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Determinants of Mexico-U.S. Outward and Return Migration Flows: A State-Level Panel Data Analysis

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Abstract Using a unique panel data set of state-to-state outward and return migration flows between Mexico and the United States from 1995 to 2012, this study is the first to analyze Mexico-U.S. migration at the state level and explore simultaneously the effect of economic, environmental, and social factors in Mexico over two decades. Pairing origin and destination states and controlling for a rich structure of fixed effects, we find that income positively impacts migration outflows, especially for Mexican states of origin with a recent migration history and for low-educated migrant flows, suggesting the existence of credit constraints. We find evidence that drought causes more out-migration, while other climatic shocks have no effect. Violence is found to increase out-migration flows from border states and to decrease migration from other Mexican states, especially where violence is directed at migrants. Last, return flows are larger when income growth at destination is lower, consistent with the accumulation of savings as a primary motivation of migrants. Exploring the impact of the crisis, we find evidence of significant changes in the geography of migration flows. Traditional flows are drying up, and new migration corridors are rising, with implications on the composition of the Mexican population in the United States. Although the effect of income on flows in both directions is unchanged by the crisis, the negative effect of violence on out-migration tends to reverse at the end of the period. Overall, this study emphasizes the interest of analyzing disaggregated flows at the infra-country level.

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Introduction

Since the mid-2000s, net migration flows of Mexicans to the United States have been characterized by an unprecedented decline (Passel et al. 2012) after decades of apparently self-sustaining growth (Massey 1990). Recent research has linked this evolution to the economic consequences of the Great Recession in the United States and, in particular, the lower demand for immigrant labor (Villarreal 2014). However, short-term variations in economic factors in the United States do not satisfactorily account for such a drastic decline.

Other studies have documented the recent evolutions of the regional patterns of Mexico-U.S. migration flows. Whereas the geography of Mexico-U.S. migration flows in the 1900s, shaped by the development of railroads (Woodruff and Zenteno 2007), continued to explain a large part of migration patterns as late as in the early 1990s (Borjas 2007; Durand et al. 2001), a radical change has been observed in the 2000s with the diversification of origins and the emergence of new destinations (Massey et al. 2010; Riosmena and Massey 2012).

This article provides a new perspective on the analysis of the recent evolutions of Mexico-U.S. migration flows, based on the original use of rich survey data. An important contribution of this study is the creation of a unique panel database of yearly outward and return migration flows from Mexican states to U.S. states over the 1995–2012 period, using data from the individual Survey of Migration at the Northern Border of Mexico (*La Encuesta sobre Migración en la Frontera Norte de México* (EMIF Norte)).

Matching origin and destination states, we build the first panel data set of both outward and return flows disaggregated at the federated state level. We use these data to study the determinants of state-to-state Mexico-U.S. migration flows over the last 20 years, focusing on dyadic variables and migration "push" factors, measured in Mexican states of origin. Thanks to the panel dimension, we are able to precisely assess the effect of the different factors because we control for unobserved U.S. and Mexican state-specific characteristics. We specifically investigate the impact of income at origin on migration depending on state migration history and migrants' education, complementing previous research on the role of networks in alleviating migration costs (Massey 1988, 1990); McKenzie and Rapoport 2010; Orrenius and Zavodny 2005). In addition, we explore the potentially different impact of migration determinants before and after the crisis.

While contributing to the growing literature applying gravity models to the analysis of migration flows (Beine and Parsons 2015; Beine et al. 2011; Bertoli and Moraga 2013; Grogger and Hanson 2011; Mayda 2010; Ortega and Peri 2013; Pedersen et al. 2008), we provide the first estimation of a gravity model of migration at the infra-country level.

This article significantly contributes to the literature on Mexico-U.S. migration by considering simultaneously the various determinants of Mexico-U.S. migration. These determinants have indeed been mostly studied in isolation in previous research, with a focus on (1) push factors: demographic pressure (Hanson and McIntosh 2010) and climatic shocks (Nawrotzki et al. 2013); (2) pull factors: labor demand in the United States (Villarreal 2014); or (3) dyadic factors with the substantial literature on networks.

Yet, we show that all these determinants are intrinsically linked. In particular, we find that the crisis has accelerated the decline of historical migration flows and precipitated returns, while income growth at origin tends to increase migration flows from Mexican poorest states with no migration history and consequently weaker networks, by loosening credit constraints. Whereas recent evidence has been produced on the decrease in net flows (Passel et al. 2012; Villarreal 2014), we go further by linking this phenomenon to changing geographical patterns. Migration flows react in very different ways to violence at the border and along southeast migration routes.

This extensive exploration is allowed by the unique scope of our analysis: this work is the first to rely on panel data at the state level. Thanks to the intermediate degree of aggregation of our data, we identify the impact of various macro determinants and document the geography of flows. The longitudinal database that we constructed provides the first comprehensive picture of Mexico-U.S. state-to-state flows by matching Mexican origin to U.S. destination. Our results illustrate the recent and rapid changes in Mexican immigration patterns and point to the beginning of a new immigration cycle, with the emergence of new origins and destinations. We find evidence that new networks are being formed, which will contribute to shaping immigration flows in the next decades after emerging networks will be mature, with implications on both the composition and location of the Mexican population in the United States. Overall, our results highlight the importance of analyzing migration between Mexico and the United States at the infra-country level.

Estimation of a Gravity Model of Migration

We estimate a standard gravity model of migration that was first applied by Pedersen et al. (2008) and Mayda (2010) to the estimation of the determinants of international migration flows using bilateral flow matrices. We adapt this model to the analysis of flows between Mexican and U.S. states.

We estimate the following equation for Mexico to U.S. flows:

$$\begin{aligned} E\left(m_{jk,t}|\mathbf{X}\right) = \exp\Big(&\beta_0 + \beta_1 \ln\left(DIST_{jk}\right) + \beta_2 BORDER_{jk} + \beta_3 NETW_{jk} + \beta_4 \ln\left(GDP_{j,t-1}\right) \\ &+ \beta_5 \ln\left(GDP\ MEX_{j,t-1}\right) + \beta_6 \ln\left(HOM_{j,t-1}\right) + \beta_7 \ln\left(HOM\ MEX_{j,t-1}\right) \\ &+ \beta_8 \ln\left(POP_{j,t-1}\right) + \beta_9' CLIM_{j,t-1} + D_j + D_{k,t}\Big)\varepsilon_{jk,t}. \end{aligned}$$

where $m_{jk,t}$ represents the gross migration flow from Mexican state j to U.S. state k at time t. $\mathbf{X}$ is a vector of independent variables. First, we explore the role of three dyadic factors: distance, contiguity, and networks. Distance is the log of the long-circle distance between the capital city of states j and k ($\ln(DIST_{jk})$). We include a dummy variable for pairs of Mexican and U.S. states sharing a border ($BORDER_{jk}$) as well as a measure of migration networks between states j and k ($NETW_{jk}$). In regard to networks, the classical approach in the literature consists in using historical, bilateral migration stocks (Beine and Parsons 2015; Beine et al. 2016). For lack of such data, we construct a dyadic network variable using the historical migration rate from Mexican state j

to the United States in 1987, weighted by the distance between Mexican state j and U.S. state k.

Regarding economic factors, we consider the log of the GDP per capita, ($\ln(GDP_{j,t-1})$),[1] and the unemployment rate in the Mexican state of origin (or destination in the case of return migration). We further explore potential heterogeneities in regard to the impact of income on migration depending on the migration history of origin Mexican states by interacting the GDP per capita with a dummy variable equal to 1 for historical migrant-sending states.[2] Finally, we disaggregate migration outflows depending on migrants' education in order to investigate the potentially different impact of income on educated and uneducated flows.

