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Spatial Dynamics of Internal Migration Flows of the Skilled and Unskilled in Mexico

Dinámica espacial de los flujos de migración interna de personas calificadas y no calificadas en México

Miguel Flores Segovia¹ Eliud Silva²

Resumen: La dinámica de la migración interna en México es un elemento determinante en la composición de la mano de obra de cierta región, por lo que su análisis coadyuva, entre otras cosas, al mejor entendimiento de los mercados laborales y cambios sociodemográficos de la región. Con la finalidad de caracterizar los patrones más recientes de los flujos migratorios de la mano obra calificada y no calificada, se consideran datos censales para los periodos 1995-2000, 2005-2010 y 2010-2015. Con esto se estiman diferentes indicadores que describen la intensidad y concentración relativa de la migración interestatal. Se evidencian cambios en los patrones migratorios y una menor concentración de la migración interna, cuyo efecto es más marcado para la mano de obra no calificada. Es decir, se observa que el número de entidades que juegan un rol preponderante en la redistribución de la mano obra en México ha aumentado. La relación de la movilidad laboral interna se hace evidente con el dinamismo regional y como resultado de nuevos patrones geográficos de ubicación de inversión, producción y aglomeración económica.

Palabras clave: migración interna, migración calificada, migración no calificada, índice de Gini.

Abstract The dynamics of the internal migration is a crucial element in the composition of the workforce of a certain region, so its analysis contributes to the better understanding of labor markets and sociodemographic changes in a region. In order to characterize the most recent patterns of migratory flows of skilled and unskilled labor, census data are considered for the periods 1995-2000, 2005-2010 and 2010-2015. The analysis considers different indicators that describe the intensity and relative concentration of interstate migration. Changes in migratory patterns are evident; a lower concentration of internal migration whose effect is more marked for unskilled labor. That is, it is observed that the number of states that play a preponderant role in the redistribution of labor in Mexico has increased. The relationship of domestic labor mobility is evident to the regional transformation as a result of new geographical patterns of location of investment, production and economic agglomeration.

Keywords: internal migration, skilled migration, unskilled migration, Gini index.

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1. Introduction

Migration, as a selective process, is related among other determining factors to levels of education (Bernard, Belly and Charles, 2014). The theory suggests that individuals with a higher level of education are more likely to emigrate than those with lower levels. Given their level of education, the redistribution of such workers could affect the relative human capital endowment of both the sending and receiving states (Greenwood, 1985). In this sense, migration represents a form human capital transfer between places of origin and destination, so it is of interest to investigate its characteristics and patterns in recent years.

The transformation of production processes at the regional level results in a permanent modification on the patterns of private investment (both national and foreign), of international trade activity, labor, and other factors related to production (Jordan and Rodríguez-Oreggia, 2012; Díaz-Bautista, 2006; Flores, Medellín and Villareal, 2018). These changes in regional economic geography can, in turn, generate dynamics in local labor markets by modifying the relative composition of demand for skilled and unskilled human capital and, therefore, in their relative wages (Hanson, 2003; Sobrino, 2016). The analysis of the mobility of labor within the country is in turn relevant to a given endowment of skilled and unskilled labor, and where both positive and negative net balances necessarily imply changes in the magnitude of migratory flows between states.

The extent to which the volumes of flows coming into a region differ in their degree of concentration from the volumes of flows leaving the region is of particular interest, because net migration is one component of population change. A region that draws its migrants from a set of origin regions different from the destination regions to which it sends out-migrants may have a zero overall net migration (total gross in-migration equals total gross out-migration), but it nonetheless may play a significant role as a redistributor of the population in the migration system. Studying people mobility is relevant in the case of Mexico which has experienced changes in its internal industrial economic structure as a result of the economic liberalization that arose at the beginning of the '90s. Industries oriented to foreign markets emerged in some states, a situation that, in turn, generated a greater demand for specialized human capital. This pattern may have had implications for the internal mobility within the country.

This paper assesses the changes in internal mobility patterns by estimating the origin-destination migration flows in Mexican states for the years 2000, 2010 and 2015. The main contribution of this

study is twofold. First, it aims assessing recent in internal mobility patterns by estimating the origin-destination migration flows, for the skilled and unskilled labor in Mexican states for the years 2000, 2010 and 2015. Second, once characterized these flows, the analysis goes a step further by means of estimating a migratory Gini index from which it is possible to analyze inequalities in the interstate migration flows of the skilled and the unskilled³.

The rest of the paper is organized as follows. In the next section we briefly review relevant literature on the subject, as well as some applied work for the case of Mexico. Section three describes the methodology used for the estimation migration flows and the migratory Gini index both. While the results from the present analysis are discussed in section four, a final discussion and some insights for future research are considered in section five.

2. Literature Review

According to the neoclassical theory of human capital, the decision to migrate conveys a rational process from which a decision is viewed as an investment in human capital. This is because migration experience adds skills, knowledge and experiences of the new occupation to stock of previously existing human capital (Haug, 2008). Hence, a rational individual decides to migrate after a cost-benefit analysis taking into account the differences wages, expected salary, transportation costs, accommodation and adaptation to the environment, time transfer, infrastructure, climate, security, among others (Galvis, 2002; Pizzolitto, 2006).

Specifically, Todaro (1980), one of the seminal articles on the subject, describes the following theoretical arguments that are involved in the migratory process:

- a. The decision to migrate is mainly due to rational economic considerations that translate into a cost-benefit analysis, which also includes psychological aspects;
- b. The decision to migrate depends mainly on the expectations of the returns to be received before that in the current differences between the income received in the regions of origin and destination; the expectation or probability of obtaining a job in the destination regions is directly proportional to the occupancy rate therein;

³ Likewise, the analysis also provides a visualization of origin-destination flow matrices through the application Shiny tool developed in the free software R which makes it possible to create circular graphs that depict migration flows among states as well as the migratory Gini index.

- c. When migration rates exceed the capacity of destination regions to generate employment creates serious imbalances that generate unemployment;

From a regional economy perspective, there exists a relationship between migration and economic development. It is argued that those who embark migration exhibits some sort of selection, that is, the people who self-selected to migrate generally present a series of positive characteristics and desirable for your destination regions. Among these characteristics we can highlight the dynamism, its minor risk aversion, their propensity to undertake and greater adaptability (Pizzolitto, 2006). Also referred as positive selection, these migrants tend to be more educated and endowed with specific skills required in the workplace.

As argued by Ottaviano and Peri (2006), migrant skill level has also become a key consideration in studies focused on the impact of migration on labour market conditions, particularly in the case of immigration. One the one hand, inmigration of workers with a specific set of skills (e.g., low-skilled workers, high skilled workers) increases the regional supply of these workers, depressing within group wages and increasing the wages of the other worker groups (known as the 'negative skill endowment effect').

Second, regional productivity of workers in a given skill group is positively affected by the in-migration of workers from the same skill group. Since workers are imperfect substitutes, inmigration is assumed to increase the range of available skills (known as the 'positive skill externality effect') (Behrens and Sato, 2011, pp.7). In that sense, attracting labor is not only important to fill vacancies in a growing industry. The influx of highly skilled labor in the regions and industries located in these regions, particularly if these new workers bring along new but relevant skills, will serve to further boost the receiving industry (Galvan, 2008). On the other hand, among the negative effects of outmigration flows (either skilled or unskilled) can be argued reductions of the workforce in the regions of origin, important variations in the level of education, demographic changes and may involve increases in unemployment rates (Galvis, 2002). In this sense, internal migration can be studied as a dynamic phenomenon that may be associated to regional economic, demographic and social transformations.

