THE ROLE OF SOCIAL CONNECTEDNESS IN SHAPING MIGRATION PATTERNS: A CASE STUDY OF MEXICO TO THE US.

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Universidad de las Américas Puebla

Miguel Angel Alcantara Demuner

María Camila Altamirano González

Natalia Torres Paredes

María José Rojas Campos

Abstract: Migration dynamics is a complex phenomenon influenced by diverse factors such as violence, GDP, and distance, among others. Also, social networks play a big role in shaping migration patterns. This paper aims to analyze whether the existing connectivity between Mexicans and Americans influences migratory flows from Mexico to the United States. The article analyses 11 years, spanning from 2010 to 2021 and measures social connectivity using the Facebook Social Connectedness Index. The consular registration records are a proxy to measure migration. The results show that social connectedness has a positive effect on the migratory flow between the studied countries. Specifically, an increase of 1% in the Facebook Social Connectedness Index results in approximately 55,035 authorized consular cards.

Key words /palabras clave: Facebook Social Connectedness Index; consular cards; Mexico-United States migration; Índice de Conectividad Social de Facebook; matrícula consular; migración México-Estados Unidos.

Resumen: La dinámica migratoria es un fenómeno complejo en el que influyen diversos factores como la violencia, el PIB y la distancia, entre otros. Asimismo, las redes sociales juegan un papel importante en la estructuración de los patrones migratorios. Este trabajo tiene como objetivo analizar si la conectividad existente entre mexicanos y estadounidenses influye en los flujos migratorios de México a Estados Unidos. El artículo analiza 11 años, comprendidos entre 2010 y 2021. La conectividad social se mide utilizando el

Índice de Conectividad Social de Facebook. Los registros de matrícula consular son un proxy para medir la migración. Los resultados muestran que la conectividad social tiene un efecto positivo en el flujo migratorio entre los países estudiados. En concreto, un aumento del 1% en el Índice de Conectividad Social de Facebook se traduce en aproximadamente 55,035 tarjetas consulares autorizadas.

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1.Introduction

Migration is a global phenomenon that has been part of human history, driven by several factors such as the search for better economic opportunities, family reunification, escape from violence and economic instability, among others. In the case of Mexico, during the five-year period 2015-2020, it is estimated that the median age of female migrants was 25 years, while for men it was 27 years (BBVA Research, 2023). However, an increase in the number of migrant children has also been observed, highlighting the inhumane conditions migrants face in this process. Examples include human trafficking that exploits them in many ways, lack of protection and adequate care in receiving countries, among others. This phenomenon has had a significant impact on societies of origin and destination, giving rise to demographic, cultural, and socioeconomic changes.

In addition, during the above-mentioned period, a masculinity index of 208 men for every one hundred women emigrant was observed, according to BBVA Research data published in 2023. These data provide us with a perspective on migration patterns and how they are distributed between men and women. It is essential to understand the implications and dynamics of this phenomenon, as migration continues to be a relevant and complex issue today.

Mexico is an interesting country for researching migration flows towards its neighbor, the United States, because it allows us to consider the possible influence that social connectivity has on these patterns. There are two reasons why addressing this issue is important: first, because migration is rooted in structural problems such as poverty, violence, and unemployment. It persists and intensifies over time. For instance, between 2021 and 2023, there was an average monthly record of 63 thousand police border encounters with undocumented migrants (BBVA Research, 2023).

Second, this migration has been the subject of debate in the political agendas of Mexico and the United States. And even after the implementation of strategies, agreements, restrictive policies, physical barriers, and unfortunately, dehumanizing treatments that violate the human rights of migrants, migration continues to increase. In this context, this paper contributes to the literature on migration flows determinants by proposing a new perspective, namely that social connectivity might enhance migration flows from Mexico to the U.S. Social connectivity is proxied by the Facebook Social Connectivity Index (SCI), to assess the potential impact of connections between people on migration flows from Mexico to the U.S.

Despite the geographical proximity between the inhabitants of both nations, measuring social connectivity is complex. Thus, there is the need for a precise metric to measure this connectivity. In this specific context, literature has employed various metrics over time to address this challenge; however, the SCI is the most recent and innovative option. Its methodology, grounded in the tools provided by globalization, positions it as a relevant instrument to address this issue.

This study becomes relevant by addressing one of the main issues for both Mexico and the United States, integrating human and social dimensions into the traditional analysis of migration. This approach not only enriches the understanding of the phenomenon, but its results can provide valuable information for institutions responsible for monitoring and addressing migration, such as the National Institute of Migration, Mexican Commission for Refugee Aid, consular offices, among others (Gobierno de México, n.d).