Among non-economic factors, we explore the role of differential growth in labor supply on out-migration flows by including the log of the population size in Mexican state j (in thousands), ($\ln(POP_{j,t-1})$). Although labor supply shocks account for about one-third of observed out-migration from Mexico during 1977–2000, their impact is expected to be lower in the recent period following the dramatic decline in fertility in Mexico since the 1970s (Hanson and McIntosh 2010).

As for environmental and climatic variables, ($CLIM_{j,t-1}$), following Beine and Parsons (2015), we distinguish between short-run unexpected natural disasters and deviations from long-run averages. In the Mexican context, several studies have stressed the importance of climatic factors on migration (Chort 2014; Munshi 2003; Pugatch and Yang 2011). As for unexpected natural disasters, we include variables for the number of hurricanes, measured at the Mexican state level, and their intensity. Indeed, Robalino et al. (2015), in their study on Costa Rica (which shares frequent extreme weather events with Mexico and other Central American countries), found a different impact of weather events on migration depending on their intensity. Focusing on the U.S. side of the Gulf of Mexico, Curtis et al. (2015) found an intensification of migration flows in response to Hurricanes Katrina and Rita in 2005. We also consider deviations in long-term averages of yearly precipitations (see the Data section for more details on the construction of the climatic variables). Interestingly, Beine and Parsons (2015) found a significant effect of climatic factors on international migration only when conditioning upon origin countries' characteristics. In the Mexican context, Nawrotzki et al. (2013) found evidence of drought-driven migration from dry states. We build on this literature and account for the potentially heterogeneous effects of climatic factors by considering separately rainfall shocks during the rainy season (from May to October) and dry season.

In addition, we investigate the impact of violence in origin Mexican states by including the log of the number of homicides in Mexican state j in year $t-1$ divided by the total population of the state, ($\ln(HOM_{j,t-1})$). Although homicides had been steadily declining through the 1990s and the mid-2000s in Mexico, drug-related violence sharply increased after 2007 (Heinle et al. 2014) and has been found by Rios Contreras (2014) to explain a large part of migration flows from Mexican border states.

[1] We include an interaction term between our GDP variable and a dummy variable equal to 1 for years 2003 to 2012, accounting for the 2003 change of the definition of state-level GDP aggregates by the Mexican *Instituto Nacional de Estadística y Geografía* (INEGI).

[2] Following Durand et al. (2001), historical migrant-sending states are Aguascalientes, Colima, Durango, Guanajuato, Jalisco, Michoacán, Nayarit, San Luis Potosí, and Zacatecas.

Finally, to partially capture the impact of a change in the attractiveness of other potential destinations that are not in our data set—that is, other Mexican states[3]—we include in the set of regressors a variable that, for each origin state j, is equal to the log of the mean value of the GDP per capita in all other Mexican states weighted by the geographical distance to state j.[4] Similarly, to capture spatial correlations across Mexican states in non-economic dimensions, such as violence, we include in our model a variable that, for each origin state j, is equal to the log of the mean distance-weighted rate of homicides in all other Mexican states.[5]

Because of obvious endogeneity concerns, migration flows at time t are related to the lagged values of explanatory variables.

Following Beine and Parsons (2015), and exploiting the longitudinal dimension of our data, we control for a rich structure of fixed effects to partially capture the unobserved factors affecting bilateral migration flows. All regressions include (1) Mexican state dummy variables that account for all time-invariant, origin-specific unobserved factors that may affect migration outflows (or return flows); and (2) U.S. state × year dummy variables that capture both time-invariant and time-variant host-specific characteristics likely to explain migration inflows, notably economic factors (income, either GDP per capita or wages) and state-specific changes in immigration policies. In addition, through these fixed effects, we can account for some of the multilateral resistance factors to migration.[6]

We estimate the earlier equation with Poisson pseudo-maximum likelihood (PPML). Using the PPML estimator, we avoid the problem of log-linearization, which leads to inconsistent estimates in the presence of heteroskedasticity (Santos Silva and Tenreyro 2006). Moreover, the PPML estimator performs well even with a large share of zeros in the data (Santos Silva and Tenreyro 2011). In our data, the share of bilateral corridors with zero flows tends to decrease over time, reflecting the diversification of both origins and destinations of Mexican migrants. However, at the end of the period, it is still close to 50 %.

We test the robustness of our results to a different structure of fixed effects by controlling for year and Mexican state × U.S. state pair dummy variables (see upcoming Table 3, column 2). In addition, we reestimate our model with ordinary least squares (OLS) using the log emigration rate from j to k as our dependent variable

[3] Bertoli and Moraga (2013) referred to this phenomenon as a "multilateral resistance factor," in analogy with the trade literature (Rose and Van Wincoop 2001). This concept captures the fact that bilateral migration flows between j and k depend not only on the relative attractiveness of origin state j and destination state k but also on the attractiveness of all other destinations. For example, an improvement of employment prospects in Durango may create incentives for individuals from the neighboring state of Zacatecas to migrate to Durango rather than to any U.S. state.

[4] Formally,

$$\ln\left(GDP\ MEX_{j,t-1}\right) = \ln\left(\sum_{l\neq j}\frac{w_{jl}}{wj}GDP_{l,t-1}\right),$$

where $GDP_{l,t-1}$ is the GDP per capita of Mexican state l at time $t-1$; $w_{jl} = \frac{1}{ln\left(d_{jl}\right)}$, with d_{jl} the great circle distance between the capital cities of Mexican states j and l; and $w_j = \sum_{l\neq j} w_{jl}$, following the trade literature (Xu and Wang 1999).

[5] Weights for distance are the same as for the mean GDP variable described in footnote 4.

[6] By choosing to focus on migration push factors, and including origin and destination × year fixed effects, we cannot capture all time-varying, origin-specific multilateral resistance factors. However, we account for the origin-specific, time-invariant attractiveness of all other destinations as well as the time-varying attractiveness of all destinations common to all origin states.

(results shown in Online Resource 1, Table S3). Indeed, the structure of fixed effects needed to fully account for multilateral resistance is less demanding with OLS (Beine et al. 2016). OLS estimation results are very similar to our main results presented in upcoming Table 2, making us reasonably confident that neither the structure of fixed effects included in our main specification nor the choice of the PPML estimator drives our results.

The same equation is adapted to the modeling of return migration flows from the United States to Mexico, the dependent variable being the gross return migration flow from U.S. host state k to Mexican state j at time t, and all other variables being the same as defined earlier. We choose to focus on the determinants of return migration flows measured in Mexico: all independent variables and the structure of the fixed effects included in the model are the same as in the out-migration equation.

Finally, we investigate the potentially different impact of migration determinants before and after the crisis by interacting our explanatory variables of interest with a post-2007 dummy variable.

Data

Immigration and return migration flow data used in this study are constructed from the EMIF surveys.[7]

The EMIF Data

The EMIF data have been collected since 1993 at different points of the Mexico-U.S. border and aim to provide a representative picture of the flows of Mexicans crossing the border in either direction. The EMIF data are not administrative data collected by customs authorities: individuals were surveyed in Mexico at transit points (such as bus or train stations) located in the main Mexican border cities, thus allowing a good coverage of undocumented flows. Several filters in the questionnaires are aimed at selecting the populations of interest: that is, Mexican migrants to the United States (excluding border dwellers) or return migrants. In addition, survey areas have changed over the years to reflect the observed changes in migration patterns.[8] The survey design relies on a multistage probability, spatiotemporal sampling frame, wherein geographical and time units are chosen interactively. The sampling of geographical units (cities, zones, and crossing points) is based on prior studies on the characteristics of Mexican migration flows, and more specifically on the probability proportionate to the size of migratory flows in the area. Further details on the survey design and the computation of the sampling weights are provided on the EMIF website.[9] Each individual questionnaire is then assigned a sampling weight that accounts for this multistage sampling frame, which we use to construct aggregate flow variables.