Several studies have considered the case of Mexico given its effects related to the economic liberalization process on internal migration, particularly at the regional level (Arendys-Kuenning, Baylis and Garduño-Rivera, 2018; Aroca and Maloney, 2005; Flores, Zey and Hoque, 2013). Other

studies have approached the internal migratory phenomenon from a demographic perspective. For example, Sobrino (2016) analyzes socio-demographic characteristics and territorial flows of internal migration in Mexico between 1995 and 2015 using models of transition from mobility to different territorial scales. Amidst the findings, on the one hand, it stands out that the migratory intensity has decreased and is currently more common among men and women of 40 years of age and older, with fewer years of formal education, and who do not insert themselves into the job market. On the other hand, the greatest migratory intensity was observed at the end of professional education, which can be a sign of territorial redistribution of human capital. Similarly, it also found a significant change of pattern in Mexico City towards 2015, which went from being a net expeller to a state with greater net attraction.

Based on census data for Mexico for the years 2000 and 2010, Pérez and Santos (2013) confirm that both urban-urban internal migration and migration between metropolitan areas have emerged as the most important modalities. Likewise, Caudillo and Tapia (2014) use internal migration flows along with network analysis techniques to seek migration patterns for the skilled population in Mexico for the period 2005-2010. The authors find low geographic mobility among the population holding a bachelor's degree or higher. In a related study, looking at the northern border region of Mexico and at the municipal level, Lomelí and Ybáñez (2017) point to a greater concentration of migration in the northeastern municipalities, but not necessarily in municipalities bordering the United States of America.

Almejo and Hernández (2016) consider migration flows of those between 18 and 64 years of age who have higher education for the period 2010-2015, based on the Intercensal Survey 2015 by the Instituto Nacional de Estadística y Geografía (INEGI), and identify cities that gain or lose this type of population. The largest attraction occurs in metropolitan areas, tourist cities, and some capitals. It is worth mentioning that Varela, Ocegueda and Castillo (2017), based on the 2014 National Survey of Occupation and Employment conducted by INEGI, utilizing a multilevel econometric model, found that the number of hours worked per week and the weeks of job search are statistically significant to explain the determinants of Internal migration in Mexico, both at the interstate and intrastate levels. Despite past work on the subject, there is still a need to consider explicitly the distinction between skilled and unskilled internal migration, a contribution that the present work aims to make.

Methodologically, it must be noted that dealing with flow matrices has routinely confronted the issue of how these complex flows can be best summarized. In the area of migration, a growing literature has sought to derive meaningful groupings of areal units based upon underlying similarities in their

structure of migration (Pandit, 1994). However, depending upon the theoretical and methodological approach taken, two distinct types of migration regions have been defined: (1) migration regions as groups of states which are highly connected to one another (termed here as migration subsystems); and (2) migration regions as groups of states which have similar patterns of interchange with other states (termed here as migration typologies). A basic understanding of the underlying age and spatial structures found in past patterns of interregional migration flows is important for accurately projecting future patterns of interregional migration (Pandit, 1994).

Hence, the flows coming into a region may differ in their degree of concentration from the volumes of flows leaving the region. For example, a region that draws its migrants from a set of origin regions different from the destination regions to which it sends out-migrants may have a zero overall net migration (total gross in-migration equals total gross out-migration), but it nonetheless may play a significant role as a redistributor of the population in the migration system (Plane and Mulligan, 1997). The specific streams of in- and out-movement may differ in their degrees of spatial concentration. A measure of the spatial concentration of in-migration fields and out-migration fields such as the migratory Gini index can aid our understanding of the spatial linkages that exist among population changes in any single region and those taking place in all other regions of the system. An interesting question to explore is whether some regions have persistently focused (highly concentrated) in- or out-migration fields while others have persistently broad (unconcentrated) fields. The next section provides the methodological aspects of the estimation of migration flows as well as the measure of its spatial concentration patterns.

3. Methodology and Data

This study uses microdata from three official and publicly available sources of information: the General Census of Population and Housing (2000), the Census of Population and Housing Units (2010), and the Intercensal Survey (EIC) 2015, all conducted by the National Institute of Statistics and Geography of Mexico (Instituto Nacional de Estadística y Geografía [INEGI], 2000, 2010, 2015). Microdata make it possible to estimate the socio-demographic characteristics of internal migrants based on their residence status five years ago by the time of the interview and education level.

Internal migration is modeled via the estimation of origin-destination migratory flows at the state level for the periods 1995-2000, 2005-2010, and 2010-2015⁴. Skilled migrants are considered those who changed their state of residence and hold a bachelor degree or higher education, while unskilled migrants are those with less than a secondary school level of education. Finally, the analysis considers internal migrants between the ages of 18 and 64, given that this group exhibits the highest probability of migrating.

According to Ybáñez, Muñoz, Cruz and Pérez (2015) the interstate internal migration in Mexico can be represented by a 32x32 origin-destination flow matrix as follows

$$M_t^{c,S} = \begin{pmatrix} 0 & \cdots & M_{1,32}^{c,S} \\ \vdots & \ddots & \vdots \\ M_{32,1}^{c,S} & \cdots & 0 \end{pmatrix} \quad (1)$$

where every $M_{i,j}^{c,S}$ represents the migration of state i towards j in the period of time t , of skilled and unskilled labor (c or nc respectively). This representation allows estimating both, total immigration and emigration flows. The upper triangle of $M_t^{c,S}$ is the emigrations of state i towards j and its lower triangle is immigration that arrives from i to j .

From $M_t^{c,S}$ it is possible to obtain, among other indicators, the net migratory balance which is defined as the difference between total immigration and emigration flows. For example, for male in state 1, this is denoted as follows:

$$SNM_t^{c,M} = I_t^{c,M} - E_t^{c,M} \quad (2)$$

Thus, a positive SNM reveals that the total flows of migrants to a state exceeded the total flows out of that state. Conversely, a negative SNM would assume that the number of people who left is greater than the number of people who entered a given state. This indicator is relevant since it will allow us

⁴ The selection of these periods is based on the availability of the information necessary to estimate flows from destination and origin between states or regions.

to know about changes at the state or regional level in the stock of skilled or unskilled migrants as a result of migratory flows.

It should be noticed that dealing with flow matrices has routinely confronted the issue of how these flows can be best summarized in a useful way. The extent to which the volumes of flows coming into a region differ in their degree of concentration from the volumes of flows leaving the region is of particular interest, because net migration is one component of population change. The specific streams of in and out-movement may differ in their degrees of spatial concentration. A measure of the spatial concentration of in-migration fields and out-migration fields can increase our understanding of the spatial linkages that exist between population changes in any single region and those taking place in all other regions of the system.

The specific streams of in- and out-movement may differ in their degrees of spatial concentration. A measure of the spatial concentration of in-migration fields and out-migration fields, in conjunction with other measures of migration, can aid our understanding of the spatial linkages that exist among population changes in any single region and those taking place in all other regions of the system. An interesting question that we ourselves to explore is whether some regions have persistently focused (highly concentrated) in- or out-migration fields while others have persistently broad (unconcentrated) fields.

In this sense, Plane and Mulligan (1997) have proposed using the Gini index to estimate the degree of geographical concentration exhibited by the migration flows; this is, considering the spatial structure of the set of origin-destination-specific streams that results from specification (1). According to Plane and Mulligan (1997), each migratory flow M_{ij} is compared with each and every one of the other flows M_{kl} , ignoring the elements of the diagonal that corresponds to non-migrants. A value of 0 indicates that there is no spatial concentration, given that each flow is about the same size; the value of 1 indicates the maximum concentration, given that the migration focuses on one flow, i.e. the flows are perfectly unequal, so that many immigrants are moving selectively to a few destinations, while many migrants are leaving only from a few origins.