For the reasons previously mentioned, the main objective of this work is to determine if the existing connectivity between Americans and Mexicans influences, in any way, migration flows from Mexico to the United States over an 11-year period spanning from 2010 to 2021. The specific objectives of the study are as follows: First, the aim is to analyze and quantify this impact and examine which states maintain the relationship between these two variables. Second, the intention is to employ the most recent measure, the Facebook Social Connectivity Index, to measure the connection between both nations. Based on these objectives, the hypothesis of this study proposes that the greater the social connectivity between two states, the higher the migratory flow from Mexico to the U.S. will be.

To address these objectives, the dataset was built including information for migration, social connectedness –measured by the Facebook SCI–, violence, FDI, trade, poverty, distance and Mexico's and United States' GDP using data at the state level. The model constructed is specified further on. Pooled ordinary least squares (POOLS) methodology was applied since the dataset is presented in the form of a panel. Additionally, the model was run using fixed effects (FE) in order to eliminate the non-observable variation that remains constant over time (fixed effect) such as the culture of each one of the states. This led to the main finding which is that social connectedness has a positive effect on migration flows between Mexican and U.S. states. Which has a magnitude of 55, 035 consular cards as the SCI increase by 1%.

The paper is organized as follows: the first section provides a literature review, the next section explains the dataset used and describes the data sources. It also presents the identification strategy. Section four shows and discusses the results. Section five discusses the limitations of the study, and the last section concludes.

2.Literature Review

The exploration of social networks and their role as determinants of migration has been insufficiently addressed in economic literature. There are still numerous gaps that must be addressed to formulate concrete policies, as the understanding of the migration phenomenon remains incomplete (Munshi, 2020). Nevertheless, recent research has incorporated the connections that individuals have both at the place of origin and destination as an influential driver of migration. Munshi (2020) incorporates into the baseline migration model, (i.e. the “Roy Model”[1]), the destination networks to highlight how social networks influence migratory decisions, the migration process, and the interactions of migrants in their new home, as well as the overall magnitude of this phenomenon. By employing the augmented Roy Model, Munshi (2020) contends that networks offer support to their members by providing essential information on employment, housing, finances, opportunities, the assimilation process, among other aspects. This support has the potential to reduce the barriers that often lead individuals to choose to remain in their place of origin. Furthermore, it is determined that, while the wage gap is positively correlated with migratory flows, research demonstrates that the most influential factor is the number of existing migrants in a specific location originating from a particular place.

Similarly, Manchin and Orazbayev (2018) examined how social networks impact people's intentions to migrate internationally and within their home countries. They analyzed data from Gallup's World Poll, which is a large, repeated cross-section, individual-level dataset conducted over multiple years in over 150 countries. The results showed that social connections both in one's

[1] Roy model was originally developed by Roy in 1951 and later popularized in 1987 by Borjas. It is a foundational model in migration which posits that and individual´s decision to migrate is determined by the wages in the place of origin, the wages at the destination and the associated costs associated, considering education and skills (Munshi, 2020).

home country and abroad were the most influential factors for migration intentions. Having close friends or relatives living in another country significantly increases someone's likelihood of planning to migrate internationally, explaining around 18% of the variability in intentions. Broad social networks also explained about 19% of the variability in intentions to migrate internationally and over 20% of the variability in intentions to migrate domestically within one's home country (Manchin and Orazbayev, 2018).

In terms of the bilateral relationship between Mexico and the United States, particularly regarding the issue of migration. Amuedo-Dorantes and Mundra (2007), found that the use of social networks, as a tool for creating and maintaining social ties in migrants, given their migration status –legal or illegal- showed no difference. But when maintaining social ties, legal migrants were more susceptible to gathering more native friends than their counterpart, meanwhile illegal migrants had more long-lasting relations with family, given that they feel closer to their communities.

Addtionally, Amuedo-Dorantes and Mundra (2007) emphasize the positive relation between family and social ties in working wages, the article demonstrates that family relations in the United States of America will increase working wages in 2.6% for illegal migrants and 8% for legal migrants on average. And for social relations this improves for illegal migrants with a 5.4% increase in working wage and 3.6% for legal migrants. Amuedo-Dorantes and Mundra (2007), point out the importance of social networks as a tool to create and maintain family and social ties, due to the impact on working wages, for both types of Mexican migrants.

Following the same logic, McKenzie and Rapoport (2007) analyze how migration networks influence the migration decisions of Mexicans to the U.S., considering origin networks and building upon Roy´s Model. Assuming that costs, which include a variety of monetized factors, decrease with the size of the community network, it is determined that the effect of the networks on the probability of individuals migrating depends on their level of education. The results indicate that in places where networks are big and strong, migration decreases as education level rises, whereas in places where networks are low, migration increases as education levels increase (McKenzie and Rapoport, 2007). These results are related to the type of migration in each community, as depending on the educational level and skills it can be determined whether it is positive or negative migration, which should be considered when stablishing policies in the United States.