[7] Details on the survey can be found online (http://www.colef.net/emif/eng/).

[8] The survey design is explained in detail in each yearly report provided by the EMIF team, available online (http://www.colef.mx/emif/publicacionesnte.php).

[9] http://www.colef.net/emif/diseniometodologico.php

Rendall et al. (2009) conducted a detailed evaluation of the representativeness of the EMIF data. The authors compared estimated migration flows from the EMIF and from other available data sources (the 1997 *La Encuesta Nacional de la Dinámica Demográfica* (ENADID), the 2000 U.S. Census, and the 2001–2004 American Community Survey (ACS)). First, the authors found that the EMIF unambiguously provides a better coverage of Mexican migrants than U.S. data sources: estimates of emigration flows from the EMIF are substantially larger than those obtained from the U.S. Census and the ACS. However, as Rendall and colleagues noted, the best benchmark survey to assess the representativeness of the EMIF data is the 1997 ENADID, which collected information on all return migrants from the United States. With regard to return migration, they found very similar male flow size in the EMIF and the ENADID, but the EMIF estimates of male emigration to the United States are 33 % lower than the ENADID. This difference may be partly due to the absence of air travelers in the EMIF (data on air travelers are available since 2009 for return migrants only), which suggests that legal migrants may be underrepresented in the EMIF data.[10] Note, however, that Rendall et al. (2009:38) concluded that the EMIF "represents reasonably well the geographic origins of Mexico's migrants to and from the US," which is a crucial point for us given that we use information collected on both the state of origin and the state of destination of migrants to construct our state-to-state flow matrix.

The original design of the EMIF, although particularly adequate to the measurement of flows, raises several other issues, noted by Carriquiry and Majmundar (2013). First, the construction of the survey weights is such that weighted data are representative of flows passing through surveyed localities and sampling zones only. However, the choice of these localities and sampling points is based on careful qualitative survey to ensure a high level of coverage of Mexico-U.S. migration flows. By focusing on a relatively small number of localities accounting for the largest part of migrant flows, the survey ignores the very small percentage of migrants crossing the border at unusual locations. This feature of the EMIF survey would lead to biases in our migration flow data only if migrants transiting through unusual crossing locations come from different Mexican states and intend to go to different U.S. states than migrants covered by the EMIF. We thus expect such biases, if any, to lead us to underestimate nonstandard flows—that is, flows from new origin states to new destinations. We discuss this point later, in the section Mexican Immigration to the United States. Second, people traveling in groups may not be adequately captured in the EMIF, particularly when they are part of the same household. Indeed, in such cases, the family head may be the most likely to be interviewed, with other family members being treated as accompanying persons in the questionnaire. This feature of the data may explain the result by Rendall et al. (2009), who showed that when compared with the ENADID data, female and young adults' emigration flows are underrepresented in the EMIF. In the following empirical analysis, we choose to focus on male flows because the evaluation of the survey

[10] As Carriquiry and Majmundar (2013) noted, the fact that survey weights are not adjusted for nonresponse suggests that the EMIF data may underrepresent illegal migrants, who are less likely to respond than legal ones. The resulting bias, if any, is indeterminate. However, we check the robustness of our results by running regressions on undocumented male Mexico-U.S. flows only. The results for undocumented flows (available upon request) are very close to those presented in this article. We are thus quite confident that potential deviations from random sampling due to the original survey design do not significantly bias our results and, in the worst case, would lead us to underestimate the effects or our variables.

coverage by Rendall et al. (2009) suggested that migrant women are underrepresented in the EMIF.[11] We further test the robustness of our results on flows of men aged 30 and older, which is the group the most accurately covered by the EMIF. Results are very similar to those obtained on total male flows, suggesting that the potential deviation from random sampling due to people traveling in groups does not bias our results (results available upon request).

Construction of the State-to-State Flow Matrix

As of this writing, 15 waves of the EMIF survey are available: 1995 and 1999–2012.[12] We use information on the state of origin and destination of all surveyed individuals to construct a matrix of aggregate yearly migration flows from Mexican states to U.S. states and return flows of Mexican immigrants from U.S. states to Mexican states. The origin of individual i is here defined as the state of last residence in Mexico (respectively, the United States for return flows), and the destination is the self-declared state of destination of individual i, either in the United States for outward flows or in Mexico for return migrants. Each individual observation is then weighted using the EMIF sampling weights to ensure the representativeness of our constructed flows. We also exploit information on gender, age, and education to construct specific subflows.

Data on hurricanes are obtained from the Historical Hurricane Tracks tool developed by the U.S. National Oceanic and Atmospheric Administration (NOAA).[13]

In addition, we use satellite data from the Tropical Rainfall Measuring Mission (TRMM) to construct state-level variables capturing deviations in precipitations from long-term averages (for a detailed description and examples of use of the TRMM data, see Baland et al. 2012; Libois 2016). We apply the same strategy as in Chort (2014) and Pugatch and Yang (2011) and create state-level yearly normalized rainfall variables (rainfall z scores).

State-level data on population,[14] income, agriculture, and crime for Mexico come from the *Mexican Instituto Nacional de Estadística y Geografía* (INEGI).[15]

Summary Statistics

Our matrix is made of 1,632 pairs of U.S.-Mexican states. We exploit 14 waves of the EMIF survey and have a total of 22,848 observations, including zero cells. We drop from our sample all the corridors exhibiting zero migration flows throughout the 1995–2012 period.[16] We use these data to construct maps of Mexico-U.S. state-to-state migrations, which provide a clear illustration of the changes in the Mexico-U.S. regional migration patterns since the mid-2000s, consistent with recent studies (Riosmena and Massey 2012). Indeed, we observe a double shift in migration patterns

[11] The results presented here are robust to using total flow data.

[12] We drop year 2003 for lack of information on the U.S. state of destination.

[13] More information on the Historical Hurricane Tracks can be found online (http://www.csc.noaa.gov/hurricanes/).

[14] Population values are linearly extrapolated for missing years.

[15] Read more at the INEGI website (http://www.inegi.org.mx/).

[16] According to Santos Silva and Tenreyro (2006), estimates obtained with the PPML method are rather insensitive to the restriction of the sample to nonzero flows.

with both the diversification of origin states and the emergence of new destinations in the United States. Maps for outflows and returns from 2010 to 2012 are shown in Figs. 1 and 2; maps for the previous periods are presented in Online Resource 1.[17]

Finally, Table 1 shows the sharp decline in Mexico-U.S. male migration flows after the 2008 crisis, following the jump of the first half of the 2000s, consistent with previous studies (Passel et al. 2012; Villarreal 2014). Table 1 also suggests that return flows outnumber out-migration flows after 2009. However, a change in the flow series has occurred in 2009, given that the EMIF has been extended to airports, in order to include migrants flying back to Mexico (column 3). In the following analysis, we consider total return flows, including airport passengers. Time fixed effects capture the effect of the change in the definition of our dependent variable in 2009.