The Gini index (Total) at time t is given by

$$G^T = G_{R^*}^T + G_{\cdot C}^T + G_{RC,CR}^T + G_{Others}^T \quad (3)$$

where $G_{R.}^T$ is the Rows index (in-migrants); $G_{.C}^T$ is the Columns index (out-migrants) $G_{RC,CR}^T$ is the Exchanges index and G_{Others}^T the remaining flows, where each term can be expressed in terms of the migration flows as follows:

$$G_{R.}^T = \frac{\sum_i^n \sum_{j \neq i}^n \sum_{l \neq h, j}^n |M_{ij} - M_{ih}|}{2n(n-1)T} \quad (4)$$

$$G_{.C}^T = \frac{\sum_j^n \sum_{i \neq j}^n \sum_{g \neq j, i}^n |M_{ij} - M_{gj}|}{2n(n-1)T} \quad (5)$$

$$G_{RC,CR}^T = \frac{\sum_i^n \sum_{j \neq i}^n |M_{ij} - M_{ji}|}{2n(n-1)T} \quad (6)$$

$$G_{Others}^T = \frac{\sum_i^n \sum_{j \neq i}^n \sum_{l \neq g, h}^n \sum_{j \neq h, g}^n |M_{ij} - M_{kl}|}{2n(n-1)T} \quad (7)$$

where n is the total number of states, in this case 32, and T is the total flow of migrant population. The so-call in-migration and out-migration field Gini indexes are a decomposed version of the Columns and Rows Gini index respectively. They represent the contribution of each region's columns and rows to the total Gini index. Note that the value of the Gini index can vary between 0 and 1, where values close to 0 indicate less degree spatially focused flows while values close to one 1 means high degree spatially focused flows.

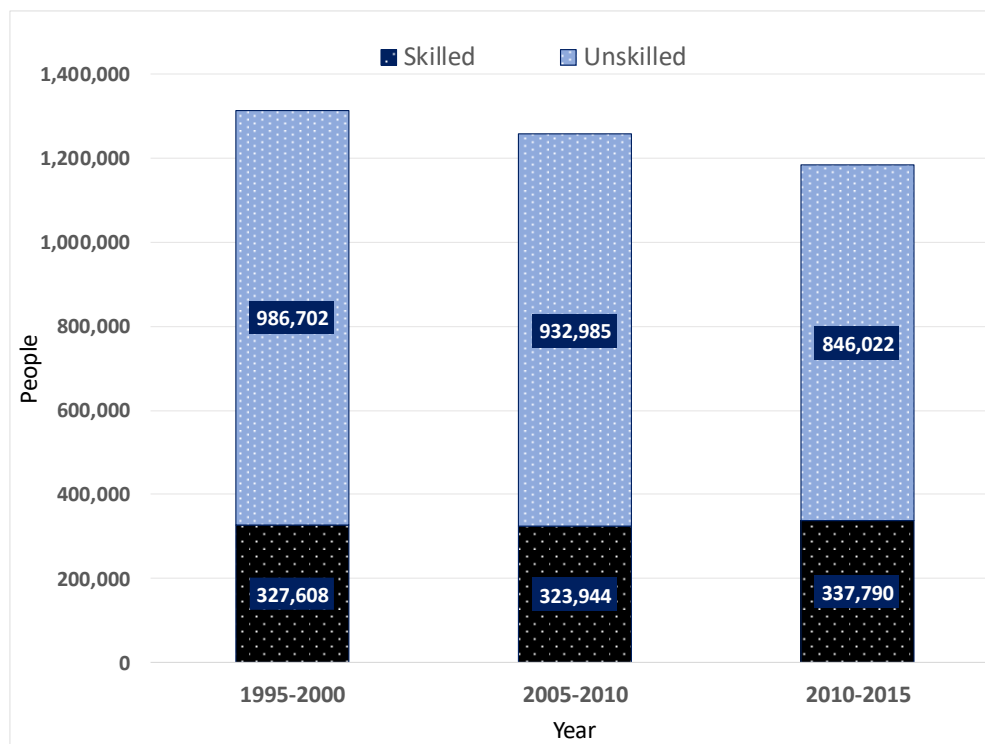
The use of the migratory Gini Index has come advantages, for example: a) useful to measure spatial inequalities and to compare results across different population segments; b) it provides an simple indicator easy for interpretation which ranges between 0 and 1; and c) it has important properties such as: anonymity, scale independence and population independence. Furthermore, given the standard values of the migratory Gini Index, it is possible to classify states according to the role playing in the system of in or out migrants flows. As showed in the next section, there are states that have played an important role as redistributors of migrants, either skilled or unskilled.

4. Results

Figure 1 shows that while the total number of interstate migrants decreased over time (from 2.5 million to 2.3 million people) and the total number of unskilled interstate migrants decreased by about 14% (from 986,000 migrants to approximately 846,000 migrants), the number of skilled migrants exhibits an increase of 3.1% (from 327,000 to 337,000).

Figure 1.

Total skilled and unskilled internal migrants, 1995-2000, 2005-2010 and 2010-2015



Source: Own elaboration, 2019

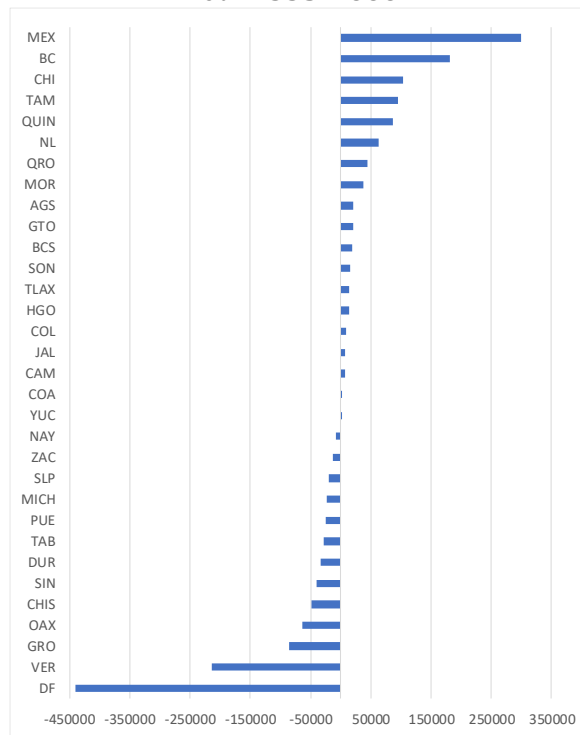
Figure 2 and Figure 3 exhibits the distribution of net migration of unskilled and skilled workers, respectively. As in Figure 2, the State of Mexico (MEX) dominated attraction of unskilled migrants for the period 1995-2000, with approximately 163,000; Baja California (BC) ranked second, with 113,000; while Chihuahua (CHI) and Tamaulipas (TAM), with approximately 69,000 and 60,000, ranked third and fourth, respectively. Quintana Roo (QUIN) completes the group of the 5 states with the highest positive net balance.

For the period 2010-2015, there are important changes in the top 5 states with positive migratory net balance. The State of Mexico (MEX) continues to act as a net receiver of unskilled migrants, with an estimated 74,000 migrants; however, Nuevo Leon now ranks second, with 64,000 (see Figure 2). Likewise, Quintana Roo (QUIN) continues to be a main attractor of unskilled migrants, ranking third and recording a positive net balance of 52,000; while Querétaro (QRO), with an SNM of 38,000, is in the fourth place of this group of states. Finally, Baja California (BC) goes from second to fifth place (with 35,000).