Regarding the Facebook Social Connectedness Index (SCI), Bailey et al. (2018) are pioneers in using this index to measure the effects of social connectedness. Their main findings include that SCI explains trade levels, migration, and patent citations –to measure economic growth– with a positive and significant correlation. All three regressions they use have as control variables distance and SCI, as well as state/county fixed effects. Specifically, in the case of migration “Social Connectedness Index has significant explanatory power (…), beyond what is predicted by geographic distance” (Bailey et al., 2018). In other words, the effect of distance on migration can be due to the social connectedness that exists.

The Facebook Social Connectedness Index (SCI) has been previously used to predict further migration patterns. For instance, Minora et al. (2022) used Facebook SCI to forecast the countries where Ukrainian refugees will be placed. Their most important finding is that there is a positive and high correlation between the number of Ukrainian citizens residing in EU countries and the number of registrations for temporary protection –proxy for migration–. This is useful for the authorities of the countries that expect to receive immigrants as they can manage issues regarding their integration and adaptation –social and economic– to the new place.

3.Data and Method

To assess the effect of social connectedness on the migratory flows of Mexicans to the United States, a diverse array of data sources is employed to gather information and data concerning migration, social connectivity, and various determinants of migration. Specifically, consular identification cards issued in the U.S. for Mexicans are used as a proxy for migration. While social connectivity is proxied by the Facebook Social Connectedness Index (SCI).

Following Mendoza-Cota (2014), the econometric specification includes the Gross Domestic Product (GDP) of Mexico and the US, Mexican unemployment, the distance between each pair of states, Foreign Direct Investment (FDI), and the total population. Nevertheless, this work will also incorporate other variables that affect migratory flows, such as poverty, trade, and violence. It is worth noting that the data were adjusted to ensure observations for all the variables mentioned for the years 2010 to 2021. Additionally, variables as unemployment, FDI, total population, poverty, trade, and violence are considered at the state level in the Mexican republic.

3.1. Sources of information

For migration, consular identification cards are used in accordance with the Mexico's Matrícula Consular Program, which is consistent with the work conducted by other authors like Massey, Rugh and Pren (2010). These data are employed because conventional information sources, such as censuses, do not have the required level of disaggregation for this study, which entails a state-level analysis for both Mexico and the United States. This data is obtained from the Institute of Mexicans Abroad (IME), which captures the number of Mexicans registered at consular offices in each state in the US, as in the moment of registration individuals indicate their state of origin (IME, n.d.). This approach allows for a proxy to measure undocumented migrants in each state of the US, identifying the Mexican state of origin from 2010 to 2021 (Massey, Rugh and Pren, 2010).

Regarding the Facebook Social Connectedness Index (SCI), it employs anonymous data to assess the probability of individuals being "friends" on Facebook between two different people from two distinct locations (HDX, 2021). This index is a ratio, with the numerator consisting of Facebook Connections which is the overall count of Facebook friendships between people in the two specified places. Meanwhile, the denominator involves the product of Mexican Facebook users and the U.S. Facebook users. Which is expressed in the following equation:

$$Social\ Connectedness_{i,j} = \frac{FB\_Connections_{i,j}}{FB\_Users_i \times FB\_Users_j}$$

In this equation, it can be observed that the information is composed of pairs, as the index provides a number representing connections between individuals from each country with a state-level breakdown. The minimum value can be one, meaning that the larger the value, the greater the likelihood of a connection between the two locations. In this context, the subscript *i* corresponds to each of the 32 states of Mexico, while j represents each of the 52 states of the United States. It is important to note that there is no temporal information in this index; there is only one data point for each pair of states. Thus, the index it is used was last updated on December 15th, 2021.

For the variable unemployment it is used the unemployment rate, data sourced from the National Survey of Occupation and Employment (ENOE) and generated by the National Institute of Statistics and Geography (INEGI). These observations correspond to a sample restricted to individuals aged 15 and over, and have a quarterly frequency, representing a percentage of the economically active population (PEA) (INEGI, 2023a).

