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What Drives Remittances During a Global Shock?
Evidence from the COVID-19 Pandemic in Mexico

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Abstract

During a global shock two forces act upon international remittances in opposite directions: income losses among migrants may reduce their ability to send remittances and, at the same time, migrants' concern for their family's wellbeing may prompt them to send more remittances back home. Which of these drivers prevail is an empirical matter. We assemble quarterly data at the subnational level in Mexico to study the behavior of remittances during the Covid-19 pandemic. We estimate elasticities of remittances with respect to employment conditions at both origin and destination places of Mexican migrants. Our results show that destination country conditions have been the main driver of remittances to Mexico, whereas origin country conditions had no discernible effect on remittances during the pandemic. We also show that contractions in consumption in Mexico are associated with reductions in remittances. We conclude that risk-coping via remittances provides limited protection during global crises.

Keywords: Migration; COVID-19; Remittances; Consumption; Mexico.

JEL: F22; F24; J23; O54.

1. Introduction and Motivation

Remittances sent by migrants are highly relevant for several developing countries. In 2019, they represented 1.6 percent of GDP for low and middle-income countries. This is roughly equivalent to the share of foreign direct investment inflows (World Bank 2021). For this reason, understanding which factors drive remittances is critical for recipient economies. There are at least two key drivers of international remittances that have been identified in the literature. First, economic conditions at the migrant's place of destination. In this case, remittances could increase (decrease) if labor market conditions improve (deteriorate) in the destination economy. Second, economic conditions in the recipient economy. In this case, remittances could act as a co-insurance mechanism for the family and could increase if economic conditions deteriorate in the origin economy. Therefore, remittances could act as a cushion to smooth consumption during harsh times.

During a global crisis, however, these two drivers would act upon remittances in opposite directions since both origin and destination economies could be affected simultaneously. Which of these key drivers would prevail in such a context is an empirical matter. The shock imposed by the COVID-19 pandemic provides a unique context for attempting to elucidate which of these two drivers may prevail during a global crisis. A priori, the implication of this shock for the behavior and impact of remittances is unclear. On the one hand, job losses among migrants may affect remittances and may have a pro-cyclical effect on spending in migrants' places of origin. On the other hand, remittances could act as a counter-cyclical force if sending is primarily motivated by migrants' concern for their families back home. In this paper, we analyze the flow of remittances across Mexican regions to gauge which of these channels has been more relevant during the pandemic.

In contexts where formal mechanisms of insurance and social protection are weak, international migration and remittances have been portrayed as informal mechanisms that diversify household income and buffer negative income shocks in migrants' countries of origin (Amuedo-Dorantes and Pozo 2011; Combes and Ebeke 2011). Remittances tend to increase in response to economic crisis (e.g., Yang 2008), natural disasters (e.g., Halliday 2006; Yang and Choi 2007) or idiosyncratic

household-level shocks such as health-related events (e.g., Ambrosius and Cuecuecha 2013; Ponce, Olivié, and Onofa 2011). However, the role of migrant remittances during shocks that hit origin and destination countries alike is uncertain. At the onset of the pandemic, most observers expected a decline in remittances due to soaring unemployment rates in many high-income countries and job losses among migrants (e.g., World Bank 2020). Whereas remittances did fall globally, remittances to Latin America and the Caribbean fell only slightly and even increased for some countries during 2020, including Mexico (Migration Data Portal 2021). This observation has been interpreted by some as a sign of resilience and evidence that migrants support their family left behind, even under adverse conditions at destination (Higgins and Klitgaard 2020; Ratha et al. 2021). Others have questioned this interpretation, arguing that remittances data show an artificial increase because travel restrictions during the pandemic caused a shift from cash carried by travelers to formally registered wire transfers (Dinarte et al. 2021).

We contribute to this debate by asking two related questions: First, what is the elasticity of remittances with respect to origin and destination country shocks? And second, what has the role of remittances been in mitigating the negative effect of the pandemic on household consumption? With respect to the first question, we expect remittances to decline in response to higher unemployment at migrants' destination and to increase in response to lower employment at migrants' places of origin. With respect to the second question, we expect a lower (higher) drop in consumption during the pandemic in places whose migrants where less (more) affected by adverse conditions at their destination.

We test these hypotheses on a panel of quarterly data from different sources during the pandemic year 2020 at the level of Mexican states and municipalities. Mexico provides a particularly relevant case to study the question at hand for a variety of reasons. First, Mexico has been severely hit by the COVID-19 pandemic in both health and economic terms (Roser et al. 2021 and Banxico 2021). Second, Mexico's economy relies heavily on migration and remittances. More than 11 million Mexican-born migrants – the equivalent of 10% of the population of Mexico – reside in the US (Pew Hispanic Center 2013). Remittances to Mexico contributed 2.9% to Mexico's pre-pandemic GDP and 5% of Mexican households regularly receive remittances (BBVA Bancomer and CONAPO 2020, 124f). The strong rise of unemployment in the US during the pandemic – from

3.5% in February 2020 to 14.7% in April 2020 (USBLS 2021b) – affected the income of Mexican migrants and their capacity to support their families back home.

We use data on migration corridors to calculate the average exposure of states and municipalities to unemployment increases at migrants' destinations. The fact that migration networks from different regions in Mexico are clustered in specific regions in the United States provides variation in terms of migrants' exposure to unemployment at the subnational level in Mexico. To estimate elasticities of remittances, we compare how remittances responded to employment conditions faced by Mexican migrants in the US with how they responded to the drop in employment in their places of origin. We then use the exposure to unemployment increase at destination as an instrument to estimate the causal effect of remittances on the amount of electronic payments made at the level of states and municipalities in Mexico.

We observe the following empirical patterns: A stronger exposure to unemployment in the US is associated with a stronger decline of remittances to Mexico, especially during the first semester of 2020, when employment on both sides of the border fell dramatically. In this period, a one percent increase in the exposure of Mexican migrants to US unemployment is associated with a one percent decrease in remittances to Mexico. At the same time, remittances did not respond to the drop in employment in Mexico during the most acute phase of the pandemic. Over the whole year 2020, we see some positive response of remittances to stronger employment drops in Mexico. However, this association between conditions in Mexico and remittances does not hold across all specifications and it is driven by outliers. The fact that the drop in electronic payments was stronger in states and municipalities that registered a stronger decline in remittances suggests a pro-cyclical effect of remittances during the pandemic.