Summary statistics are presented in Tables S1 and S2 in Online Resource 1.

Results

Mexico-U.S. Flows

Estimation results for Mexico-U.S. flows are shown in Table 2. The dependent variable is the migration flow (in level), and all specifications are estimated using the PPML estimator. Column 1 presents the basic specification; column 2 explores the heterogeneity in the impact of climatic variables depending on the meteorological season; column 3 controls for unemployment at origin to better proxy for labor market conditions; column 4 investigates the differential effect of income on migration depending on state migration history, which is assumed to partly capture the strength of migration networks; and column 5 investigates how the impact of violence varies across regions.

Results on dyadic variables all have the expected sign: distance leads to a decrease in migration flows, and sharing a common border and networks increase bilateral flows. Migration networks in particular are found to have a strong and significant impact. The variable has been constructed so that it depends positively on the historical migration rate and negatively on the distance between Mexican and U.S. states. When considering the average value of the network variable, 1 standard deviation more means an increase by 89 % and translates into an increase in migrant flows by about 98 %.

More surprising at first is the sign of the coefficient on GDP per capita variable. Whereas research on international migration in general has found a negative impact of income at origin on migration outflows (Grogger and Hanson 2011), our results suggest the opposite. However, whereas other studies have focused on country-to-country flows, our results are obtained at the infra-country level and are not directly comparable. The elasticity of migration flows to GDP at origin is found to be between 2 and 2.5. The elasticity is somewhat smaller after 2003 than for the 1995–2003 period.[18] Thus, after controlling for the average level of the GDP per capita at origin, we find that economic growth in Mexico has a positive impact on out-migration. The average

[17] See the online version of this article for color depictions of Figs. 1 and 2.

[18] As noted earlier, we interact the GDP variable with a dummy variable for the post-2003 period in order to account for the change in 2003 in the definition of the GDP aggregate used by the INEGI.

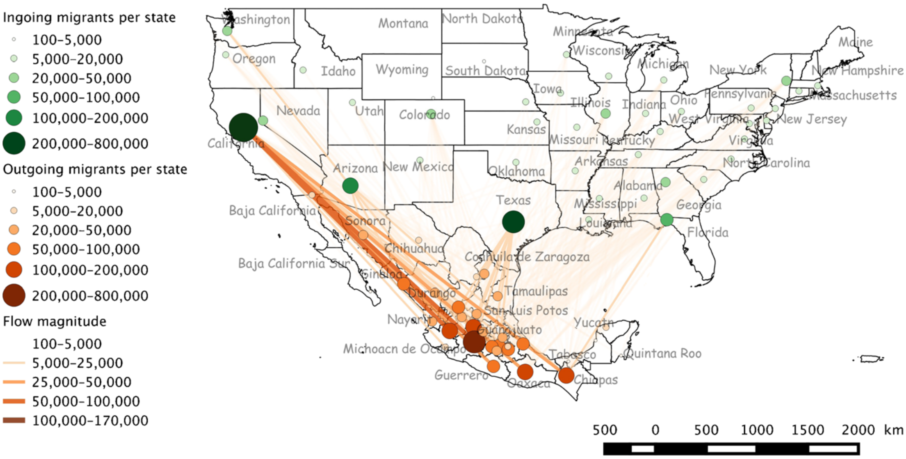

Fig. 1 Mexico-U.S. total migration flows in 2010, 2011, and 2012

growth rate of the GDP per capita in Mexican states over the period is 1.97 %, implying a 4 % to 5 % increase in migration outflows.

This result may be explained by the coexistence of high migration costs and limited access to credit: growth has a positive impact on migration by relaxing credit constraints. This finding may also be consistent with the predictions of the world systems theory (with applications to Mexico; see, for example, Alvarado and Massey 2010; Massey and Espinosa 1997).

Our estimates shown in column 4 tend to support the interpretation in terms of credit constraints, consistent with the theory of social capital (Massey and Espinosa 1997). Indeed, because networks may contribute to relaxing credit constraints by lowering migration costs (Massey 1988; McKenzie and Rapoport 2010; Orrenius and Zavodny 2005), we interact the GDP per capita with a dummy variable that equals 1 for historical migrant-sending Mexican states (following Durand et al. 2001). We find that income at origin, proxied by the GDP per capita, has a stronger impact on migration

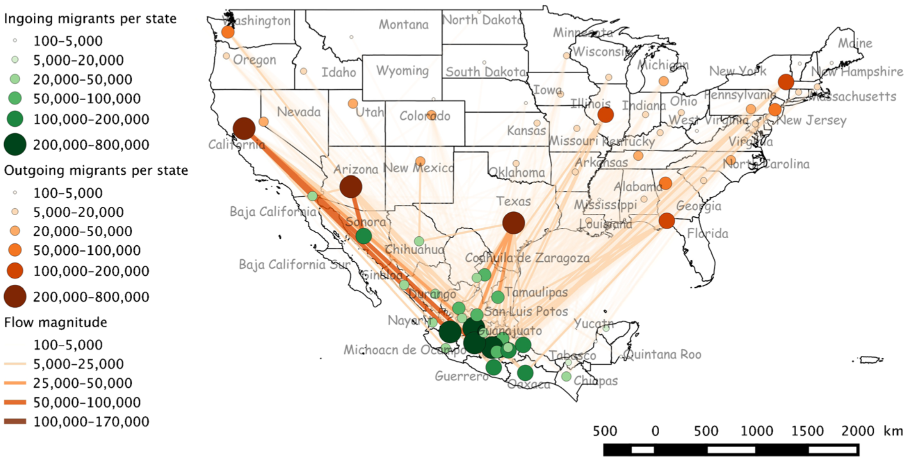

Fig. 2 U.S.-Mexico total migration flows in 2010, 2011, and 2012

Table 1 Evolution of Mexico-U.S. migration flows

Year	Male Outflow Size	Male Return Flow Size	Male Return Flow Size (airports)
1995	399,173	435,610	
1999	429,695	361,542	
2000	362,326	314,425	
2001	303,204	607,411	
2002	618,515	490,863	
2004	429,587	326,326	
2005	601,318	346,442	
2006	730,496	421,606	
2007	750,919	471,217	
2008	608,272	511,555	
2009	517,693	711,576	206,084
2010	367,489	370,943	183,700
2011	230,742	315,242	140,700
2012	228,040	259,689	113,072

Source: EMIF data, authors' calculations.

from nonhistorical states:[19] potential migrants are expected to be able to rely on weaker networks than emigration candidates from historical states, suggesting that migration networks tend to be substitutes to economic capital and/or education (McKenzie and Rapoport 2010). Because previous research has suggested that migration responds nonlinearly to income variations (see, e.g., De Haas 2010), in an additional specification (results available upon request), we test for potential nonlinear effects of income by grouping Mexican states according to their quartile of GDP per capita in 1995 and interacting the GDP variable for each quartile with the historical state dummy variable. We indeed find contrasted results, depending on states' migration history. For new migration states, income is found to have a more positive impact on out-migration from poorer states. However, the result is the opposite for historical migration states: the impact of income growth is negative for the poorest states, although not significantly different from zero for richer states. These results further confirm the role of networks in reducing migration costs. The coefficients on the distance-weighted mean of the GDP per capita in all other Mexican states are positive in all specifications. Growth in other Mexican states does not seem to divert flows away from international routes but instead tends to increase migration flows to the United States.

