap and keep Home and Foreign consumption responses close together. When the economy consists mostly of individuals, this insurance channel is absent, so the same shock generates a larger gap between $\hat{c}_t$ and

$\hat{c}_t^*$. In summary, remittances insure the country hit by an adverse relative income movement, compress the gap between Home and Foreign consumption, and reduce the variance of log consumption across countries.

The dispersion also increases with the home-bias share, $1 - \gamma$. A higher home bias weakens the trade channel that would otherwise transmit demand across countries. As a result, shocks remain more concentrated in the country where they originate, and cross-country consumption comovement falls. The pattern is present for both shocks, but the magnitude differs sharply across panels. The transfer shock generates substantially larger log-consumption dispersion than the productivity shock; in terms of the underlying variance, the transfer-shock heatmap is roughly an order of magnitude larger over comparable grid points.

# 6 Conclusion

How do remittances respond to economic shocks? Can private cross-border transfers act as a risk-sharing mechanism? Despite the growing relevance of remittances in the international markets, the absence of high-frequency microdata has made it difficult to answer these questions.

We use over 150 million transactions processed by a fintech money transfer operator from 2014 to 2023 and event-study difference-in-differences designs to shed light on these questions. The combination of administrative transaction data, high-frequency identification around sharply dated shocks, and broad corridor coverage makes our framework well-suited to draw inferences about the timing, magnitude, and margins of adjustment of remittance flows.

First, we find that remittance senders anchor their transfer decisions in the currency of the sending country. Transaction amounts cluster sharply at round numbers in the sender's currency only, indicating that senders target a fixed nominal share of their own income rather than a fixed real transfer to the recipient. Second, remittances respond rapidly to recipient-side natural disasters, rising by approximately 30% in the first week after the shock and dissipating within a month. Third, sender-side income shocks transmit to recipient countries with economically large magnitudes: the easing of COVID-19 lockdown restrictions raised remittance volumes by up to 80% at peak. The third-round U.S. Economic Impact Payments produced a sharper but more transient 20% increase, consistent with a one-off liquidity transfer rather than a durable shift in earnings. Fourth, the exchange-rate elasticity of remittances is negative and builds gradually, going from -0.06 on impact to -0.2 at a twenty-week horizon, reflecting income effects dominating substitution effects.

Finally, we present a model of remittance as transfers between members of a family. We provide an explicit micro-foundation for remittance flows as a method of risk-sharing in response to endowment shocks and provide an analytical characterization of the linearized model, which we will solve and estimate in future iterations of this paper.

One interesting avenue is to formally test which theories of remittance flows put forward by Rapoport and Docquier (2006) fit with the micro data. Another interesting avenue could be to study how remittance flows react to macroeconomic shocks such as monetary policy shocks and exchange rate fluctuations. It would be interesting to quantify the role of remittance flows in providing risk-sharing across individuals based in different countries. To do so, our future research will also focus on shocks to the receiving countries, like natural disasters and wars.

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