2. Empirical Setting and Context

The COVID-19 pandemic had enormous social and economic costs in Latin America in general and in Mexico in particular. Mexico reported the third-largest number of official death counts from the pandemic at the time of writing, topped only by Brazil and the US (Roser et al. 2021). In terms of per capita excess deaths, Mexico ranks fourth in a global sample, with 43% more deaths in 2020

relative to pre-pandemic means, behind only Peru, Ecuador, and Bolivia (Karlinsky and Kobak 2021). Latest data by ECLAC (2020) detects an average contraction of Latin American GDP by 7.7% for 2020. Mexico registered a GDP drop of 8.5% in 2020 (Banxico 2021), with tourism being particularly affected (Campos-Vazquez and Esquivel 2021). Because of the difficulty of working from home, those working in blue-collar and other non-office jobs generally suffered both a higher infection risk and a higher risk of job loss (Valentino-DeVries, Lu, and Dance 2020; and Peluffo and Viollaz 2021 for the case of Mexico). Employment decline was strongest for women, who, in addition, had to spend more time in child-care activities due to school closures (see Monroy-Gómez-Franco 2021).

In Latin America, the pandemic hit countries with relatively weak social protection systems and lack of universal coverage (Ocampo and Gómez-Arteaga 2017). Not surprisingly, poverty risk has increased strongly. For Mexico, estimates by Lustig et al. (2020) predict an increase of the poverty head count – those who live with less than 5.5 USD per day – by 9 percentage points or 11 million persons. Although social assistance programs in response to the crisis had an offsetting effect in some Latin American countries, there was no expansion of social assistance in Mexico (Lustig et al. 2020) and the fiscal response was minimal (IMF 2021). We aim to explore whether remittances were able to compensate for this lack of social protection during the pandemic or whether remittances were a pro-cyclical force that led to an additional decline of household consumption.

[Figure 1: Key variables during the COVID-19 pandemic in Mexico]

Figure 1 shows trends for some key variables during the pandemic year. The plot at the top left shows the year-over-year change in formal employment in Mexico, defined as all employees who are registered with the Mexican Institute for Social Security (IMSS). After the pandemic hit Mexico in March 2020, the number of formally employed in April 2020 was 4% lower than in April 2019. Over the year, the total number of formally employed recovered slowly although it was still 3% lower in December 2020 compared to the pre-pandemic level in December 2019.

The plot at the upper right shows the drop in the amount of electronic payments smoothed over biweekly periods, relative to 2019 values. Electronic payments include all payments made via debit or credit card. This information allows us to trace consumption patterns in real time and use the geo-location of payments at the state and municipal level to explore subnational variation in spending. In response to the lockdown, the value of total payments fell by approximately 23% during the second quarter of 2020 relative to the previous year (Campos-Vazquez and Esquivel 2021). Throughout the rest of 2020, payments recovered slowly but in general stayed below their 2019 levels.

The plot at the bottom left shows year-over-year differences in unemployment rates in the US. Unemployment rates rose to an historic high of 14.7% in April 2020, 11 percentage points higher than rates in April 2019. Unemployment rates gradually fell over the year but were still 3 percentage points higher at the end of 2020 compared to the year before. Migrants in the US were particularly vulnerable to the pandemic-related economic shock for at least two reasons. First, many migrants work in mostly low-paid jobs in the service sector that were strongly affected during the pandemic (OECD 2020). Second, undocumented migrants did not qualify for unemployment benefits or social programs granted during the pandemic crisis.

Remittances at the bottom right are reported as year-over-year differences in million USD. Aggregate remittances did not decline in 2020. A spike in remittances occurred in March, just before the pandemic started to hit both Mexico and the US with full force from April 2020 onwards. One explanation for this spike could be travel restrictions. As Dinarte et al. (2021) argue, travel restrictions inhibited carrying cash over the border. As a result, previously unregistered remittances in cash shifted to formal channels. The fact that the spike in March coincides with a time when Mexicans frequently schedule trips to Mexico over the Easter break lends some support to this hypothesis. In the empirical models that follow, we use subnational variation in these variables to explore systematic patterns between employment conditions, remittances, and spending during 2020.

3. Elasticity of Remittances with Respect to Local Economic Conditions

The New Economics of Labor Migration has argued that international migration and remittances are a strategy used by households to diversify their sources of revenue and to insure against negative shocks, especially in those contexts where formal mechanisms of social protection are rudimentary or absent (see Taylor 1999; Rapoport and Docquier 2006). Several empirical studies have shown that remittances help recipient households to smooth consumption over time (Amuedo-Dorantes and Pozo 2011; Combes and Ebeke 2011). Remittances usually respond to economic conditions at migrants' places of origin and increase in cases of economic crisis, natural disasters or household-level shocks (e.g., Yang 2008; Halliday 2006; Yang and Choi 2007; Ambrosius and Cuecuecha 2013; Ponce, Olivié, and Onofa 2011). Based on these models of migration as a co-insurance mechanism, we expect remittances to react to the COVID shock at origin, and formulate hypothesis H1 as follows:

> *H1: A more severe negative employment shock in Mexico is associated with an increase in remittances.*

In addition to conditions at places of origin, we also expect that remittances may be affected by economic conditions faced by migrants in their destination. Higher income among migrants has generally been associated with a higher propensity to remit (cp. Carling 2008, 586). A stronger inflow of remittances has been found to be related to better labor market conditions for migrants (e.g., Adams and Cuecuecha 2010; Anzoategui, Demirgüç-Kunt, and Martínez Pería 2014; Ambrosius and Cuecuecha 2016). Likewise, worsening labor market conditions may led to reductions in remittances. For instance, during the global financial crisis that affected labor market opportunities among migrants, there was a temporary drop in global remittances (Sirkeci, Cohen, and Ratha 2012). We therefore formulate the second hypothesis H2 as follows:

> *H2: An increase in unemployment rates at migrants' destinations is associated with a decline in remittances.*

For H1 we use formal employment levels from the Mexican Institute of Social Security (IMSS, its acronym in Spanish). Mexican employers are required by law to register their employees and their wages. Social security contributions cover benefits such pensions, medical care, health insurance, and disability insurance, among others. The data is available monthly at the state and municipality level. We obtain quarterly figures with mean values of monthly data, and we match this information with remittances data provided by the Central Bank.

For H2, exposure to US unemployment along migration corridors is calculated as follows: first, we calculate the distribution of Mexican migrants in the US based on requests for consular documents that include place of birth and current state of residence for both documented and undocumented migrants (IME 2020); second, following an approach previously used in the literature (e.g., Adams and Cuecuecha 2010; Anzoategui, Demirgüç-Kunt, and Martínez Pería 2014; Ambrosius and Cuecuecha 2016), we use migration corridors between Mexican municipalities of origin and US states of residence to calculate the average exposure of migrants from each Mexican administrative entity i during quarter q using the weighting formula $\sum_{k=1}^{K} Unempl_{i,q} * D_{k,i}$, where D denotes the share of the diaspora from i in destination state k and $Unempl$ is the unemployment rate at destination state k. See Appendix 1 for a description of the data and sources.