We find a negative and significant impact of violence, measured by the log share of homicides in the total population of the state, on outward migration. Violence in other Mexican states is also found to negatively affect migration, although not significantly in most specifications. What was known for Mexico as a whole over the 1979–2003 period (Alvarado and Massey 2010) is further confirmed at the more disaggregated

[19] The coefficients on the GDP per capita for historical and new migration states are significantly different at the 1 % level.

Table 2 Determinants of state-to-state male Mexico-U.S. migration flows: PPML estimation

	Dependent Variable: Migration Flows (in level)				
	(1)	(2)	(3)	(4)	(5)
ln Distance Between Capitals	–2.774**	–2.767**	–2.637**	–3.584**	–2.839**
	(0.65)	(0.64)	(0.73)	(0.67)	(0.64)
Common Border	0.867**	0.873**	0.853**	0.889**	3.762*
	(0.27)	(0.27)	(0.27)	(0.27)	(1.57)
ln Network	1.113**	1.111**	1.107*	0.253	1.141**
	(0.38)	(0.36)	(0.52)	(0.56)	(0.36)
ln GDP per Capita (lag 1)	2.108**	2.094**	2.569**		2.150**
	(0.54)	(0.52)	(0.55)		(0.53)
ln GDP per Capita (lag 1) × Post-2003	–0.678**	–0.665**	–0.697**		–0.654**
	(0.14)	(0.14)	(0.14)		(0.14)
ln Weighted Average GDP per Capita Other Mexican States (lag 1)	19.633*	19.000*	20.214**	11.543	18.934*
	7.76	(7.61)	(7.21)	(7.89)	(7.48)
ln Share of Homicides (lag 1)	–0.286**	–0.269**	–0.231*	–0.226**	–0.217†
	(0.08)	(0.08)	(0.10)	(0.07)	(0.11)
ln Weighted Average Share of Homicides Other Mexican States (lag 1)	–3.421†	–3.026	–2.576	–2.401	–3.395†
	(1.83)	(1.90)	(1.99)	(1.84)	(1.99)
ln Population (in thousands) (lag 1)	1.895†	1.831*	2.697†	1.586*	1.719†
	(0.98)	(0.91)	(1.47)	(0.70)	(0.91)
Number of Hurricanes and Tropical Storms (lag 1)	0.082	0.052	0.080	0.059	0.035
	(0.07)	(0.06)	(0.07)	(0.06)	(0.06)
Hurricane Maximum Intensity (lag 1)	–0.040	–0.038	–0.052	–0.045	–0.037
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Yearly Rain Anomalies (*z* score) (lag 1)	–0.018				
	(0.03)				
Rain Anomalies During Rainy Season (*z* score) (lag 1)		0.001	–0.036	–0.007	0.001
		(0.03)	(0.03)	(0.03)	(0.03)
Rain Anomalies During Rainy Season (*z* score) (lag 1)		–0.092**	–0.065*	–0.061**	–0.076**
		(0.02)	(0.03)	(0.02)	(0.02)
Unemployment Rate (lag 1)			0.036		
			(0.03)		
ln GPD per Capita (lag 1) × Historical Mexican State				0.352	
				(0.80)	
ln GPD per Capita (lag 1) × Post-2003 × Historical Mexican State				–0.725**	
				(0.13)	
ln GPD per Capita (lag 1) × New Mexican State				2.721**	
				(0.61)	
ln GPD per Capita (lag 1) × Post-2003 × New Mexican State				–0.707**	
				(0.14)	
ln Share of Homicides (lag 1) × Common Border					0.321†
					(0.18)
ln Share of Homicides (lag 1) × High Risk of Kidnapping State					–0.264*
					(0.12)

Table 2 (continued)

	Dependent Variable: Migration Flows (in level)				
	(1)	(2)	(3)	(4)	(5)
Constant	–112.974**	–106.609**	–117.573**	–54.017	–107.572**
	(39.62)	(38.50)	(36.57)	(36.02)	(37.70)
Mexican State Fixed Effects	Yes	Yes	Yes	Yes	Yes
U.S. State × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
R^2	.765	.768	.772	.778	.769
N	15,667	15,667	13,435	15,667	15,667

Notes: Standard errors, clustered at the Mexican state–U.S. state pair level, are shown in parentheses. Historical migrant-sending Mexican states are as follows: Aguascalientes, Colima, Durango, Guanajuato, Jalisco Michoacán, Nayarit, San Luis Potosí, and Zacatecas (Durand et al. 2001). "New Mexican states" refers to all states other than the listed historical ones. States with a high risk of migrant kidnapping are as follows: Veracruz, Tabasco, San Luis Potosí, and Chiapas (*Comisión Nacional de Los Derechos Humanos* 2011).

$^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$

state level. An explanation for this result is that a surge in violence is expected to be correlated with a deterioration of the economic environment, which may not be fully captured by aggregate economic measures, such as GDP. If individuals are credit-constrained (which is suggested by our results for GDP), violence may have a negative impact on their capacity to finance migration costs and may explain why outward migration flows are lower when violence at home increases. This interpretation in terms of credit constraints is also confirmed by the smaller coefficient on the homicides variable for educated migrants than uneducated ones (see Table 3, columns 4 and 5), suggesting that violence has a larger negative impact on the migration of the most vulnerable individuals. However, violence could also make traveling riskier. Southeastern states of Mexico are infamous for kidnappings and robberies targeting migrants. Roads and railways leading to the Northern border are subjects to frequent attacks by gangs. Such a risk should nonetheless play a smaller role if travel distance within Mexico is small. Indeed, the analysis of Rios Contreras (2014), focused on border towns, found a positive impact of violence on Mexican migration to the United States. We thus allow the violence variable to have a different effect for states characterized by a high number of reported cases of migrants' kidnapping and for pairs of Mexican and U.S. states which share a common border. Column 5 in Table 2 includes interactions of the log share of homicides with a common border dummy variable, and with a dummy variable signaling states with a high risk of kidnapping, which we identify using the reported cases of kidnapping as compiled by the *Comisión Nacional de Los Derechos Humanos*.[20] Consistent with the aforementioned interpretations, we find that

[20] These states are Veracruz, Tabasco, San Luis Potosí, and Chiapas, which are regularly mentioned for their high number of kidnappings (*Comisión Nacional de Los Derechos Humanos* 2011). Tamaulipas is also known for a high level of violence, but its effect is captured by the interaction with the dummy variable for common border.

violence has a positive and significant impact on migration between Mexican-U.S. bordering states. Moreover, violence has a stronger negative impact on migration from states with a high risk of kidnapping. In the rest of the country, the effect of violence is negative but less significant.

Regarding climatic variables, column 1 in Table 2 suggests that deviations in yearly precipitations have a negative albeit small and nonsignificant impact on migration flows. The relationship between rainfall shocks and outward migration is further explored by separately investigating the impact of precipitations during the rainy and the dry season. We find no significant effect of rain anomalies on migration during the rainy season. However, we find a negative and significant effect during the dry season, which is consistent with drought-driven migration: lower-than-average precipitations in the dry season increase migration flows. We find that hurricanes have a positive but not significant impact on migration flows.

Finally, as appears in column 3 of Table 2, the unemployment rate at home does not have a significant impact on migration outflows.

In Table 3, we test the robustness of our results to different structures of fixed effects, exploring the potential heterogeneity in the impact of income on migration, depending on education. In the first two columns, the dependent variable is the size of male flows, while the structure of fixed effects changes. The specification shown in column 1 is the same as that of column 2 in Table 2. In column 2 of Table 3, year fixed effects and Mexican state–U.S. state pair fixed effects are substituted to the initial set of fixed effects. Because the impact of dyadic variables is captured by pair fixed effects, these variables are excluded from the specification estimated in column 2. The comparison between columns 1 and 2 of Table 3 suggests that our results are robust to changes in the structure of fixed effects, and in particular are not driven by unobserved, time-invariant characteristics of migration corridors—or, put differently, that our three dyadic variables capture most of the specificities of migration corridors.