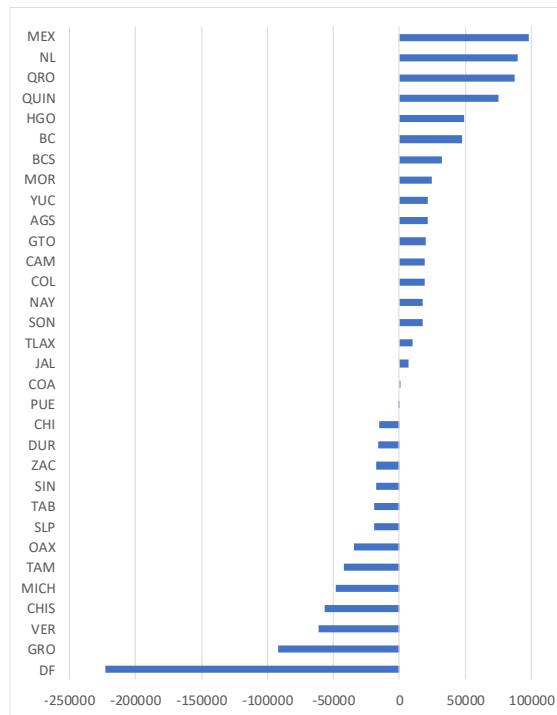
Figure 2.

Net migration Unskilled Migrants

a. 1995-2000



b. 2010-2015



Source: Own elaboration, 2019

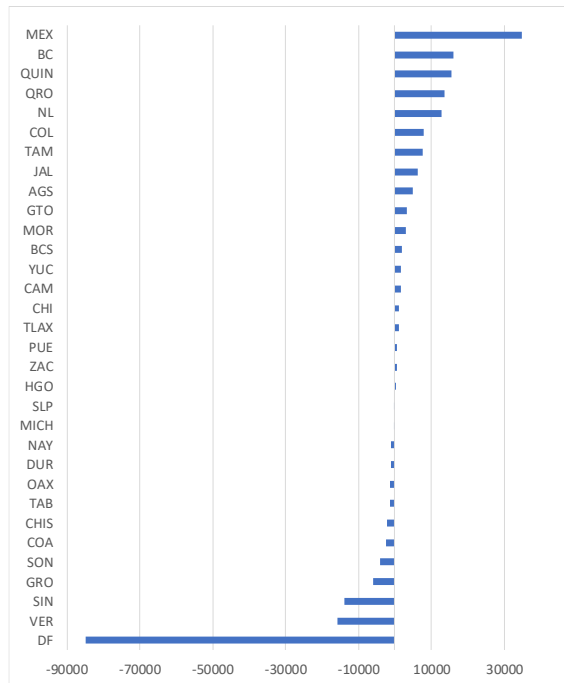
Regarding interstate skilled migrants, Figure 3 indicates that among the states with the highest positive net balance for the period 1995-2000, the State of Mexico (MEX) ranks first, with an estimated net balance of approximately 34,000 migrants. In second and third place are Baja California (BC) and Quintana Roo (QUIN), with net balances of approximately 16,000 and 15,000 respectively. Queretaro (QRO), with 13,000 migrants, and Nuevo Leon (NL), with 12,000, complete the list.

The period 2010-2015 shows movement regarding to the first 5 states with a greater net migratory balance. Queretaro (QRO) becomes the state that exhibits a greater attraction of migrants, with approximately 27,000. Quintana Roo (QUIN) goes from third to second place, registering a net gain of 10,000 skilled migrants, while Nuevo Leon (NL) goes from fifth to third place, with an estimated net balance of close to 9,000 migrants. In addition, Jalisco (JAL) and Yucatan (YUC) experience the greatest changes in the rankings of skilled migrants. Specifically, Jalisco (JAL) exhibits a change of position from eighth to fourth place, while Yucatan (YUC) goes from thirteenth place to fifth place.

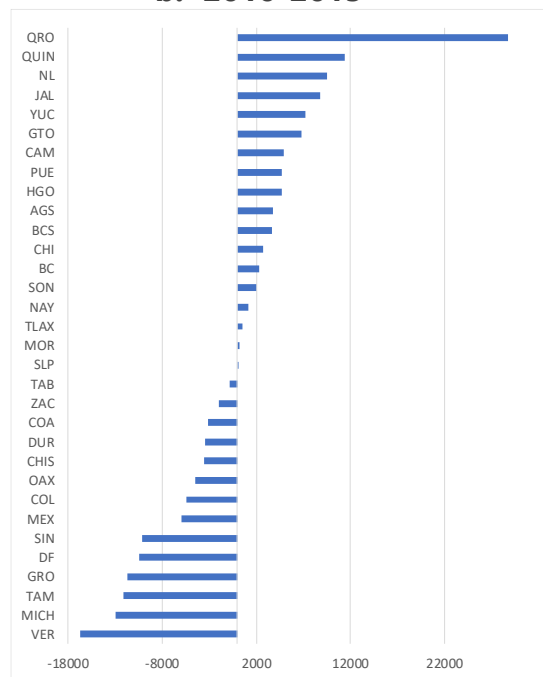
Figure 3.

Net Migration Skilled Migrants

a. 1995-2000



b. 2010-2015



Source: Own elaboration, 2019

An interesting pattern emerges from the participation of the leading states as inflow receivers. Specifically, migration inflows of both unskilled and skilled migrants have become less concentrated as the 5 leading states for total inflows of unskilled migrants experienced a reduction in participation of 6 percentage points, from 41% to 35% total inflows, while a higher reduction of 12 percentage points in the participation of total inflows is observed for skilled migration, from 35% to 23% of total inflows.

Appendix A1 aids in the visualization of these patterns by means of circular graphs called chordDiagrams⁵ (Gu, Gu, Eils, Schlesner and Brors, 2014). In order to identify the flows of the states, a single color is used for each of them in the three figures, and their abbreviations are also used as shown in Appendix A2. It should be noted that each graph represents the origin-destination dynamics of the respective type of labor force, whereas the perimeter color coincides with the color of the flow that corresponds to the origin⁶.

The main findings are the following: a) Both the State of Mexico (MEX) and Mexico City (DF) are the main destinations and origins of internal migration over time, and have gradually lost the domain they had in 2000, which is also reflected in the evolution of the corresponding Gini indexes; b) it is notable how, over the years, for some states the flow of origin is less for unskilled labor vs. skilled labor, as is the case in the states of Nuevo León, Coahuila, and Tamaulipas (NL, COA and TAM); c) the opposite occurs – that is, the flow of unskilled labor is greater than that of skilled labor – in states such as Veracruz, Chiapas and Oaxaca (VER, CHIS and OAX).

Even though the above visualization aids to the understanding of the migration flows among states, there is a need to summarize the whole system of flows. As discussed earlier, one approach is to look at specific streams of in-and out-movements and the extent to which differ in their degrees of spatial concentration. A measure of the spatial concentration of in-migration fields and out-migration fields, such as the Gini index, helps to shed light on the spatial linkages that exist between population change in any single region and that taking place in all other regions of the system. Table 1 shows the estimated Gini index and its decomposition for total, unskilled and skilled migrants, for each of the periods considered. The results suggest that interstate flows became less spatially focused, or, in other words, less spatially concentrated, as the Gini index (G^T) show a decreasing pattern⁷, changing from 0.78 in 2000 to 0.72 in 2015 which represents a reduction of approximately 7% along the period.

⁵ This visualization was developed in R-software and the code is available upon request to the authors.

⁶ Visualization by sex and type of human capital are available upon request to the authors.