Figure 2 depicts the relationship between remittances and economic conditions at origin (MX) and destination (US) during the second quarter of 2020, when employment conditions in both Mexico and the US were strongly affected by the pandemic. The y-axis in both graphs shows the change in remittances received by each of the 31 Mexican states relative to the previous quarter. The left-hand side of the figure depicts the drop in formal employment relative to the previous quarter on the x-axis. The largest contraction in formal employment (above 20%) was registered in a Mexican state that heavily relies on tourism (Quintana Roo). A preliminary visual inspection does not point to a systematic relationship between formal employment contraction in Mexico and changes in remittances during the second quarter of 2020.

The x-axis on the right-hand side of Figure 2 shows the growth in exposure to unemployment rates in the US relative to the previous quarter. The graph suggests a negative relationship between

exposure to unemployment at destination and remittances received, which is in line with H2. In the most exposed states, unemployment exposure grew by 230%. In the state of Puebla, for example, this increase corresponds to a rise of 10 percentage points in migrants' average unemployment exposure, relative to a previous rate of 4.3%. Since a large number of migrants from Puebla work in New York City (Massey, Rugh, and Pren 2010), one of the places hardest hit by the pandemic, this resulted in a large increase in unemployment exposure for migrants from Puebla. Not surprisingly, the state of Puebla had a relatively less favorable trend in remittances in the second quarter compared to other Mexican states.

[Figure 2: remittances, US unemployment and Mexican employment during Q2]

We formally test these empirical patterns at the state and municipality level in Mexico. As an addition to previous studies on remittances behavior in response to either origin or destination country conditions (e.g., Yang 2008; Halliday 2006; Yang and Choi 2007; Ambrosius and Cuecuecha 2013; Ponce, Olivié, and Onofa 2011; Sirkeci, Cohen, and Ratha 2012), we estimate the simultaneous effect of shock variables at both origin and destination. To test hypotheses H1 and H2, we use the following equation to estimate the elasticity of remittances with respect to the COVID-19 shock in host and origin countries:

$$Eq(1)\ Remit_{i,q} = \beta_1 CovidShockMX_{i,q} + \beta_2 CovidShockUS_{i,q} + \delta_i + \tau_q + \mu_{i,q},$$

where $Remit$ refers to the total amount of remittances received by administrative entity i during quarter q. We use data either at the level of 31 states or 385 municipalities. Mexico City is excluded from the analysis because it is an outlier in many dimensions (size, mobility, effects of the pandemic, and economic importance). For the municipal-level regression, we only include municipalities with population above 50 thousand.[1]

[1] Although Mexico has a total of 2,456 municipalities, they vary significantly in size. The state of Oaxaca alone has 570 municipalities, many of these very sparsely populated.

$CovidShockMx$ and $CovidShockUS$ stand for the COVID-19 shock at the state of origin in Mexico and at the destination of Mexican migrants in the US, respectively. δ are unit fixed effects that control for variables that differ by state or municipality but that are relatively constant over time, such as institutional differences, demographic compositions, or labor market structures. τ are time fixed effects that are shocks absorbed by all units at a given time. These may include policies defined at the national level or macroeconomic conditions, among others. μ is the error term. We employ OLS for this and all following models. Since we use logarithmic transformations on all variables, coefficients can be directly interpreted as elasticities.

To evaluate the elasticity of remittances with respect to conditions in Mexico, the explanatory variable $CovidShockMx$ measures the level of formal employment at the state or municipality level. We measure formal employment relative to the adult population to obtain formal employment rates that are comparable across states and municipalities. According to H1, we expect a negative value for coefficient β_1, indicating that a stronger drop in formal employment in Mexico is associated with an increase in remittances.

Remittances should also be affected by conditions at migrants' places of destination, as postulated in H2. To evaluate the elasticity of remittances with respect to migrants' conditions in the US, $CovidShockUS$ uses the exposure of migrant populations from Mexican states or municipalities i to unemployment rates in their US host states k during quarter q, using the weighting formula explained above. Because a stronger impact of COVID-19 should affect migrants' sending capacity, we also expect a negative coefficient β_2 for shocks at destination (fewer remittances when exposure to unemployment in the US increases).

One aspect that must be considered is the increase in total remittances that was observed in Mexico during the pandemic. It has been argued that this result could have been artificial, since mobility restrictions affected informal mechanisms for sending remittances and led to a greater degree of formalization (for the case of Mexico, see Dinarte et al. 2021). It is possible that money that was previously carried or sent through other travelers may have been switched to formal channels instead. If this was the case, the increase in remittances during the pandemic might have been an artificial result of data-reporting practices rather than an increase in money send or received. We

address this possibility in different ways. First, all regressions use time fixed effects to capture formalization trends that affect all states or municipalities simultaneously. Second, since transaction costs of carrying cash are lower for those closer to the border, their share of unregistered (informal) remittances was possibly larger before the pandemic. We therefore include an interaction between time fixed effects and the average distance between every municipality or state of origin in Mexico and their migrants as distributed across the US (cp. Dinarte et al. 2021 for a similar approach).

Table 1 shows the results for the response of (the log of) remittances to employment conditions in Mexico and the US for 31 Mexican states during 2020. All specifications control for state and time fixed effects. Since we use logarithmic transformation on all variables, coefficients can be interpreted as elasticities. The first columns show results for the first two quarters of 2020 only. Column I uses migrants' exposure to US unemployment rates as an explanatory variable, whereas Column II adds an indicator for formal employment rates in Mexico. These columns capture the relationship between remittances and labor market conditions at the peak of the pandemic crisis, when generalized lockdowns were still in place in both Mexico and the US. Columns III and IV repeat the same specifications for the whole year of 2020. Columns V and VI exclude the state of Quintana Roo, a strong outlier in terms of employment contraction and remittances (see Figure 2). Column VI also includes an interaction between time and the average distance between each state capital and the state's migrants as distributed across the US.

Table 1 reveals that in line with H2, exposure to US unemployment has a consistently negative effect on remittances in all specifications. During the most acute period of the pandemic crisis, a one percent increase in unemployment exposure at destination reduces remittances by one percent (column I), everything else being equal. The size of this coefficient is unaffected by adding employment conditions in Mexico in column II. When we extend the period of analysis to the whole year, the size of the coefficient diminishes to 0.50–0.55 (columns III and IV). These results suggest that the estimated effect is mainly driven by the strong rise in US unemployment during the second quarter. During the recovery occurred in the second half of 2020, the relationship between remittances and US labor market conditions becomes weaker. This result holds in the last two columns of Table I when we exclude the state of Quintana Roo from our analysis.