The last three columns of Table 3 separately investigate the impact of migration push factors on the flows of low- and high-educated migrants. Columns 3 and 4 present results for the flows of migrants with at most lower secondary education, with different structures of fixed effects, and column 5 shows results for the flows of migrants with higher secondary education with year and pair fixed effects.[21]

Results shown in Table 3, columns 3–5 suggest that income at origin has a positive impact on the flows of low-educated migrants only. This finding supports our interpretation of the positive impact of income on migration flows, shown in Table 2, in terms of credit or liquidity constraints, given that those constraints are less likely to bind for the most educated. We find that the distance-weighted GDP per capita in other Mexican states has a significant positive impact on migration flows of those with low education but does not significantly affect migration of the most educated. We also find that rain anomalies during the dry season significantly affect migration only for those with low education, suggesting that drought-driven migration is specific to the most vulnerable categories of the population, although flows of high-educated migrants are

[21] Given the relatively low proportion of high-educated migrants, resulting in a large proportion of zero cells, estimation with Mexican state and U.S. state × year fixed effects did not converge. However, we are confident that results are not driven by the structure of fixed effects because for total and low-educated migration flows, results are very similar whatever the type of fixed effects included. For the same reason, we could not consider the very small flows of migrants with tertiary education.

Table 3 Determinants of state-to-state male Mexico-U.S. migration flows: PPML estimation

	Dependent Variable: Migration Flows (in level) for:				
	All (1)	All (2)	(3) Low Education	(4) Low Education	(5) High Education
ln GDP per Capita (lag 1)	2.094**	2.398**	2.250**	2.615**	0.491
	(0.52)	(0.65)	(0.57)	(0.69)	(0.55)
ln GDP per Capita (lag 1)	–0.665**	–0.782**	–0.682**	–0.827**	–0.726**
× Post-2003	(0.14)	(0.17)	(0.16)	(0.19)	(0.13)
ln Weighted Average GDP per Capita	19.100*	21.667**	23.428**	26.032**	–3.094
Other Mexican States (lag 1)	(7.61)	(8.30)	(7.75)	(8.47)	(8.27)
ln Share of Homicides (lag 1)	–0.269**	–0.268**	–0.302**	–0.294**	–0.246*
	(0.08)	(0.08)	(0.08)	(0.09)	(0.11)
ln Weighted Average Share of	–3.026	–3.244	–3.162	–3.290	0.078
Homicides Other Mexican States (lag 1)	(1.90)	(2.06)	(2.18)	(2.45)	(1.84)
ln Population (in thousands) (lag 1)	1.831*	1.990†	2.551*	2.885*	–1.875
	(0.91)	(1.04)	(1.00)	(1.18)	(1.21)
Number of Hurricanes and Tropical Storms (lag 1)	0.052	0.044	0.051	0.041	0.160†
	(0.06)	(0.07)	(0.06)	(0.07)	(0.09)
Hurricane Maximum Intensity (lag 1)	–0.038	–0.037	–0.034	–0.034	–0.070
	(0.04)	(0.03)	(0.03)	(0.03)	(0.06)
Rain Anomalies During Rainy Season	0.001	0.019	0.020	0.040	–0.053
(z score) (lag 1)	(0.03)	(0.03)	(0.03)	(0.03)	(0.05)
Rain Anomalies During Dry Season	–0.092**	–0.096**	–0.076**	–0.077**	–0.069
(z score) (lag 1)	(0.02)	(0.03)	(0.02)	(0.02)	(0.05)
ln Distance Between Capitals	–2.767**		–2.980**		
	(0.64)		(0.70)		
Common Border	0.873**		1.007**		
	(0.27)		(0.31)		
ln Network	1.111**		1.045**		
	(0.36)		(0.39)		
Constant	–106.609**	–138.579**	–129.920**	–164.159**	23.126
	(38.50)	(40.98)	(39.33)	(41.80)	(38.69)
Mexican State Fixed Effects	Yes	No	Yes	No	No
U.S. State × Year Fixed Effects	Yes	No	Yes	No	No
Mexican State × U.S. State Fixed Effects	No	Yes	No	Yes	Yes
Year Fixed Effects	No	Yes	No	Yes	Yes
R^2	.768	.803	.758	.800	.584
N	15,667	14,980	15,494	14,518	8,946

Notes: Standard errors, clustered at the Mexican state–U.S. state pair level, are shown in parentheses. Low-educated flows are flows of migrants with, at most, some lower secondary education. High-educated flows refer to migrants who attended high school.

†$p < .10$; *$p < .05$; **$p < .01$

sensitive to the number of hurricanes. Note that the size of the coefficient on the homicides variable is somewhat larger for uneducated flows, which is consistent with both our earlier interpretation of this result and with Alvarado and Massey (2010). Finally, the population variable, capturing demographic pressure, is unsurprisingly positively and significantly correlated with migration of the low-educated only.

Return Migration

Table 4 presents the estimation results of the determinants of state-level return migration flows. The specifications are the same as in Table 2 except for the dependent variable, which is the size of return flows (in levels).[22] All specifications include Mexican state fixed effects and U.S. state × year fixed effects capturing the effect of all time-invariant factors at the Mexican state level and time-varying and time-invariant characteristics of U.S. states, including the economic downturn of 2008, or the restrictive immigration policies implemented in several states in the late 2000s. Unsurprisingly, the signs of the coefficients on our first two dyadic variables proxying for migration costs—namely, distance and contiguity—are the same as for outward flows: distance is negatively correlated with return migration, and sharing a common border increases return flows. Conversely, the coefficient on the network variable is no longer significant for return migration flows: a larger network in a given U.S. state is not found to have any impact on return migration from this state. Again, this result is not surprising because the cost-decreasing impact of migrant networks is likely to be specific to outward migration.

The impact of the GDP per capita is symmetrical to what is observed in the case of Mexican out-migration: we find that an increase in the GDP per capita of a given Mexican state negatively affects return flows from the United States to that state, with an elasticity of about 2.5, and no significant pre- and post-2003 difference. One possible interpretation could be that settling or investing in a Mexican state could be more profitable when growth is low. This finding is consistent with the literature on saving targets as a motive for return (Yang 2006) as well as with the new economics of migration, which posits that access to capital is a primary motivation to migrate (Massey and Espinosa 1997). According to Taylor et al. (1996), the acquisition of a home is one of the main motivations for Mexicans to migrate abroad. Because house prices are procyclical and decrease in time of crisis, an economic downturn at origin is expected to positively affect returns of those who migrated in order to accumulate savings to purchase a home in their origin state by allowing them to attain their saving target sooner or even overshoot their target and be able to finance a level of consumption exceeding their home earnings (Djajíc and Vinogradova 2015). These results are also consistent with migrants' relative concerns. As Akay et al. (2012) showed, the well-being of rural-to-urban migrants in China is negatively affected by the income of individuals at home. Following Durand et al. (1996), we explored in an additional specification the impact of investment opportunities at home, using the log of the volume of electricity sales as an infrastructure indicator. The coefficient on this

[22] Return flows include here air travelers since 2009 and repatriated individuals. However, results are robust to the restriction of our sample to voluntary land returns, with only marginal differences in border and network effects.