⁷ Worth mentioning is that the evolution of the migratory Gini index here estimated coincides with the experience documented in international studies as well as for Mexico. In Mohd and Ishak (2007), a region in Malaysia is analyzed finding a downward trend in the migratory Gini index for the period from 1995 to 2000. Likewise, Liu, Pu, Han, Wang and Song (2015) shows that the migratory Gini index in China tends to fall for the period from 2000 to 2010, that is, migratory flows have ceased to be spatially focused. For Mexico, López and Velarde (2011) estimate a G^T for total migration of 0.0224 and 0.0214 in 2000 and 2010.

Table 1.

Migratory Gini index and its Decomposition

Flows	Period								
	2000	2010	2015	2000	2010	2015	2000	2010	2015
	Total			Skilled			Unskilled		
$G_{R^*}^T$	0.022	0.021	0.021	0.021	0.021	0.020	0.023	0.022	0.021
$G_{\bullet C}^T$	0.021	0.020	0.020	0.020	0.020	0.020	0.022	0.021	0.020
$G_{RC,CR}^T$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
G_{Others}^T	0.735	0.697	0.683	0.716	0.698	0.690	0.752	0.711	0.699
G^T	0.779	0.739	0.724	0.758	0.739	0.730	0.797	0.754	0.741

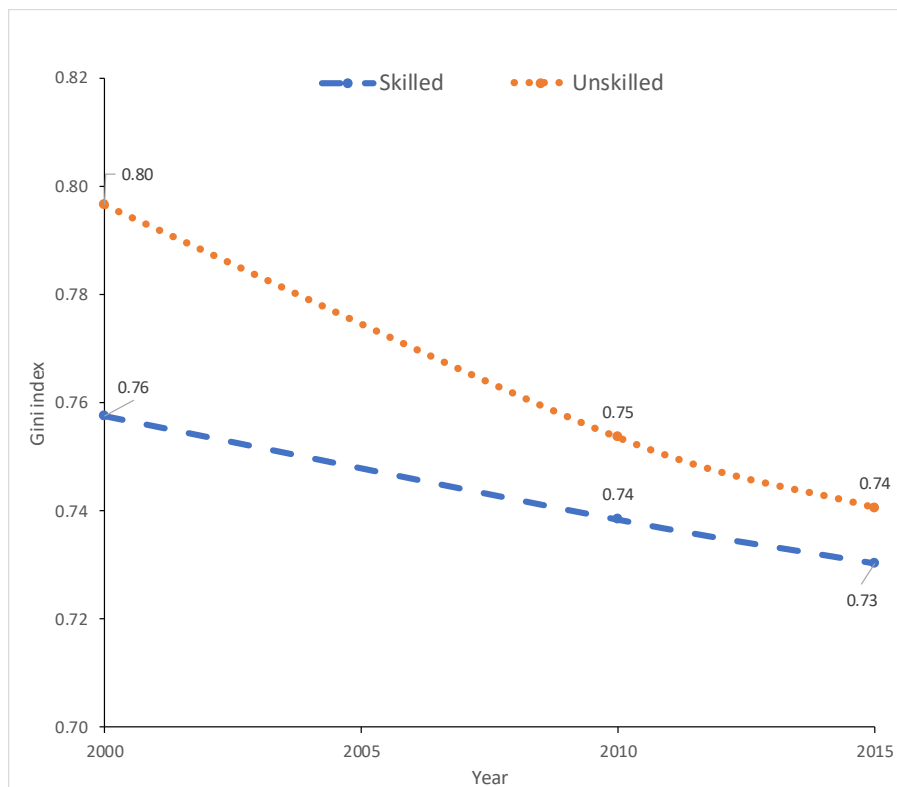
Source: Own elaboration, 2019

Even though total internal migration is still characterized by unequal stream flows, some interesting patterns emerge when comparing the type of human capital. Figure 4 shows that the unskilled tend to show higher migration inequality as compared to the skilled, although such gap tends to diminish and almost converge by 2015. Hence, the largest reduction in the inequality indicator is exhibited by the unskilled as compared to the skilled⁸. This suggests that some states, as destination of migrants, began to emerge as an option for both skilled and unskilled populations, with a higher effect on the latter group. This result may not be surprising as unskilled migrants might not be as selective as the skilled migrants in terms of selecting a state to migrate. For the skilled migrants, they tend to concentrate in states that offer well paid job opportunities which tend to occur in fewer states.

⁸ The complete results of the migratory Gini Index by state are provided in Appendix A3.

Figure 4.

Evolution of Migratory Gini index



Source: Own elaboration, 2019

In order to investigate what states may have played a role on attracting or sending out migrants relative to the whole system of flows, the next step consists on analyzing the outflow and inflow field Gini indices for each state. One way to do it is through standardizing the Gini index values in a form of z-score. Following Lee and Hewings (2015), a positive z-score suggests that a state's migration flows are more spatially focused than average, indicating in turn its strong role in the interstate migration system. Negative z-scores indicate state's fields broader, or less focused. Negative z-scores for inflows indicate that migrants are sent from diverse origin states, whereas negative z-scores for the outflow field Gini index suggest that migrants are sent to widely dispersed destinations. When a 45° line is drawn on the scatter plots the relative magnitudes of the standardized outflows and inflows field indices can be compared and located states are plotted above the 45° line, for example, those with larger z-score of inflow field index than that of outflow are the ones where outflow is relatively uniform across all destinations, whereas inflow is more highly focused and comes from selective origins. States plotted below the 45° line represent to have a larger outflow field index values than inflow field index values. The state that falls into

the latter category is one where inflow is relatively uniform across all origins while outflow goes to selective destinations wherever they might be.

An state with a z-score of the row field index value greater than 1 implies that the state has spatially focused destinations for its outflows, whereas the state whose z-score of the column field index is greater than 1 means that the source states of its inflows are spatially focused. Furthermore, each states's z-score can be located in a graph divided by four quadrants from which the appropriate interpretation is as follows (Plane and Mulligan, 1997):

Quadrant I: *Focused* (upper right), it refers to the states that send and receive migrants from relatively few states.

Quadrant II: *Pure Inward* (upper left), it refers to the states that have strongly focused destinations for immigration but moderately broad outmigration.

Quadrant III: *Redistributors* (bottom left), it refers to the states showing a relatively broad interaction within the migration system.

Quadrant IV: *Pure Outward* (bottom right), it refers to states that have strongly focused destinations for outmigration but moderately broad immigration.