Employment conditions in Mexico do not seem to have affected remittances during the peak of the pandemic (column II). The coefficient for this variable is not only small and positive (contrary to expectations), but also statistically non-significant. When we extend our estimation to the whole year, the coefficient turns negative and significant (column IV). However, this result seems to be driven by the presence of an outlier; the state of Quintana Roo (see Figure 2). When we exclude this state from the analysis, the coefficient shrinks and becomes statistically non-significant (Column V). Including an interaction of distance to the diaspora with time (column VI) does not change this result.

[**Table 1: Elasticity of Remittances, State-Level]**

Table 2 repeats the same analysis but now at the municipality level. The estimated coefficients for US unemployment exposure are very similar in size to those for state-level regressions in Table 1. As in Table 1, the effect of US unemployment shocks is stronger during the first two quarters (close to −1) compared to estimates for the whole year (−0.58). However, in contrast to state-level regressions, in this case there is no statistically significant effect of employment decreases in Mexico on the amount of remittances received. The results do not change if we include an interaction of weighted distance to diaspora with time (column V).

[Table 2: Elasticity of Remittances, Municipality-level]

In sum, we estimate that a stronger exposure to the pandemic-related shock in the US has a robust effect on the amount of remittances sent to Mexico across all specifications, whereas conditions in Mexico have a null (or at best weak) effect on remittances. For the case of conditions at origin, coefficients are sensitive to outliers, depending on the level of aggregation and the period covered. At least during the most acute period of the pandemic, destination country conditions clearly dominated over origin country conditions in explaining the amount of remittances sent.

Robustness analysis

One shortcoming of measuring the pandemic-related shock in Mexico using information from the Mexican Social Security Institute is that it only reflects changes in formal employment and omits changes in the informal sector, which absorbs close to 60% of the Mexican workforce (ENOE Various Years). As a robustness check, we use mobility as an alternative indicator of the intensity of the pandemic-related shock. At the state level, we use an indicator on workplace mobility from Google Analytics (Google LLC 2021). We also use this indicator to construct the equivalent of our measure of unemployment exposure in the US. Unfortunately, we do not have the same mobility data at the municipality level. Instead, we use an alternative indicator by Grandata (2021), which calculates the daily median of all out-of-home events by cell phone users, relative to a pre-pandemic baseline.[2]

For the case of destination country shocks, the analysis of mobility decreases confirms the patterns we observe for unemployment shocks: a larger exposure of migrants to decreases in workplace mobility is associated with lower remittances. for the effect of exposure to unemployment shocks is mainly driven by the first semester of 2020 and is consistent at the level of states and municipalities (see Appendixes 3 and 4). The effect of decreases in mobility in Mexico on the amount of remittances is contrary to the expected effect: a larger drop in mobility is associated with *lower* remittances and this effect is statistically significant in some of the specifications (Appendix 4). Several factors may explain this counter-intuitive result for mobility decreases at origin: first, a higher decrease in mobility could reflect more opportunities for working from home (e.g., a higher share of white collar office jobs); second, the drop in mobility was generally lower in rural areas compared to urban areas. Both characteristics are likely correlated with a higher vulnerability to the social and economic effects of the pandemic.[3] If this is the case, a larger drop in mobility would not necessarily indicate a more severe social or economic shock. We therefore prefer results based on the drop in employment, because this indicator reflects better the economic impact of the pandemic.

[2] See Online Appendix 2 for trends in mobility during 2020 in Mexico and correlations between these different mobility indicators. See Online Appendix 1 for details and data definitions.

[3] This is less of a concern for the indicator of exposure to mobility decrease at destinations, where mobility decreases are measured at the more aggregate level of US states.

4. The Effect of Remittances on Spending during the Pandemic

The pandemic in Mexico was accompanied by a strong drop in consumption, as reflected in the decline of the total amount of electronic transactions during 2020 (see Figure 1). This drop in consumption was the result of two effects: first, households reduced their out-of-home consumption (visits to restaurants, malls etc.) due to fear of contagion and because many non-essential establishments were closed during lockdown; and second, many Mexican households lost earnings during the pandemic due to business closures and layoffs. In addition, some household members – mostly women – left paid labor market activities in order to take care of children due to school closures (Monroy-Gómez-Franco 2021). As a result, the original supply-side shock also turned into a demand-side shock for many households (Guerrieri et al. 2020).

Did the behavior of remittances affect consumption in Mexico? On the one hand, we expect remittances to have helped Mexican households weather the storm during the pandemic in terms of consumption. Provided households received remittances, they may have been able to maintain a higher level of consumption despite restrictions on mobility and employment losses. On the other, a drop in remittances caused by the pandemic at destination may have imposed an additional hardship on receiving households. Accordingly, we formulate the hypothesis H3 as follows:

> *H3: Consumption in Mexico during the pandemic dropped less in places that received larger amounts of remittances and vice versa.*

To estimate the effect of remittances on consumption, we use quarterly data of point-of-sale electronic transactions ($POS\ transactions$) that include all payments via debit or credit card. This information allows us to measure consumption at the state and municipality level on a quarterly basis. This data is confidential, and it is provided by the Mexican Central Bank.

Despite controlling for time and unit fixed effects, a direct regression of remittances on consumption is likely to be biased for two reasons. As claimed in H1, remittances are expected to respond positively to the COVID-19 shock in Mexico. This means that a more severe shock in Mexico would likely be associated with an increase in remittances. At the same time, the inflow

of remittances also stabilizes the drop in consumption that resulted from COVID-19 in Mexico. These effects may partly cancel each other out and therefore lead to a downward biased coefficient for remittances with respect to consumption. Second, an increase in remittances could be at least partly artificial due to formalization trends in remittances.

As a solution to this measurement error, as well as to the endogeneity in remittances, we propose a 2SLS approach that exploits the fact that remittances also respond to exogenous variation at destination, an approach that has previously been used in the migration literature (Adams and Cuecuecha 2010; Anzoategui, Demirgüç-Kunt, and Martínez Pería 2014; Ambrosius and Cuecuecha 2016 among others). In the first step, we predict remittances from migrants' exposure to unemployment increases in the US as in Equation 2. This equation is like equation 1 but uses exposure to the COVID employment shock in the US only. In addition to unit and time fixed effects that control for all variables that are either constant over time or change for all units, the regression also controls for reductions in mobility measured at either the state or the municipality level (unit i) during quarter q. We then use the exogenous variation in remittances $\widehat{Remit}$ as predicted in $(\text{Eq. } 2)$ to explain the total amount of electronic payments in Equation 3.

$$Eq.(2): Remit_{i,q} = \beta_3 CovidShockUS_{i,q} + \beta_4 MobilityDropMX_{i,q} + \delta_m + \tau_q + \mu_{i,q}$$

$$Eq.(3): POS\ transactions_{i,q} = \beta_5 \widehat{Remit}_{i,q} + \beta_6 MobilityDropMX_{i,q} + \delta_m + \tau_q + \mu_{i,q}$$

The coefficient β_5 estimates a causal effect of remittances on the amount of electronic payments under the exogeneity assumption that the instrument (exposure to the COVID-19 shock in the US) is uncorrelated with the error term in $(\text{Eq. } 3)$. Since the historic distribution of migrants across the US (and, as a result, variation in their exposure to conditions in the US) is unrelated to the timing and intensity of the COVID-19 shock in Mexico, we believe the exogeneity assumption holds. We also assume that the instrument $CovidShockUS$ affects electronic payments in Mexico only via the suggested channel (i.e., via changes in remittances). We control for the decrease in mobility to identify changes in consumption that cannot be ascribed to changes in mobility. As in $(\text{Eq. } 1)$, all variables are used as logarithmic transformations.