Population data for the years 2010 and 2020 were obtained from the National Institute of Statistics and Geography (INEGI) and are expressed in thousands of people (INEGI, n.d). For the other years, the population projection estimated by the Ministry of Economy (SE) was used (Secretaría de Economía, n.d.a). U.S. Gross Domestic Product (GDP) data for the U.S. were obtained from the Bureau of Economic Analysis (BEA) and are expressed in billions of dollars at current prices (Bureau of Economic Analysis, 2023). For each state in Mexico, GDP data were obtained from INEGI and are expressed in millions of pesos at current prices (INEGI, 2022). To calculate the distance between the capitals of each U.S. state and each Mexican state, Google Maps was used. The measurement was made considering the distance in a straight line between these geographic points.

As well as population data, violence data was obtained from the mortality statistics of the National Institute of Statistics and Geography (INEGI, 2023b). It is expressed in the number of deaths which cause was catalogued as murder.

Both for Foreign Direct Investment (FDI) and for trade, data is obtained from Data México, a data platform constructed and realized by the Ministry of Economy (SE). While FDI is measured in millions of dollars, trade is measured by the trade flow amount in millions of dollars. Both are only related to the United States and restricted to the years mentioned (Secretaría de Economía, n.d.b).

To what it refers to poverty, data was obtained from the Evaluation National Council (CONEVAL). It is measured in thousands of people, and it considers anyone who is under the poverty line (not moderate nor severe poverty). Information includes the following years: 2010, 2012, 2014, 2015, 2016, 2018 and 2020 (CONEVAL, 2022).

3.2 Methodology

As it was mentioned previously, the econometric specification includes all these variables, so the model is represented as follows:

$$Mig_{ijt} = \beta_0 + \beta_1 SCI_{ij} + \beta_2 Unemp_{it} + \beta_3 Pop_{it} + \beta_4 GDP_{jt} + \beta_5 GDP_{it} + \beta_6 Dist_{ij} + \beta_7 Violence_{it} + \beta_8 Pov_{it} + \beta_9 FDI_{it} + \beta_{10} Trade_{it} + \mu_{it}$$

Where: Mig = migration, which are the consular identification cards issued in the United States for undocumented Mexican migrants.

SCI = Facebook Social Connectedness Index.

Unemp = unemployment rate in Mexico at the state level.

Pop = total population in each state of Mexico.

GDP = Gross Domestic Product, both for Mexico and for the United States.

Dist = distance between each state of Mexico with each state of the United States.

Violence = rate of violence in Mexico at the state level.

Pov = rate of poverty in Mexico, at the state level.

FDI = Foreign Direct Investment in Mexico.

Trade = trade flow in Mexico.

While the subscript *i* represents each of the states of Mexico, the *j* indicates each state of the U.S., and the *t* corresponds to the specific year so $t = 1$, will be the first year under analysis (2010), $t = 2$ will be 2011 and so on until 2021.

In this way, the following procedure is followed in order to estimate the effect of the social connectedness on Mexican migration flows to the United States from 2010 to 2021. Firstly, a database was constructed comprising all variables involved in the model, which is considered as a panel dataset as it contains information for each state in Mexico for the 11 years studied in this work. Secondly, an estimation is carried out using Pooled Ordinary Least Squares (POLS) with the aim of testing the proposed hypothesis and determining if there is a relationship with the theory.

Finally, the econometric model is estimated by adding two more variables to control for the time and each states' fixed effects, as will account for the economic conditions of each year and state. So, the econometric representation will look as follows:

$$Mig_{ijt} = \beta_0 + \beta_1 SCI_{ij} + \beta_2 Unemp_{it} + \beta_3 Pop_{it} + \beta_4 GDP_{jt} + \beta_5 GDP_{it} + \beta_6 Dist_{ij} + \beta_7 Violence_{it} + \beta_8 Pov_{it} + \beta_9 FDI_{it} + \beta_{10} Trade_{it} + \gamma_i + \gamma_j + \tau_t + \mu_{it}$$

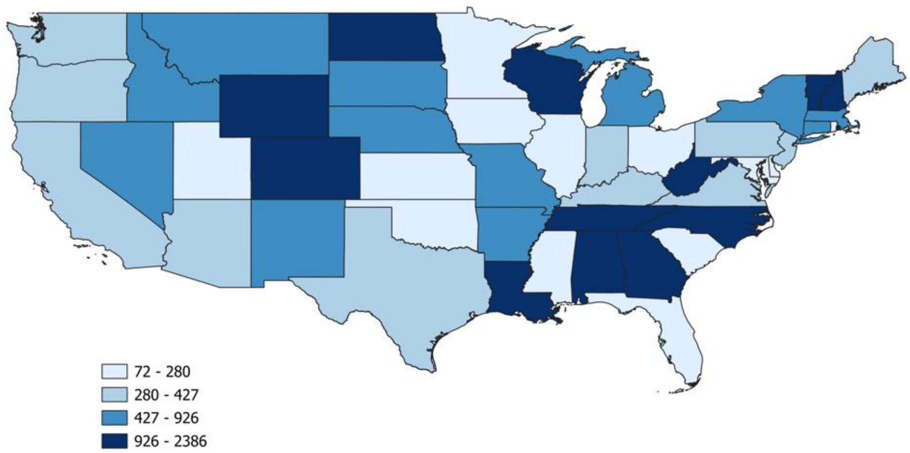
Where the variables are the same as the previous formula but adding three terms; γ_i, that represents the fixed effects for each state of Mexico while γ_j the fixed effects for each state of the United States, finally τ_t stands for the fixed effects for each year.