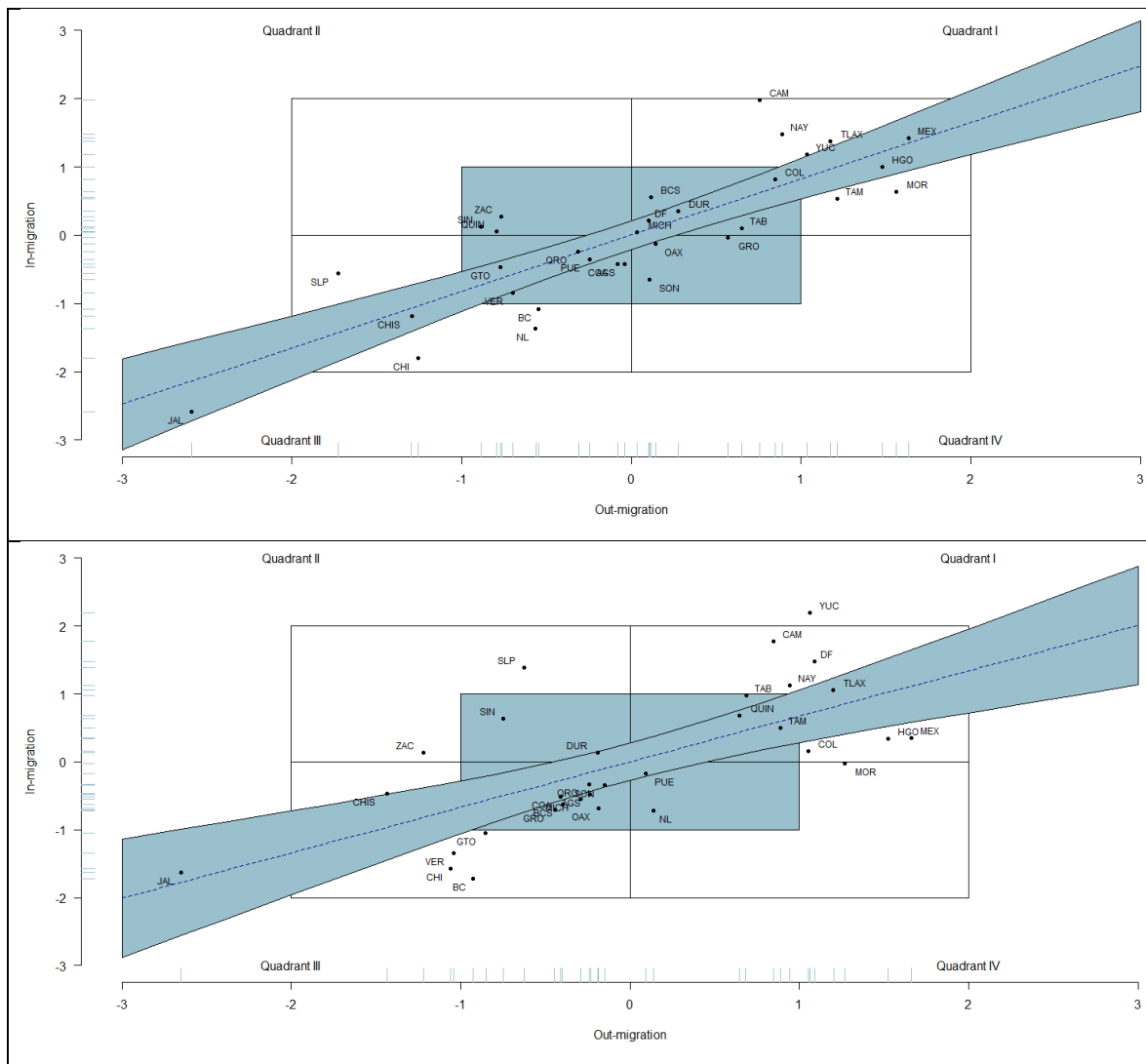
Figure 5 shows the results of the migratory Gini Index z-scores for the skilled and unskilled in the period 2010-2015, Appendix A4 and A5 shows the complete set of results for the rest of the periods⁹. Furthermore, Table 2 describes state's typology according to the distribution of the z-score in each period and by type of human capital. The number of states in each quadrant and period is recorded and those that repeat in the three periods are identified in bold. The results are especially relevant for quadrant III as to identify states playing as redistributors of human capital. These are states showing a relatively broad interaction within the migration system. For the skilled, comparing the initial and final period, the number of states serving as redistributed increased from 11 to 12 states. While Coahuila (COAH) and Queretaro (QRO) entered as

⁹ The association level was measured by means a simple linear regression model (SLRM) among the Gini indexes, where the dependent and independent variables are in-migration and out-migration, respectively. The highest determination coefficient R^2 both for skilled and unskilled labor was found for 2015, in other words the relationship is increasing. It can be also observed that the regression model has best explanatory capacity for the skilled flows for all years. See Appendix 2 and 3 for all the Gini indexes at state level and the Migration Field Diagrams respectively.

redistributors states, Michoacan (MICH) and Tabasco (TAB) left the group. In the case of the unskilled, the number of states in quadrant III increased from 11 to 14 states. The states that entered into these group are Coahuila (COAH), Jalisco (JAL), Sonora (SON), and Querétaro (QRO) where only the state of Nuevo Leon (NL) left the group.

Figure 5.

Skilled (upper) and unskilled (lower) migrants by states, 2010-2015



Source: Own elaboration, 2019

Table 2.

Typology of focusing interstate inflow and outflow fields for 1995-2000, 2005-2010 and 2010-2015

Quadrant Classification	Labor	Period					
		1995-2000		2005-2010		2010-2015	
		Number	States	Number	States	Number	States
(Quadrant I) Focused	Skilled	11	CAM, COL, DUR, HGO, MEX, MOR, NAY, OAX, TAM, TLAX, YUC	12	CAM, COL, DUR, HGO, MEX, MOR, NAY, TAB, TLAX, SON, SIN, YUC	14	BCS, CAM, COL, DF, DUR, HGO, MEX, MICH, MOR, NAY, TAB, TLAX, TAM, YUC
	Unskilled	12	CAM, COL, DF, DUR, HGO, NAY, PUE, TAB, TAM, TLAX, YUC	12	CAM, COL, DF, DUR, HGO, NAY, QUIN, TAB, TAM, TLAX, SIN, YUC	11	CAM, COL, DF, HGO, MEX, NAY, QUIN, TAB, TAM, TLAX, YUC
(Quadrant II) Pure inward	Skilled	6	COA, DF, QUIN, SIN, SON, ZAC	3	BCS, GRO, QUIN	3	QUIN, SIN, ZAC
	Unskilled	4	COA, SIN, SON, SLP	1	SLP	4	DUR, SIN, SLP, ZAC
(Quadrant III) Redistributors	Skilled	11	AGS, BC, CHI, GTO, JAL, MICH, NL, PUE, SLP, TAB, VER	15	AGS, BC, COA, CHI, CHIS, DF, GTO, JAL, MICH, NL, OAX, PUE, SLP, VER, ZAC	12	AGS, BC, COA, CHI, CHIS, GTO, JAL, NL, PUE, QRO, SLP, VER
	Unskilled	11	AGS, BC, BCS, CHI, CHIS, GTO, GRO, MICH, NL, VER, ZAC	13	BC, BCS, CHI, CHIS, COA, GTO, GRO, MICH, NL, OAX, VER, ZAC	14	AGS, BC, BCS, CHI, CHIS, COA, GTO, GRO, JAL, MICH, OAX, QRO, SON, VER
(Quadrant IV) Pure outward	Skilled	4	BCS, CHIS, GRO, QRO	2	TAM, QRO	3	GRO, OAX, SON

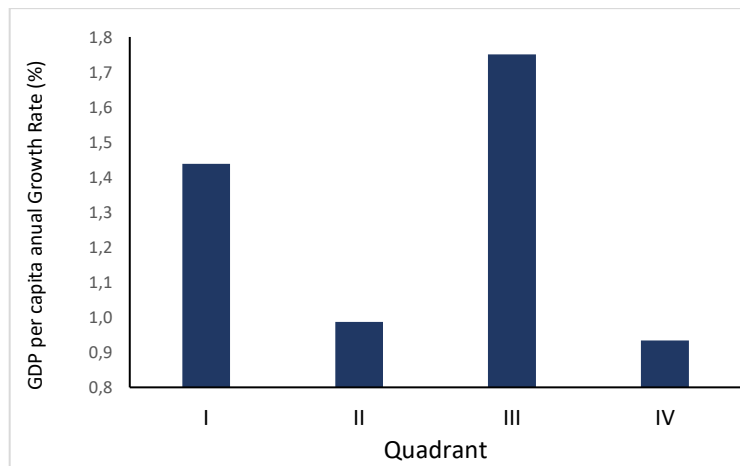
	Unskilled	4	MEX, MOR , OAX, QRO	6	AGS, MEX, MOR , PUE, SON, QRO	3	MOR , NL, PUE
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Source: Own elaboration, 2019

Finally, the results associated to quadrant III concentrate states experiencing internal migration dynamism not only by attracting but also sending migrants to other states. These states also differentiate from the rest for having better economic growth performance along the period. For example, As showed in Figure 6, these states had in average an annual growth rate of GDP per capita of 1.8% which is higher than the other quadrants, see Figure 6. The particular cases of Queretaro (QRO) and Jalisco (JAL) stand out as they have become poles of economic development in central and central northern Mexico. On the contrary, quadrants II and IV have exhibited annual growth rates almost half of that corresponding to leading economic states.