Table 3 summarizes second-step results for the effect of remittances on total electronic payments, using the predicted amount of remittances that comes from migrants' exposure to unemployment shocks at destination from the first-step regression. First-stage models are equivalent to columns I and III in Table 1 (for state-level models) and Table 2 (for municipality-level models). Columns I and II show results from state-level regressions for the second step. At the state level, we show estimation results for the first two quarters during which exposure to unemployment in the US had a clearly identified effect and exclude quarters Q3 and Q4 due to weakness of the instrument over the entire year. Columns III to VI show results at the municipality level, for quarters Q1 and Q2 (columns III and IV) and for all quarters of 2020 (columns V and VI). We control for the decrease in mobility in Mexico in columns II, IV, and VI to identify an "excess variation" in remittances that cannot be ascribed to the decrease in mobility. All specifications include unit and time fixed effects. F-tests in all regressions are above the critical thresholds for weak instruments.[4]

Across all specifications, the (logged) amount of remittances has a strong effect on the (logged) amount of electronic payments. At the state level, a one percent increase in remittances caused a 1.2 percent higher amount of electronic payments during the first two quarters of the year. Vice versa, a stronger decline in remittances led to a stronger drop in payments. Interpreted jointly with results from Table 1 on the elasticity of remittances, we can trace an effect of the pandemic-related shock in the US to spending in Mexico via the decline in remittances. A one percent increase in unemployment at migrants' destination led to a one percent decrease in remittances, and a one percent decrease in remittances led to more than a one percent decline in electronic payments.

Measured at the level of municipalities, a one percent increase in remittances led to 0.7 percent higher spending over the first two quarters of the year, and 0.5 percent higher spending over the entire year. At the municipality level, a lower decrease in out-of-home events is associated with a lower drop in spending, as expected. Controlling for the decrease in mobility in columns II, IV and VI does not alter results. We interpret this as a sign of instrument exogeneity: provided the instrument is unrelated to the pandemic-related shock at origin, the second-step coefficient for

[4] We use two definitions of weak instruments, the Anderson–Rubin (AR) test and the Wald test as provided by Mikusheva and Poi (2006) and Finlay, Magnusson, and Schaffer (2013)

remittances should be unaffected by changes in mobility in Mexico. We show non-instrumented regression results for the effect of remittances on the amount of spending in Appendix 5. As expected, coefficients for remittances are downward biased in the non-instrumented regression (roughly 50% smaller). We ascribe this result to two factors: the possibility that remittances may have increased in response to conditions at origin, and a formalization bias in remittances data. Both concerns have been addressed using a plausibly exogenous instrument for remittances.

[Table 3: Remittances and Electronic Payments, Two-Stage Least Squares]

5. Conclusion

During the pandemic year 2020, we observe a strong effect of migrants' exposure to unemployment at their places of destination on the amount of remittances received in Mexico, especially during the second quarter of the year, when US unemployment rates soared. At the same time, the effect of employment contraction in Mexico on the amount of remittances received was not clear. In fact, during the first two quarters of the year, remittances did not respond to prevailing economic conditions in Mexico. Over the entire year, we see some positive response of remittances to employment decreases in Mexico, but this effect does not hold across different levels of aggregation and periods, and it is strongly driven by outliers. Hence, under the pandemic crisis that hit both origin and destination countries, remittances seem to have responded more to sending capacities of migrants than to employment and income losses of their families left behind. These patterns are hidden at the aggregate country level, likely because travel restrictions during the pandemic led to an artificial increase in remittances sent through formal channels.

We also observe that a stronger decline in remittances translated into a stronger decrease in spending. Hence, migrants' unemployment during the pandemic had a pro-cyclical effect on spending in their states and municipalities of origin. This observation contrasts with migration models of risk pooling within transnational households, which typically build on the assumption that destination countries provide a source of stability to the uncertain environments that plague households in the Global South. We conclude that informal self-insurance of transnational households against idiosyncratic shocks is not a fully adequate risk-coping mechanism in the context of a global crisis such as the COVID-19 pandemic.