It is also worth noting that the SCI used in the estimations will not be the real values. As this index only considers the number of connections between the two states, taking into account the number of Facebook users, but don´t considers the fact that in places where the territory and the population is larger there will be more users and simultaneously more connections and friendships in Facebook. For this reason, to control for this variation among the states, the SCI is adjusted with the total population of each of the Mexican states.

In addition, below it is graphically represented the relation analyzed in this study in two maps of the contiguous United States territory, reflecting the variables of interest. The first map (Figure 1) measures the average Social Connectivity Index between Mexico and the U.S. across the 32 states of the Mexican Republic with each state in the U.S. Meanwhile, Figure 2 gauges the average number of Consular Identification Cards issued in the U.S. for Mexicans from the 32 states of the Mexican Republic with each state in the U.S.

Figure 1

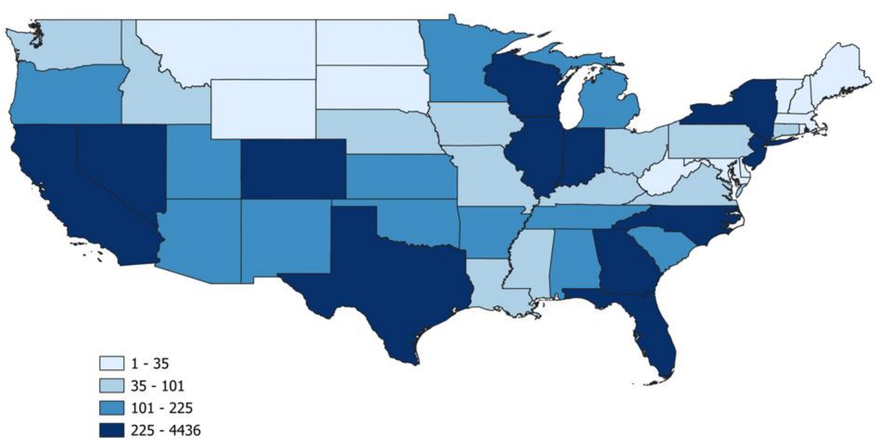
Average Social Connectivity Index between Mexico and the U.S. across the 32 states of the Mexican Republic with each state in the U.S.



Notes: authors' elaboration with software QGIS using data from HDX, 2021.

Figure 2

Average number of Consular Identification Cards issued in the U.S. for Mexicans from the 32 states of the Mexican Republic



Notes: authors' elaboration with software QGIS using data from IME, n.d.

It can be observed that certain states, such as –Michigan, Wisconsin, North Carolina, Arkansas, among others-, display a comparable intensity in the average Social Connectedness

Index and the number of consular identification cards issued. More thoroughly, the maps can indicate that in states where there is a high average of social connectivity index, there is also a high average of consular identification cards issued. Similarly, in these states with similar average intensities, when there is a low average of Social Connectedness Index, there is also a low average number of Consular Identification Cards issued.

It is important to acknowledge that there are some key states - Texas, California, Florida, among others- that should follow these relationship –high Social Connectedness Index states have high Consular Identification Card emissions-, but there are some external factors that affect this relationship, which will be address and discussed in the limitations section.

Table 1 presents the descriptive statistics of the data. The number of consular identification cards each state received on average each year during the study period is 492.36, nevertheless the standard deviation indicates that the data is highly dispersed around the mean. Mexican states had on average 1,689.86 thousands of people living in poverty, 886.10 murders per year and around 4.11 percentage of the population were unemployed during the time span. U.S. states have on average a GDP of 340,576.94 billions of US dollars, whereas Mexican states have a significant lower GDP with only 510,369.80 millions of Mexican pesos (MXN).