Table 4 Determinants of state-to-state return migration flows: PPML estimation

	Dependent Variable: Migration Flows (in level)				
	(1)	(2)	(3)	(4)	(5)
ln Distance Between Capitals	–3.790**	–3.801**	–4.171**	–4.267**	–3.830**
	(0.65)	(0.65)	(0.79)	(0.70)	(0.65)
Common Border	1.175**	1.176**	1.197**	1.177**	2.910
	(0.27)	(0.27)	(0.27)	(0.27)	(1.78)
ln Network	0.501	0.494	0.298	0.008	0.559
	(0.43)	(0.43)	(0.61)	(0.56)	(0.44)
ln GDP per Capita (lag 1)	–2.564**	–2.531**	–2.214**		–2.461**
	(0.59)	(0.59)	(0.65)		(0.59)
ln GDP per Capita (lag 1) × Post-2003	0.192	0.188	0.242		0.184
	(0.17)	(0.16)	(0.19)		(0.16)
ln Weighted Average GDP per Capita	–22.044*	–21.460*	–20.116†	–27.703**	–20.917*
Other Mexican States (lag 1)	(10.00)	(10.09)	(10.32)	(10.01)	(10.06)
ln Share of Homicides (lag 1)	–0.343**	–0.338**	–0.313*	–0.312*	–0.391**
	(0.12)	(0.12)	(0.14)	(0.12)	(0.13)
ln Weighted Average Share of Homicides	–5.158**	–5.200**	–5.318**	–4.744**	–5.462**
Other Mexican States (lag 1)	(1.69)	(1.66)	(1.79)	(1.58)	(1.76)
ln Population (in thousands) (lag 1)	–1.466†	–1.422†	0.098	–1.777*	–1.434†
	(0.79)	(0.79)	(1.64)	(0.76)	(0.79)
Number of Hurricanes and Tropical Storms (lag 1)	0.024 (0.08)	0.028 (0.08)	0.087 (0.09)	0.024 (0.08)	0.028 (0.08)
Hurricane Maximum Intensity (lag 1)	0.022	0.023	–0.042	0.021	0.020
	(0.04)	(0.04)	(0.06)	(0.04)	(0.04)
Yearly Rain Anomalies (*z* score) (lag 1)	–0.021				
	(0.04)				
Rain Anomalies During Rainy Season		–0.030	–0.080†	–0.034	–0.030
(z score) (lag 1)		(0.04)	(0.05)	(0.04)	(0.04)
Rain Anomalies During Dry Season		0.011	0.040	0.028	0.015
(*z* score) (lag 1)		(0.03)	(0.03)	(0.03)	(0.03)
Unemployment Rate (lag 1)			0.017		
			(0.04)		
ln GPD per Capita (lag 1) × Historical				–3.672**	
Mexican States				(0.96)	
ln GPD per Capita (lag 1) × Post-2003				0.107	
× Historical Mexican States				(0.17)	
ln GPD per Capita (lag 1) × New				–2.408**	
Mexican states				(0.62)	
ln GPD per Capita (lag 1) × Post-2003				0.123	
× New Mexican States				(0.17)	

Table 4 (continued)

	Dependent Variable: Migration Flows (in level)				
	(1)	(2)	(3)	(4)	(5)
ln Share of Homicides (lag 1) × Common Border					0.199
					(0.20)
Constant	94.552*	91.449†	85.044†	132.385**	86.377†
	(46.96)	(47.21)	(51.09)	(48.35)	(47.31)
Mexican State Fixed Effects	Yes	Yes	Yes	Yes	Yes
U.S. State × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
R^2	.880	.880	.890	.880	.879
N	16,312	16,312	13,984	16,312	16,312

Notes: Standard errors, clustered at the Mexican state–U.S. state pair level, are shown in parentheses. Historical migrant-sending Mexican states are as follows: Aguascalientes, Colima, Durango, Guanajuato, Jalisco Michoacán, Nayarit, San Luis Potosí, and Zacatecas (Durand et al. 2001). "New Mexican states" refers to all states other than the listed historical ones.

†$p < .10$; *$p < .05$; **$p < .01$

additional regressor was positive but not significant, and other results, including those for GDP, were unchanged (results available upon request).[23]

This result, however, may also be driven by the Great Recession, which caused both a decrease in the per capita GDP and massive return migration flows. We tested this hypothesis by reestimating our model without the years 2009 and 2010, and found results that were very similar to those shown in Table 4 (results available upon request.). In addition, we find no significant pre- and post-2003 difference in the impact of the GDP per capita. Neither do we find a different impact of the GDP per capita on return flows depending on the migration history of Mexican states of return, as shown in column 4, contrary to what we found for outward flows. The coefficient on the distance-weighted average GDP per capita in other Mexican states is negative and significant in all specifications: growth elsewhere in Mexico tends to decrease return flows to any given Mexican state.

The share of homicides negatively affects return flows, suggesting that the recent drug-related increase in violence observed in some Mexican states might deter Mexican migrants from coming back home. This effect is less significant but still negative after we control for unemployment. Contrary to what we found for migration outflows, climatic variables do not seem to have any significant impact on return flows: return migration is less sensitive to climatic shocks in Mexico than outward migration. Finally, unemployment rate in Mexico does not significantly affect return migration.

[23] Durand et al. (1996) used the presence of a bank in the community as an infrastructure indicator; however, we do not observe enough yearly variation in the number of banks at the federated state level in Mexico.

Mexican Immigration to the United States: The End of a Cycle?

One of the most striking and somewhat unexpected evolutions of Mexico-U.S. migration flows is the decline in net flows since the mid-2000s, which may have even become negative (Passel et al. 2012) because of the combination of lower migration inflows and more returns. Beyond the description of this double trend observed in our data (shown earlier in Table 1), the longitudinal dimension of our data allows us to explore a possible change in the determinants of migration at the end of the period under study, which may help us to understand contemporary evolutions of Mexico-U.S. flows. Because the Great Recession seems to have played a catalytic role, we interact all our variables of interest with a post-2007 dummy variable to allow for a different impact of determinants of migration outflows and returns before and after the crisis. Results are presented in Table 5, column 1 for Mexico-U.S. flows and column 2 for return flows. The effect of each variable after 2007 is read in the table by summing the coefficients on the main effect and the variable interacted with the post-2007 dummy variable. A significant coefficient on the interacted term suggests that the effect of the considered determinant has changed after 2007.

First, no significant difference is observed regarding the role of income growth after the crisis. Throughout the period, an increase in the per capita income at origin leads to more out-migration and less returns. The underlying mechanisms (discussed earlier) thus do not seem to be challenged by the crisis.

Apart from the identical impact of income growth, our results point to an important change of pattern after 2007. The positive and significant coefficient on the log distance variable after 2007 indeed suggests that the impact of distance tends to be less negative after the crisis, meaning that we observe more migrations between pairs of states that are geographically distant, but also more returns. Results on networks are particularly interesting: the impact of network on migration is positive before 2007, but it tends toward zero at the end of the period. As for returns, the impact of networks is not significant before 2007 and becomes positive after the crisis, suggesting that the geography of Mexico-U.S. migration is rapidly changing. Flows tend to reverse in historical migration corridors, with networks accelerating returns after the crisis and having a smaller impact on out-migration. Such findings are unlikely to be caused by a potential selection of sampled migrants in the EMIF survey scheme. Indeed, as noted earlier, if the focus on a few major entry points in the United States to collect the data were to introduce biases (Carriquiry and Majmundar 2013), we would expect nonstandard flows—that is, flows connecting new origins and destinations—to be underrepresented.