6. Literature

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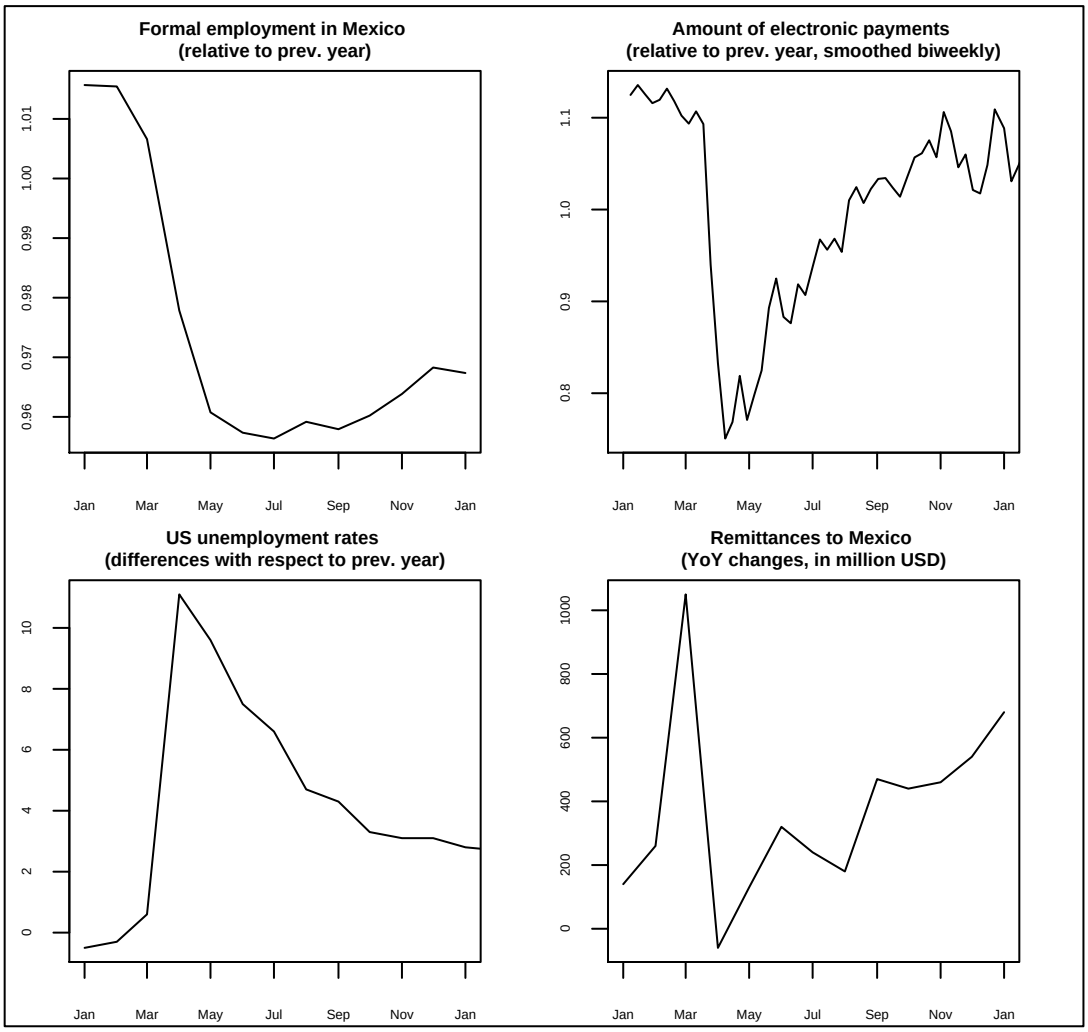
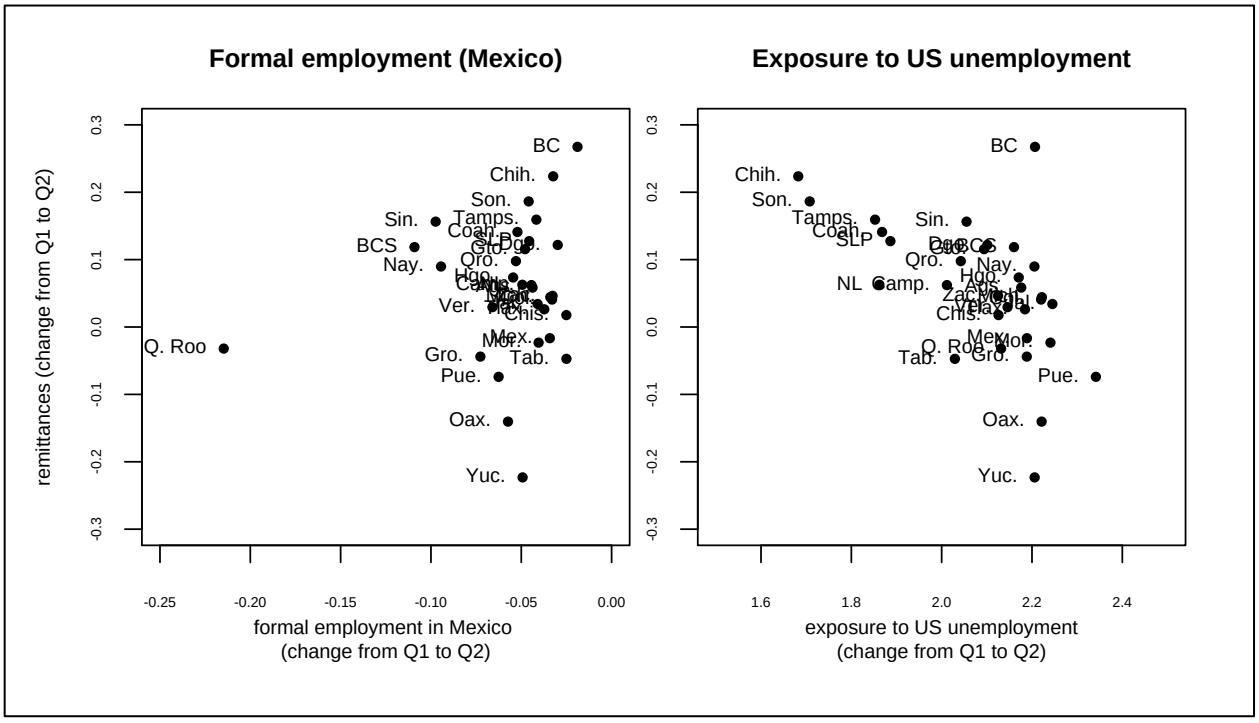
7. Figures

Figure 1: Trends in key variables during the pandemic year 2020



Notes: Authors' calculations. See Online Appendix 1 for a description of variables.

Figure 2: Remittances and employment situations in the US and Mexico (2020-Q2)



Notes: Authors' calculations. Data on employment levels in Mexico (left) is based on data on formal employees from the Mexican Institute for Social Security (IMSS). Exposure to unemployment in the US is calculated from a weighted portfolio of migrants from each of the 31 Mexican states (not including Mexico City) across their destination in the US (right).

8. Tables

Table 1: Elasticity of remittances with respect to employment. State-level regressions

	Level of remittances (log)					
	I	II	III	IV	V	VI
US unemployment exposure (log)	-1.02***	-1.00***	-0.50**	-0.55***	-0.55***	-0.60*
	[0.20]	[0.21]	[0.20]	[0.21]	[0.20]	[0.32]
MX employment (log)		0.19		-1.13***	-0.73	-0.56
		[0.30]		[0.26]	[0.60]	[0.59]
Level of aggregation	state	state	state	state	state	state
Quarters covered	Q1, Q2	Q1, Q2	Q1, Q2, Q3, Q4	Q1, Q2, Q3, Q4	Q1, Q2, Q3, Q4	Q1, Q2, Q3, Q4
Interaction between weighted distance to diaspora and time	No	No	No	No	No	Yes
R^2	0.43	0.44	0.51	0.55	0.56	0.58
No. of observations	62	62	124	124	120	120

Notes: Authors' calculations. Heteroscedasticity robust standard errors clustered at the state level in parenthesis. State-level regressions are run on 31 Mexican states (excluding Mexico City). Columns V and VI also exclude the state of Quintana Roo, a strong outlier in terms of employment and remittances. Stars denote significance at the 10% (*), 5% (**) and 1% (***) level. All results with municipality and quarter fixed effects.