Table 1
Descriptive Statistics

Variables	mean	sd	min	max
Migration	492.36	2283.56	0	59427
SCIadjusted	0	0	0	0.01
Distance	2727.34	942.33	462	7400
Poverty	1689.86	1615.4	151.74	9206.18
Unemployment	4.11	1.42	1.17	7.6
Violence	886.1	917.38	34	6421
FDI	14263720.26	85063988.08	-1258.6	7.62E+08
Trade	1.09E+10	1.31E+10	14706000	5.86E+10
GDPMX	510369.8	528027.62	81992.18	3132839
GDPUSA	340576.94	430043.38	28403.7	2874731
Observations	19584			

Source: authors' calculations using data from sources previously mentioned

4.Results

First, simple POLS results are presented, where all the variables mentioned above are included, and then the POLS results with the time and entity fixed effects. Table 2 shows the POLS results of the effect of social connectivity (measured by the SCI) on migration, with data from the Instituto de los Mexicanos en el Exterior (IME) and the Facebook Social Connectedness Index. Where this effect is positive with a magnitude of 579.6, which means that when the SCI increases by 1 percent approximately 580 consular cards are authorized, however this result is not significant at any level. This regression proves the initial theory that the greater the connection between people, the greater the migration flows between states, and it also proves a secondary hypothesis that the greater the distance between each of the Mexican states and each of the U.S. states, the lower the migration will be.

Table 2
POOLS results

VARIABLES	(1) Migration
SCIadjusted	579.6
	(13,254)
Distance	-0.127***
	(0.0167)
Poverty	0.126***
	(0.00962)
Unemployment	-30.67***
	(10.05)
Violence	0.0875***
	(0.0183)
GDPMX	6.26e-05*
	(3.44e-05)
GDPUSA	0.00251***
	(0.000141)
Constant	-211.6***
	(79.14)

Table 2

POOLS results

Observations	16,416
R-squared	0.246

Notes: authors' calculations using data from sources previously mentioned. It is used the SCIadjusted instead of the SCI. Robust standard errors in parentheses. *** p<0.01,

One of the reasons why the effect of social connectivity on migration is not significant is because the regression is not controlling for time and states fixed effects. Since there could be economic characteristics in each of the years or in each state that could be driving or reducing migration flows. Therefore, three types of fixed effects are added in the model to take into account this effect of the economic situations. Which lead to the results presented in Table 3.

As mentioned, in Table 3 fixed effects for each year and for each state for both nations are added, nevertheless not all years and states are shown in Table 3, but complete results are presented to a further examination in Appendix 1. Again, there is a positive impact from the social connectivity to migration with a magnitude of 55,035. However, in this case the effect between the SCIadjusted variable and migration flows is significant, meaning that when the SCI increases by 1 percent approximately 55,035 consular cards are authorized. That is, an increase in social connectivity implies higher migration flows between each pair of states. Finally, the R-squared is 0.368 which indicates that approximately 36.8% of the variability of migration can be explained by the independent variables included in the model.

Table 3

POLS Fixed Effects results

VARIABLES	(1) Migration
SCIadjusted	55,035***
	(13,435)
Distance	-0.223***
	(0.0346)

Table 3

(continued)

Poverty	0.0301
	(0.0908)
Unemployment	0.481
	(23.78)
Violence	-0.0541
	(0.0336)
GDPMX	-0.000426
	(0.000321)
GDPUSA	-0.00226***
	(0.000778)
Trade	4.49e-10
	(5.33e-09)
FDI	1.45e-08
	(2.51e-07)
Year fixed effects	Yes
Mexican states fixed effects	Yes
U.S. states fixed effects	Yes
Constant	671.3***
	(220.8)
Observations	16,416
R-squared	0.368

Notes: authors' calculations using data from sources previously mentioned. It is used the SCIadjusted instead of the SCI. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

In addition to the above, it can be observed that distance continues to have a negative and significant effect. This may be because distance is usually considered in the literature as a migration cost, so the greater the distance, the more complex is the decision to migrate. Meanwhile, the rest of the controls mentioned in the model do not show any significance, except for the GDP of the United States, which has a negative and significant effect on migration flows. Result that will require an independent and deeper analysis.

The second part of the table, which can be analyzed in Appendix 1, shows the results of the fixed effects for each of the 11 years analyzed, of which all of them had a positive effect on the migration phenomenon, except for 2020. Which could be due to the COVID-19 pandemic, which led to the establishment of policies and measures of asylum and social distancing to prevent the spread of the virus. For these reasons, migration flows decreased this year, as many offices and borders were closed, and the decrease in resources made it difficult for people to leave Mexico. As it was mentioned by the Migration Data Portal (2023) it is estimated that by 2020 migration flows to OECD countries will have declined by more than 30%. However, this year is not significant, while years like 2017, 2018 and 2021 are.