Although it is too early to assess the persistence of such evolutions, these findings suggest that flows are more responsive to changes in the economic climate—in origin states but also presumably at destination—in the presence of strong migration networks.

Another significant difference concerns the role of violence. Indeed, whereas an increase in violence reduced outward migration before 2007, the impact of violence tends to reverse at the end of the period. Note that after 2007, Mexico experienced a dramatic increase in violence. Contrasting with the steady decline through the 1990s and the mid-2000s, the number of recorded homicides has almost tripled at the national level between 2007 and 2010, largely due to drug-related violence (Heinle et al. 2014), with important regional variations. Were this trend to persist, we would very likely observe in the near future a positive impact of violence on out-migration.

Table 5 Determinants of state-to-state outward and return male migration flows, and interactions with post-2007: PPML estimation

	Dependent Variable	
	Mexico-U.S. Flows (1)	U.S.-Mexico Total Flows (2)
ln Distance Between Capitals	–3.037**	–4.356**
	(0.62)	(0.67)
ln Distance Between Capitals × Post-2007	0.733**	1.000**
	(0.27)	(0.35)
Common Border	0.897**	0.955**
	(0.29)	(0.33)
Common Border × Post-2007	–0.178	0.495†
	(0.23)	(0.26)
ln Network	1.179**	0.356
	(0.34)	(0.43)
ln Network × Post-2007	–0.105**	0.191**
	(0.03)	(0.07)
ln GDP per Capita (lag 1)	2.218**	–2.192**
	(0.53)	(0.57)
ln GDP per Capita (lag 1) × Post-2003	–0.783**	0.184
	(0.15)	(0.18)
ln GDP per Capita (lag 1) × Post-2007	0.482	–0.012
	(0.31)	(0.37)
ln Weighted Average GDP per Capita Other Mexican States (lag 1)	18.195*	–15.847†
	(8.00)	(9.61)
ln Weighted Average GDP per Capita Other Mexican States (lag 1) × Post-2007	1.776	2.169
	(5.40)	(7.70)
ln Share of Homicides (lag 1)	–0.700**	–0.710**
	(0.14)	(0.21)
ln Share of Homicides (lag 1) × Post-2007	0.684**	0.476**
	(0.14)	(0.17)
ln Weighted Average Share of Homicides Other Mexican States (lag 1)	–15.781**	–24.377**
	(4.67)	(6.08)
ln Weighted Average Share of Homicides Other Mexican States (lag 1) × Post-2007	16.735**	21.299**
	(4.34)	(5.83)
ln Population (in thousands) (lag 1)	2.708**	–0.961
	(0.92)	(0.78)
ln Population (in thousands) (lag 1) × Post-2007	–0.019	0.188†
	(0.05)	(0.10)

Table 5 (continued)

	Dependent Variable	
	Mexico-U.S. Flows (1)	U.S.-Mexico Total Flows (2)
Constant	–222.647**	–102.381
	(62.62)	(66.58)
Mexican State Fixed Effects	Yes	Yes
U.S. State × Year Fixed Effects	Yes	Yes
Climatic Variables	Yes	Yes
R^2	.785	.884
N	15,667	16,312

Notes: Standard errors, clustered at the Mexican state–U.S. state pair level, are shown in parentheses. Climatic variables are the same as in Table 2, column 1.

$^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$

Conclusion

This article studies the geographic, economic, climatic, and social determinants of Mexico-U.S. outward and return migration flows over the 1995–2012 period, using panel data of bilateral state-to-state flows constructed from the EMIF survey conducted at the Mexico-U.S. border.

We focus our analysis on out-migration push factors and on return migration pull factors, measured in Mexican states of origin. The unique longitudinal dimension of our data allows us to control for both time-variant and time-invariant characteristics of U.S. states through a rich structure of fixed effects. In addition, we control for dyadic factors specific to each pair of Mexican and U.S. states and likely to affect bilateral flows, such as distance, contiguity, and a measure of migration networks.

We find a positive impact of income at origin on migration outflows, which is larger for Mexican states with a recent migration history and is observed for low-educated migrants only. These results suggest the existence of credit constraints and emphasize the cost-decreasing effect of migration networks in line with social capital theories (Massey 1990; Massey and Espinosa 1997). This result, in contrast with empirical findings in studies of country-to-country flows (Grogger and Hanson 2011), is made salient by the unique disaggregation of our data at the infra-country level. Our finding of a negative effect of income on return flows supports the assumption of return migration being conditioned on the accumulation of savings abroad. As documented in the Mexican case (Massey and Espinosa 1997; Taylor et al. 1996), the acquisition of a home is a primary motivation to migrate. As a consequence, an economic downturn at origin tends to precipitate return by speeding the attainment of the savings target (Yang 2006), which is consistent with previous evidence on Mexico (Lindstrom 1996).

The 2008 Great Recession accelerated the decline in net migration flows that began in the mid-2000s (Passel et al. 2012; Villarreal 2014). The unique bilateral flow data that we use, being disaggregated at the state level, allow us to uncover some of the underlying phenomena and emphasize the connection between two recent evolutions in the geography of Mexico-U.S. migration: the diversification of origins coupled with the emergence of new destinations (Massey et al. 2010; Riosmena and Massey 2012). The trend reversal in the impact of distance and networks after 2007 indeed highly suggests that historical migration flows tend to dry up, only partly replaced by new flows, away from traditional migration corridors. Such evolutions may mark the start of a new immigration cycle, potentially leading to new migration corridors and causing net Mexico-U.S. flows to rise again after emerging networks will be strong enough to make these flows self-sustaining.

Regarding expected evolutions of Mexico-U.S. flows, the impact of income growth on flows in both directions is not significantly different after 2007. An increase in income per capita at origin still has a positive effect on outward migration and a negative impact on return flow, suggesting that net flows could rise again with a return to sustained growth in Mexico.

Our findings inform the literature on the determinants of Mexico-U.S. migration flows by showing that along with traditional geographic and economic factors, climatic and social factors contribute to shaping regional migration patterns. Consistent with previous research on Mexico-U.S. migration, (Chort 2014; Nawrotzki et al. 2013; Pugatch and Yang 2011), we provide evidence of significant drought-driven migration. If drought episodes become more frequent in the near future as a consequence of climate change, we may expect an intensification of migration outflows. As for social factors, we find that violence in origin Mexican states negatively affects both out-migration and returns. The effect on out-migration, consistent with previous studies (Alvarado and Massey 2010), is very likely explained by the fact that the number of homicides partially captures a worsening of economic conditions. Thanks to the fine-grained level of our data, we go beyond past research by showing that violence positively affects migration from border states and has the largest negative impact on migration in southeastern states where migrant travelers face the largest risk of being the victims of violence and kidnapping. We find that the dramatic surge in crime observed since the mid-2000s (Heinle et al. 2014) tends to reverse the effect of violence on out-migration at the end of the period, suggesting that it may become positive if violence in Mexico continued to increase. Finally, although climatic shocks have no impact on return flows, violence has the expected deterrent effect on returns.

A major contribution of this study is the construction of a panel database of state-to-state migration flows. Besides the analysis conducted here of the determinants of both outward and return flows and their evolution over the last 20 years permitted by the longitudinal dimension of our data, the exploitation of disaggregated flow data will contribute to research and policy information. Yearly data on state-to-state flows on such a long period may indeed be particularly useful to symmetrically analyze the impact of changes in U.S. states' attractiveness, including economic or legislative factors.

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