Table 2: Elasticity of remittances with respect to employment. Municipal-level regressions

	Level of remittances (log)				
	I	II	III	IV	V
US unemployment exposure (log)	-0.98***	-0.98***	-0.58***	-0.58***	-0.58**
	[0.17]	[0.17]	[0.14]	[0.14]	[0.25]
MX employment (log)		0.08		-0.02	-0.02
		[0.16]		[0.12]	[0.12]
Level of aggregation	municipal	municipal	municipal	municipal	municipal
Quarters covered	Q1, Q2	Q1, Q2	Q1, Q2, Q3, Q4	Q1, Q2, Q3, Q4	Q1, Q2, Q3, Q4
Interaction between weighted distance to diaspora and time	No	No	No	No	Yes
R^2	0.21	0.22	0.24	0.24	0.27
No. of observations	770	770	1540	1540	1540

Notes: Authors' calculations. Heteroscedasticity robust standard errors clustered at the municipal level in parenthesis. Municipal regressions are run on 385 municipalities with at least 50 thousand inhabitants. Stars denote significance at the 10% (*), 5% (**) and 1% (***) level. All results with municipality and quarter fixed effects.

Table 3: Effect of remittances on the amount of electronic payments. Two-stage least squares

	Amount of electronic payments (log)					
	I	II	III	IV	V	VI
Amount of remittances (log)	1.16***	1.17***	0.73***	0.72***	0.50***	0.50***
	[0.21]	[0.21]	[0.17]	[0.16]	[0.17]	[0.167]
Decrease in workplace		0.48				
Mobility (×100)		[0.51]				
Decrease in out-of-home				0.40***		0.16**
events (×100)				[0.08]		[0.06]
Level of aggregation	state	state	municipal	municipal	municipal	municipal
Quarters covered	Q1, Q2	Q1, Q2	Q1, Q2	Q1, Q2	Q1, Q2, Q3, Q4	Q1, Q2, Q3, Q4
Weak instrument F-stat	12	14	66	67	16	16
Weak instrument Wald CI	[0.75, 1.56]	[0.76, 1.58]	[0.39, 1.06]	[0.41, 1.04]	[0.17, 0.83]	[0.18, 0.83]
Weak instrument AR CI	[0.82, ...]	[0.84, ...]	[0.45, 1.19]	[0.47, 1.18]	[0.24, 1.03]	[0.25, 1.02]
No. of observations	62	62	772	772	1544	1544

Second-step results instrumenting for remittances using migrants' exposure to unemployment at the level of US states as an exogenous instrument. Heteroscedasticity robust standard errors clustered at the group level in parenthesis. Stars denote significance at the 10% (*), 5% (**) and 1% (***) level. All results with municipality (state) and year fixed effects. Weak instruments confidence intervals clustered at the group level in brackets and estimated as in Mikusheva and Poi (2006). Limited information maximum likelihood estimates are provided in Online Appendix 6. The confidence interval is similar to that shown for weak instrument Wald CI.

9. Online Appendix

Online Appendix 1: Data description

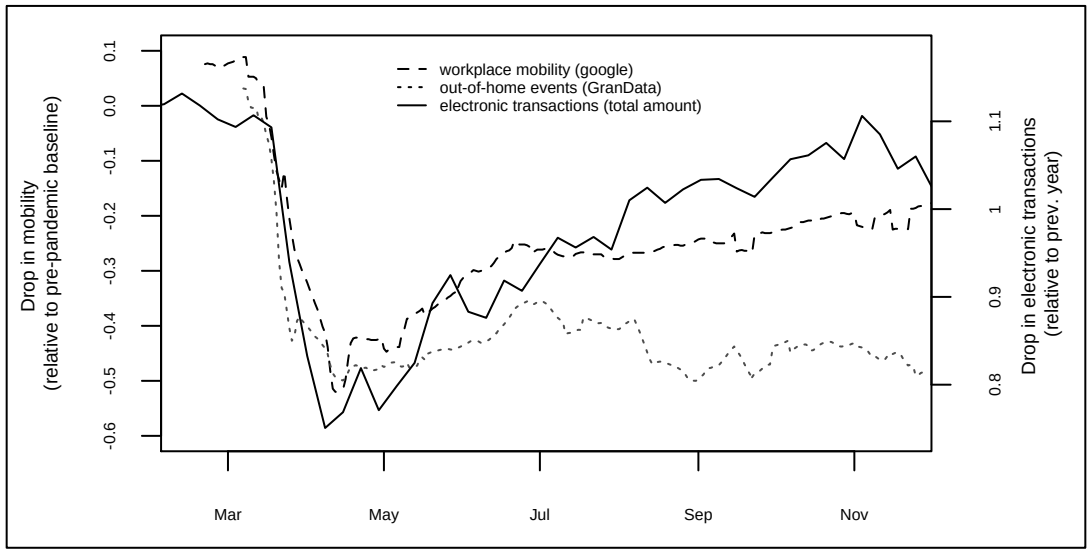
Variable	Data Description	Level	Q1	Q2	Q3	Q4
Remittances	Inflow of total amount of remittances, in millions of USD [a]	state	284.24	298.88	321.47	320.73
			[248.65]	[258.78]	[258.48]	[272.49]
		municipal	15.48	16.26	17.68	17.49
			[19.09]	[20.21]	[22.38]	[21.29]
MX employment levels	Number of formally employed persons registered with the Mexican Institute for Social Security IMSS, as a share of the adult population. [b] [c]	state	0.23	0.22	0.22	0.22
			[0.10]	[0.10]	[0.10]	[0.10]
		municipal	0.18	0.17	0.17	0.17
			[0.16]	[0.15]	[0.15]	[0.15]
US unemployment exposure	Average exposure of migrants from each Mexican administrative entity i during quarter q using the weighting formula $\sum_{k=1}^{K} Unempl_{i,q} * D_{k,i}$, where D denotes the share of diaspora from i in destination states k, and $Unempl$ is the unemployment rate in destination state k. Data on migration corridors between Mexican municipalities of origin and US states of residence obtained from consular documents that register Mexican municipality of birth and US state of residence of all applicants. [d] [e]	state	0.04	0.13	0.09	0.07
			[0.00]	[0.01]	[0.01]	[0.00]
		municipal	0.04	0.13	0.09	0.07
			[0.00]	[0.01]	[0.01]	[0.00]
Electronic payments	Total amount of electronic payments made via debit or credit card, geo-located at its point of sale. In millions of current Mexican Pesos. [f]	state	8845.12	6737.49	9170.64	9656.16
			[7268.58]	[5437.24]	[7452.55]	[7660.82]
		municipal	675.79	509.52	651.06	785.08
			[1541.01]	[1160.97]	[1480.99]	[1772.43]
Decrease in workplace mobility	Percentage drop in mobility between residence and workplace using location history from Google accounts on people's mobile devices, with respect to a median value for baseline days in the five-week period from January 3 to February 6, 2020. [g]	state	-0.04	-0.36	-0.26	-0.20
			[0.02]	[0.06]	[0.04]	[0.03]

Online Appendix 1: Date description (continued)