In the third part, which can be analyzed in Appendix 1, the individual effects of every Mexican State are presented. Where it is observed that of the 32 states of the Mexican Republic, half show a significant impact on migration, among which are: Colima, Chiapas, Guanajuato, Durango, State of Mexico, Guerrero, Hidalgo, Jalisco, Michoacan, Morelos, Oaxaca, Puebla, San Luis Potosi, Sinaloa, Nuevo Leon, Tamaulipas, Veracruz and Zacatecas. However, the states with the highest values are Mexico City, Jalisco, and Michoacán.

Finally, at the end of the table of Appendix 1, the results for the 52 U.S. states showed that most of the states are not significant Alabama, Delaware, District of Columbia, Idaho, Iowa, Kansas, Kentucky, Maine, New Hampshire, Oklahoma, Rhode Island and Vermont, which show a high degree of significance, meaning that in these states there are some things that are causing a higher degree of undocumented migrants.

5. Limitations

The economic analysis conducted in this study presents several limitations. The first of these is the lack of data measuring migratory flows with a state-level breakdown between Mexico and the United States. Many information sources only provide state or municipal data for Mexican migrants leaving the country, without specifically indicating their destination. Other sources only capture the number of Mexicans living in the United States without specifying the Mexican state they originate from. Thus, commonly used censuses and surveys in the analysis of the migratory phenomenon are not useful for examining migratory flows, as they do not allow the observation of the origin-destination of migrants.

However, the analysis required in this study specifically focuses on migrants whose destination is the United States, and it is necessary to know in detail which state they are heading to. Therefore, to measure migration in this study, consular registrations of undocumented migrants in the United States are used as a proxy for migratory flows from each state in Mexico to each state in the United States.

This leads to the second limitation, as this variable used to measure migration does not accurately reflect migratory flows, as it excludes certain groups of migrating Mexicans. Additionally, many migrants do not register in these offices, which could lead to underestimating or overestimating values since not all types of migration are captured.

Another evident limitation lies in the econometric specification. As mentioned earlier, the variable capturing observations of migratory flows does not fully encompass all migrants, resulting in a problem known as measurement error. This issue, combined with a possible bidirectional causality between migration and social connectivity, may cause an endogeneity problem, which would need to be addressed using instrumental variables.

On the other hand, the Facebook Social Connectedness Index (SCI), which is the control of interest and a determinant of migration analyzed in this study, is not a variable that can be tracked over time. Only one observation is available, calculated in 2021 (cross-section data). This implies that changes in the connection between people in the United States and Mexico over time cannot be observed. This could also lead to underestimating results since social networks have strengthened, and more people are in contact with electronic devices and social media over time.

6. Conclusion

México has a high migratory flow towards the U.S., with approximately 63,000 encounters of undocumented migrants between 2021 and 2023 (BBVA Research, 2023); reason why this has become a topic of debate in the political agenda of both nations and a subject of study in identifying the causes of this phenomenon. Likewise, studies on migration in other parts of the world have linked migration to social connectivity as a determinant (Bailey, 2018). However, this relationship has been barely studied in Latin America, specifically in the bilateral relationship between the U.S. and Mexico, therefore, this study lays the groundwork for future research using the Facebook Social Connectivity Index as a tool.

Using the POOLS estimator with fixed effects, it is found that the SCI has explanatory power in migratory flows between the two countries from 2010 to 2021; this explanatory power can be explained as an increase of 1% in the SCI results in an approximate 55,035 authorized consular identification cards. On the other hand, among the variables included in the model, distance stands out as a reducer of migratory flows, serving as a proxy variable for transportation costs.

Finally, it is important to mention that one of the main limitations of this study was obtaining data to measure migration, therefore it is hoped that for future research, there will be metrics reflecting the reality of this migratory phenomenon to ensure more precise results. This would allow to contribute to a better understanding, facilitating the creation and implementation of policies for the benefit of both countries, encouraging a better and prosperous relationship.

Appendix

Appendix 1.

Table 2

Complete POLS results with Fixed Effects

VARIABLES	(1) Migration
SCIadjusted	55,035***
	(13,435)
Distance	-0.223***
	(0.0346)
Poverty	0.0301
	(0.0908)
Unemployment	0.481
	(23.78)
Violence	-0.0541
	(0.0336)
GDPMX	-0.000426
	(0.000321)
GDPUSA	-0.00226***
	(0.000778)
Trade	4.49e-10
	(5.33e-09)
FDI	1.45e-08
	(2.51e-07)
2011.Year	90.25
	(204.6)
2012.Year	88.77
	(72.46)
2013.Year	115.1
	(72.27)
2014.Year	94.81
	(68.55)
2015.Year	110.7
	(75.03)
2016.Year	52.33
	(65.86)
2017.Year	146.0**
	(73.12)
2018.Year	160.4**
	(75.45)