Figure 6.

Annual GDP growth and Quadrants, 2000-2015



Source: Own elaboration, 2019

5. Conclusion

The results presented in study show changes in the internal migration patterns of both skilled and unskilled labor in Mexico during the periods 1995-2000, 2005-2010, and 2010-2015. The relationship of domestic labor mobility with regional transformations as a result of new geographical patterns of location of investment, production and economic agglomeration is also made evident.

The analysis of the mobility of labor within the country is in turn relevant to a given endowment of skilled and unskilled labor, and where both positive and negative net balances necessarily imply changes in the magnitude of migratory flows between states. The migratory Gini index has been showed as a useful element to have a better understanding of migration to urban areas, depending on the type of labor. It also illustrates the links between states within the country in terms of migration over time.

Among the main findings are the following. While some states in the Northern region have experienced a net decrease in the number of migrants, both unskilled and skilled, states in the Central region, such as Queretaro, has been the one reporting the greatest gain of migrants with respect to other regions of the country, particularly in the period 2010-2015. These results also suggest the consolidation of the Central region as a potential new development pole of the country this is due to increasing role on redistributing human capital in Mexico.

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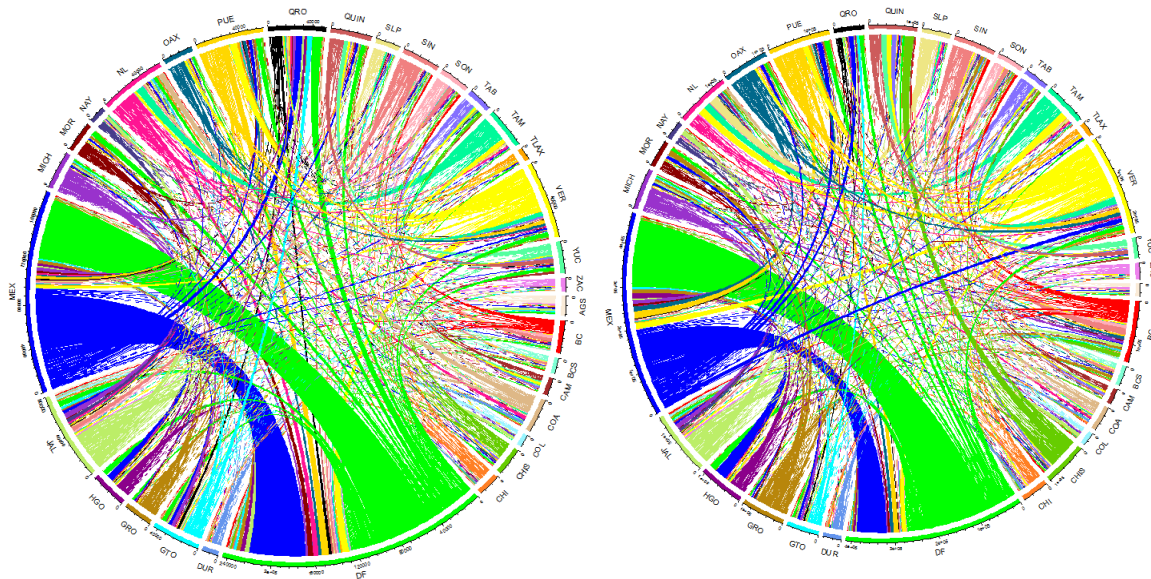
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c. Period, 2010-2015



Source: Own elaboration, 2019

Appendix A2:

State abbreviations

AGS: Aguascalientes; BC: Baja California; BCS: Baja California Sur; CAM: Campeche; COA: Coahuila; COL: Colima; CHIS: Chiapas; CHI: Chihuahua; DF: Ciudad de México; DUR: Durango; GTO: Guanajuato; GRO: Guerrero; HGO: Hidalgo; JAL: Jalisco; MEX: Estado de México; MICH: Michoacán; MOR: Morelos; NAY: Nayarit; NL: Nuevo Leon; OAX: Oaxaca; PUE: Puebla; QRO: Queretaro; QUIN: Quintana Roo; SLP: San Luis Potosi; SIN: Sinaloa; SON: Sonora; TAB: Tabasco; TAM: Tamaulipas; TLAX: Tlaxcala; VER: Veracruz; YUC: Yucatan; ZAC: Zacatecas.

Appendix A3.

Gini indexes at state level

State	Period											
	1995-2000				2005-2010				2010-2015			
	Skilled		Unskilled		Skilled		Unskilled		Skilled		Unskilled	
	in	out	in	out	in	out	in	out	in	out	in	out
AGS	0.5944	0.6723	0.6496	0.7116	0.5891	0.6443	0.6183	0.7059	0.6343	0.6552	0.6328	0.6677
BC	0.5996	0.6635	0.5575	0.6235	0.6054	0.6203	0.5971	0.5962	0.5899	0.6172	0.5338	0.6127
BCS	0.6372	0.7189	0.6473	0.7056	0.7117	0.6703	0.5905	0.6276	0.7008	0.6671	0.6211	0.6547