Variable	Data Description	Level	Q1	Q2	Q3	Q4
Migrants' exposure to decrease in workplace mobility	Average exposure of migrants from each Mexican administrative entity *i* to the drop in workplace mobility in their US states of residence k, using the same weighting formula as for exposure to unemployment. [g) d)]	state	-0.13	-0.36	-0.32	-0.27
			[0.00]	[0.01]	[0.00]	[0.01]
		municipal	-0.13	-0.36	-0.32	-0.27
			[0.00]	[0.01]	[0.01]	[0.01]
Decrease in out-of-home events	Drop in the number of out-of-home events of cell-phone users, relative to the baseline data (March 2). The indicator first calculates the daily median for out-of-home events of all cell phone users, and then calculates the median over quarterly periods. Data before March 1 is set to zero and the fourth quarter ends on November 30. [h)]	municipal	0.00	-0.21	-0.28	-0.32
			[0.00]	[0.17]	[0.15]	[0.15]
Distance	Weighted average of direct distance in km from state capitals in Mexico to the state capital in the US state where migrants reside using the haversine formula. For exposure to unemployment, the average (weighted) distances between origin and destination is calculated depending on the distribution of migrants across the US. [c) d)]	state	2016.13			
			[526.60]			
		municipal	2183.45			
			[589.86]			

Sources: [a)] Banxico (2021) , [b)] IMSS [c)] INEGI (2021), [d)] IME (2020), [e)] USBLS (2021a), [f)] Banxico (confidential data), [g)] Google LLC (2021), [h)] Grandata (2021). Mean values and standard deviations in squared brackets for 31 states excluding the capital city of Mexico or 385 municipalities with a population of at least 50 thousand persons.

Online Appendix 2: Decrease in mobility relative to baseline (left axis) and decrease in electronic transactions relative to previous year (right axis) during 2020 (daily values, smoothed)



See Online Appendix 1 for a description of variables.

Online Appendix 3: Elasticity of remittances with respect to mobility drops. State-level regressions.

	Level of remittances (log)						
	I	II	III	IV	V	VI	VII
Migrants exposure to decrease in workplace mobility	8.33***		8.11***	3.30**		3.28*	3.24
	[2.19]		[2.10]	[1.58]		[1.63]	[2.35]
Decrease in workplace mobility		0.52*	0.48*		0.08	0.05	0.04
		[026]	[0.27]		[0.24]	[0.26]	[0.28]
Level of aggregation	state	state	state	state	state	state	State
Quarters covered	Q1, Q2	Q1, Q2	Q1, Q2	Q1, Q2, Q3, Q4	Q1, Q2, Q3, Q4	Q1, Q2, Q3, Q4	Q1, Q2, Q3, Q4
Interaction between weighted distance to diaspora and time	No	No	No	No	No	No	Yes
R^2	0.35	0.26	0.40	0.50	0.49	0.50	0.52
No. of observations	62	62	62	124	124	124	124

Heteroscedasticity robust standard errors clustered at the group level in parenthesis. State-level regressions are run on 31 Mexican states (excluding Mexico City). Stars denote significance at the 10% (*), 5% (**) and 1% (***) level. All results with state and year fixed effects.

Online Appendix 4: Elasticity of remittances with respect to mobility drops. Municipality-level regressions.

	Level of remittances (log)					
	I	II	III	IV	V	VI
Migrants exposure to decrease in workplace mobility	7.93***		8.24***	2.76***	2.76***	-0.47
	[1.16]		[1.16]	[0.87]	[0.87]	[1.47]
Decrease in out-of-home events		0.09	0.12*		0.20***	0.19**
		[0.06]	[0.06]		[0.07]	[0.07]
Level of aggregation	municipal	municipal	municipal	municipal	municipal	municipal
Quarters covered	Q1, Q2	Q1, Q2	Q1, Q2	Q1, Q2, Q3, Q4	Q1, Q2, Q3, Q4	Q1, Q2, Q3, Q4
Interaction between weighted distance to diaspora and time	No	No	No	No	No	Yes
R^2	0.18	0.09	0.20	0.23	0.24	0.27
No. of observations	772	772	772	1544	1544	1544

Heteroscedasticity robust standard errors clustered at the group level in parenthesis. Regressions are run on 385 municipalities with a population of at least 50 thousand. Stars denote significance at the 10% (*), 5% (**) and 1% (***) level. All results with municipality and year fixed effects.

Online Appendix 5: Remittances and electronic payments. Non-instrumented OLS

	Amount of electronic payments (log)					
Level of remittances (log)	0.80***	0.69***	0.34***	0.28***	0.03**	0.01
	[0.17]	[0.14]	[0.06]	[0.06]	[0.01]	[0.02]
Decrease in workplace mobility		0.72				
		[0.55]				
Decrease in out-of-home events				0.44***		0.29***
				[0.07]		[0.04]
Level of aggregation	state	state	municipal	municipal	municipal	municipal
Quarters covered	Q1, Q2	Q1, Q2	Q1, Q2	Q1, Q2	Q1, Q2, Q3, Q4	Q1, Q2, Q3, Q4
R^2	0.89	0.91	0.47	0.57	0.66	0.70
F-stat	116	106	167	144	562	299
No. of observations	62	62	772	772	1544	1544

Heteroscedasticity robust standard errors clustered at the group level in parenthesis. Stars denote significance at the 10% (*), 5% (**) and 1% (***) level. All results with municipality and year fixed effects.

Online Appendix 6: Effect of remittances on the amount of electronic payments. LIML estimation

	Amount of electronic payments (log)					
Amount of remittances (log)	1.16***	1.17***	0.73***	0.72***	0.50***	0.50***
	[0.21]	[0.21]	[0.17]	[0.16]	[0.17]	[0.167]
Decrease in workplace		0.48				
mobility		[0.51]				
Decrease in out-of-home				0.40***		0.16**
events				[0.08]		[0.06]
Level of aggregation	state	state	municipal	municipal	municipal	municipal
Quarters covered	Q1, Q2	Q1, Q2	Q1, Q2	Q1, Q2	Q1, Q2, Q3, Q4	Q1, Q2, Q3, Q4
Weak instrument F-stat	12	14	66	67	16	16
LIML CI	[0.75, 1.56]	[0.76, 1.58]	[0.39, 1.06]	[0.41, 1.04]	[0.17, 0.83]	[0.18, 0.83]
No. of observations	62	62	772	772	1544	1544

Second-step results instrumenting for remittances using migrants exposure to unemployment at the level of US states as an exogenous instrument. Heteroscedasticity robust standard errors clustered at the group level in parenthesis. Stars denote significance at the 10% (*), 5% (**) and 1% (***) level. All results with municipality (state) and year fixed effects. Weak instruments confidence intervals clustered at the group level in brackets estimated as in Mikusheva and Poi (2006).

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