Table 2
(continued)

2020.Year	-47.75
	(72.96)
2021.Year	132.8*
	(69.38)
2.EntityMX	219.3
	(151.5)
3.EntityMX	-130.8
	(86.12)
4.EntityMX	76.25
	(128.3)
5.EntityMX	164.5
	(328.4)
6.EntityMX	462.5**
	(211.3)
7.EntityMX	1,993**
	(798.8)
8.EntityMX	158.9
	(164.1)
9.EntityMX	-15.87
	(81.35)
10.EntityMX	262.8***
	(64.78)
11.EntityMX	1,200**
	(577.0)
12.EntityMX	1,432***
	(232.4)
13.EntityMX	1,414***
	(229.9)
14.EntityMX	340.4***
	(112.8)
15.EntityMX	1,585***
	(317.4)
16.EntityMX	1,586***
	(256.8)
17.EntityMX	267.6***
	(94.62)
18.EntityMX	71.50
	(71.93)
19.EntityMX	515.5*
	(285.6)

Table 2
(continued)

20.EntityMX	771.6***
	(240.4)
21.EntityMX	949.2***
	(298.0)
22.EntityMX	41.24
	(65.53)
23.EntityMX	-41.72
	(105.8)
24.EntityMX	542.9***
	(145.5)
25.EntityMX	200.7
	(170.0)
26.EntityMX	116.5
	(110.9)
27.EntityMX	84.79
	(121.2)
28.EntityMX	377.0**
	(151.8)
29.EntityMX	-49.79
	(79.85)
30.EntityMX	871.9**
	(344.3)
31.EntityMX	-138.5
	(113.3)
32.EntityMX	407.1***
	(79.49)
2.EntityUS	251.6
	(160.9)
3.EntityUS	413.2***
	(87.56)
4.EntityUS	-238.8***
	(66.78)
5.EntityUS	12,779***
	(1,944)
6.EntityUS	644.6***
	(112.0)
7.EntityUS	343.6***
	(71.97)
8.EntityUS	-139.3
	(113.7)

Table 2
(continued)

9.EntityUS	-111.0
	(75.89)
10.EntityUS	2,158***
	(527.4)
11.EntityUS	1,280***
	(240.7)
12.EntityUS	459.0***
	(170.6)
13.EntityUS	-170.6
	(107.3)
14.EntityUS	3,194***
	(446.1)
15.EntityUS	605.6***
	(105.4)
16.EntityUS	-34.76
	(38.35)
17.EntityUS	-50.24
	(44.80)
18.EntityUS	22.35
	(34.80)
19.EntityUS	-124.8***
	(43.84)
20.EntityUS	-94.60
	(127.4)
21.EntityUS	501.7***
	(130.4)
22.EntityUS	831.1***
	(226.4)
23.EntityUS	754.5***
	(199.8)
24.EntityUS	486.9***
	(106.7)
25.EntityUS	-376.3***
	(76.94)
26.EntityUS	160.3**
	(71.92)
27.EntityUS	-290.7**
	(123.6)
28.EntityUS	-178.0**
	(70.53)

Table 2
(continued)

29.EntityUS	342.1***
	(56.12)
30.EntityUS	-104.7
	(114.9)
31.EntityUS	1,287***
	(272.8)
32.EntityUS	-239.6***
	(91.69)
33.EntityUS	3,621***
	(935.1)
34.EntityUS	1,443***
	(233.7)
35.EntityUS	-334.4***
	(117.9)
36.EntityUS	979.3***
	(299.3)
37.EntityUS	35.18
	(31.14)
38.EntityUS	397.8***
	(53.85)
39.EntityUS	1,308***
	(376.6)
40.EntityUS	-122.4
	(124.3)
41.EntityUS	193.3***
	(34.09)
42.EntityUS	-367.1***
	(120.4)
43.EntityUS	419.7***
	(90.67)
44.EntityUS	8,136***
	(1,149)
45.EntityUS	170.4***
	(41.96)
46.EntityUS	-210.4
	(144.5)
47.EntityUS	775.7***
	(212.1)
48.EntityUS	996.5***
	(217.7)

Table 2
(continued)

49.EntityUS	-319.9***
	(102.1)
50.EntityUS	455.9***
	(80.92)
51.EntityUS	-430.1***
	(124.1)
Constant	671.3***
	(220.8)
Observations	16,416
R-squared	0.368

Notes: authors' calculations using data from sources previously mentioned. It is used the SCIadjusted instead of the SCI. Robust standard errors in parentheses. *** $p<0.01$,

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