CAM	0.7864	0.7524	0.7772	0.8106	0.7738	0.7353	0.8297	0.7550	0.7963	0.7149	0.8136	0.7534
COA	0.6976	0.6178	0.7876	0.6747	0.5811	0.6578	0.6628	0.6948	0.6343	0.6521	0.6306	0.6539
COL	0.7225	0.7173	0.7757	0.7435	0.6943	0.7470	0.6895	0.7308	0.7183	0.7217	0.6841	0.7698
CHIS	0.5620	0.7108	0.6372	0.7090	0.5969	0.6427	0.6179	0.5914	0.5833	0.5616	0.6338	0.5726
CHI	0.5989	0.6038	0.6161	0.7334	0.5865	0.5184	0.5628	0.6317	0.5416	0.5643	0.5462	0.6025
DF	0.6957	0.6681	0.7872	0.7972	0.6535	0.6426	0.7914	0.7661	0.6777	0.6658	0.7893	0.7727
DUR	0.7076	0.7538	0.8378	0.7361	0.6944	0.7890	0.7077	0.7725	0.6872	0.6790	0.6828	0.6713
GTO	0.6133	0.6426	0.5860	0.6818	0.6068	0.6439	0.5708	0.6111	0.6319	0.6005	0.5875	0.6188
GRO	0.6079	0.7329	0.6622	0.7049	0.7059	0.6766	0.6317	0.6378	0.6607	0.7009	0.6152	0.6511
HGO	0.6903	0.7620	0.7522	0.8200	0.6892	0.7758	0.6910	0.8112	0.7304	0.7687	0.6983	0.8071
JAL	0.4506	0.5277	0.5488	0.5185	0.4934	0.5418	0.5416	0.5044	0.4888	0.4644	0.5416	0.4763
MEX	0.6849	0.8583	0.6911	0.8584	0.7493	0.8128	0.6598	0.8278	0.7585	0.7805	0.6993	0.8179
MICH	0.6167	0.6652	0.6710	0.6989	0.6573	0.6816	0.6496	0.6774	0.6661	0.6608	0.6275	0.6632
MOR	0.6935	0.7934	0.6844	0.8109	0.7347	0.8419	0.6284	0.7996	0.7062	0.7751	0.6693	0.7869
NAY	0.7532	0.7503	0.7995	0.7450	0.8001	0.7643	0.7702	0.7577	0.7628	0.7246	0.7614	0.7610
NL	0.6017	0.6036	0.7057	0.7051	0.5689	0.5338	0.6547	0.6922	0.5708	0.6161	0.6143	0.6972
OAX	0.6680	0.7304	0.6915	0.7574	0.6441	0.6701	0.6340	0.6933	0.6543	0.6690	0.6167	0.6716
PUE	0.5938	0.6703	0.7391	0.7683	0.5825	0.6253	0.6768	0.7221	0.6394	0.6400	0.6581	0.6936
QRO	0.6278	0.7392	0.6436	0.7622	0.5968	0.7120	0.6193	0.7333	0.6467	0.6348	0.6447	0.6672
QUIN	0.6742	0.6901	0.7501	0.7958	0.6961	0.6608	0.7200	0.7335	0.6668	0.5988	0.7256	0.7376
SLP	0.6277	0.6396	0.7797	0.6937	0.6452	0.5976	0.7870	0.6690	0.6256	0.5291	0.7823	0.6368
SIN	0.7458	0.6752	0.8281	0.7228	0.7421	0.6860	0.7624	0.7307	0.6714	0.5922	0.7222	0.6270
SON	0.7451	0.6784	0.7935	0.7158	0.6773	0.7716	0.6755	0.7180	0.6191	0.6663	0.6440	0.6743
TAB	0.6413	0.6745	0.7376	0.7918	0.6630	0.7223	0.7772	0.7280	0.6703	0.7070	0.7498	0.7406
TAM	0.6982	0.7500	0.7282	0.7912	0.6469	0.7233	0.7135	0.7560	0.6992	0.7490	0.7118	0.7567
TLAX	0.7938	0.7948	0.7727	0.8354	0.7753	0.7896	0.7447	0.7911	0.7560	0.7458	0.7562	0.7815
VER	0.6073	0.6415	0.6575	0.6520	0.6050	0.6132	0.6182	0.6076	0.6066	0.6061	0.5640	0.6038

YUC	0.7975	0.7558	0.9106	0.7939	0.7951	0.7013	0.8791	0.8080	0.7431	0.7355	0.8470	0.7705
ZAC	0.6660	0.6490	0.7109	0.6626	0.6533	0.6057	0.6792	0.6343	0.6815	0.6011	0.6825	0.5896

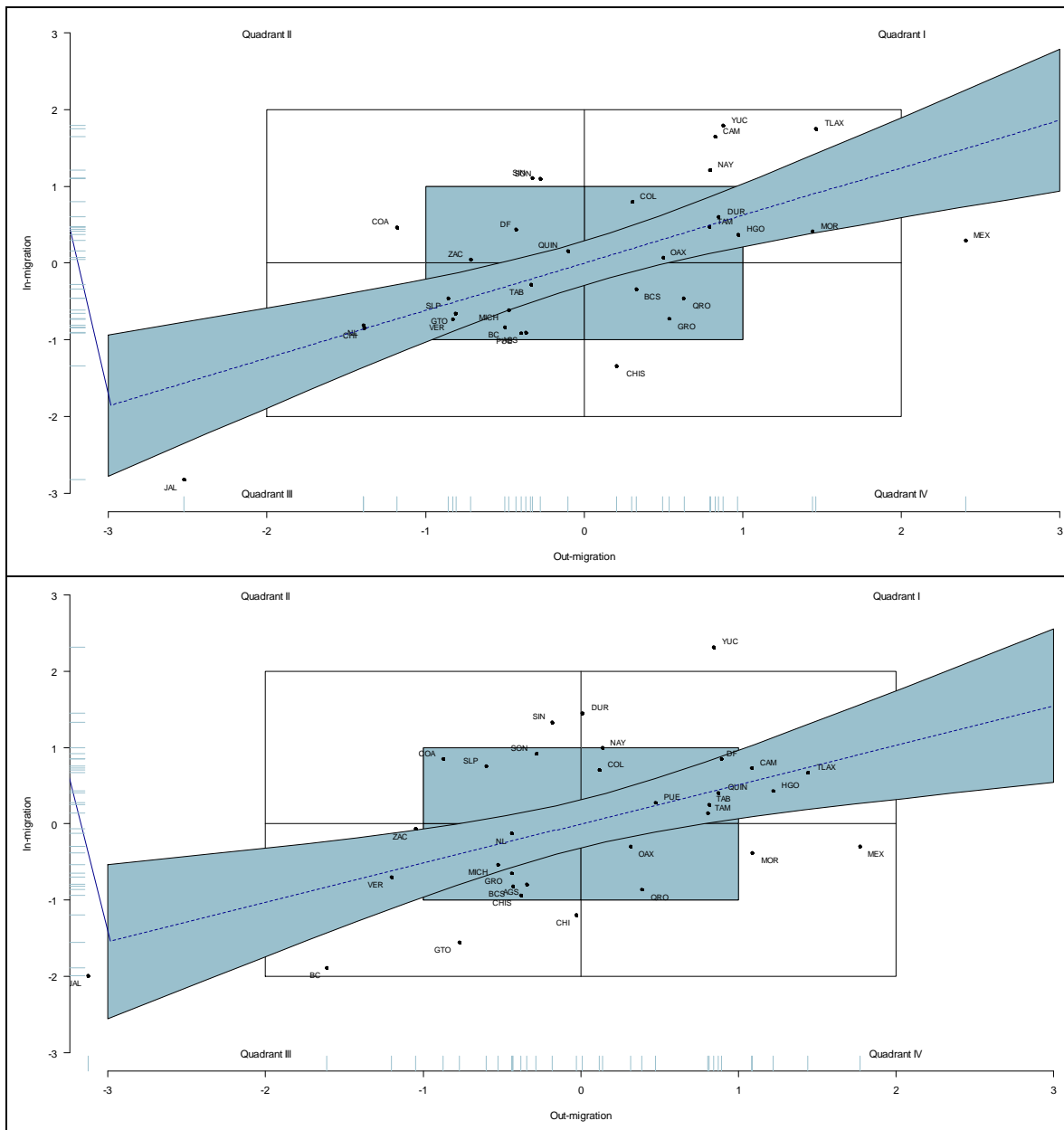
in: Immigration field Gini index; out: Outmigration field Gini index.

Source: Own elaboration, 2019

Appendix A4.

Migration Field Diagrams

Figure A4.1 Skilled (upper) and unskilled (lower) migrants by states, 1995-2000



Source: Own elaboration, 2019

Appendix A5.

Main statistics of SLRM among Gini indexes at state level

Year	Skilled	Unskilled
2000	$\hat{b}_1 = 0.62, R^2 = 0.39, RMSE = 0.77$	$\hat{b}_1 = 0.52, R^2 = 0.27, RMSE = 0.84$
2010	$\hat{b}_1 = 0.73, R^2 = 0.53, RMSE = 0.68$	$\hat{b}_1 = 0.64, R^2 = 0.42, RMSE = 0.75$
2015	$\hat{b}_1 = 0.82, R^2 = 0.68, RMSE = 0.56$	$\hat{b}_1 = 0.67, R^2 = 0.45, RMSE = 0.73$

RMSE: root mean square error; \hat{b}_0 was statistically equal to zero for all years.

Source: Own elaboration, 2019

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