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shocks. Evidence from the Panic of 1907**

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Migrant self-selection in the presence of random shocks. Evidence from the Panic of 1907

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Abstract

We evaluate the responsiveness of migrant self-selection to short-run changes in the economic environment. Using novel historical micro data, we estimate the initial selectivity of Mexican migration (1906-08) and focus on labor institutions as short-run adjustment channels of self-selection. We find that the first Mexican migrants were positively self-selected on the basis of height—a proxy for physical productivity of labor. Additionally, the US financial crisis of 1907 significantly modified self-selection. Shifts in migrant self-selection during and after the crisis were influenced by the *enganche*, an institution that reduced migration costs, but only for the “best” Mexicans during “good” economic times.

Keywords: labor migration, migrant self-selection, Panic of 1907, Mexico

JEL Classification Numbers: F22, J61, N36, O15

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1. Introduction

Migrants are not selected randomly from the sending population. To explain migrant self-selection, previous literature predominantly focuses on systemic drivers that are fixed in the short run and tend to change slowly over time: earnings inequality in sending and destination countries ([Borjas, 1987](#)), migration costs ([Chiquiar & Hanson, 2005](#); [Chiswick, 1999](#)) and factors relaxing liquidity constraints ([McKenzie & Rapoport, 2010](#); [Orrenius & Zavodny, 2005](#)). Therefore, this literature gives the impression that self-selection patterns tend to remain sticky in the short run. To our knowledge, changes in immigration restrictions (immigrant quotas and skill-based admission systems) are the only disruptive factors that have been studied to explain shifts in migrant self-selection ([Belletini & Ceroni, 2007](#); [Greenwood & Ward, 2015](#); [Massey, 2016](#); [Spitzer & Zimran, 2018](#)). However, immigration policy interventions may be implemented with long lags, allowing migrants to anticipate changes and adjust to them.¹

Overall, we know little about the responsiveness of migrant self-selection to drastic changes in the economic environment produced by unanticipated events such as natural disasters, epidemics or stock market crashes. Large shocks from the demand or supply-side offer an opportunity to assess the speed that the composition of migration may change and under which conditions. Sudden shifts in self-selection patterns can have important implications. For example, in the destination economy, they may affect earnings of natives and existing immigrants. Altering competition in the labor market can in turn modify in and out-migration patterns at the local level ([Abramitzky et al., 2019](#), p. 16). Shifts in self-selection patterns can also affect the assimilation process of the immigrant population ([Massey, 2016](#), p. 21). In the country of origin, short-run changes in the composition of migration can affect inequality across households through remittance income from abroad ([Ibarraran & Lubotsky, 2007](#), p. 160).

¹For example, it took 25 years to pass the 1917 Immigration Act, which banned the entry of illiterate immigrants to the United States ([Spitzer & Zimran, 2018](#), p. 236).

This paper fills this void in the literature by asking a main question. Can migrant self-selection change in the short-run? To answer this question, we estimate the selectivity of Mexican migration in the early twentieth century (1906–08) and identify short-run shifts in self-selection exploiting a large but temporary shock that affected unexpectedly the demand of Mexican migrants: the US financial crisis of 1907. We then ask through which specific channels the composition of migrants may adjust in the short run. We provide evidence suggesting that institutionalized systems of labor recruiting constitute a feasible short-run adjustment channel of migrant self-selection. To our knowledge, the role of labor institutions in shaping migrant self-selection has not been studied before. We frame the paper at the beginning of the Mexico-US migration, because this period represents a unique setting to study selection into migration. During this period Mexican mass migration started (Cardoso, 1980; Feliciano, 2001; Gratton & Merchant, 2015) and Mexican migrants could cross the border without restrictions (Durand, 2016; Fogel, 1978; Samora, 1982). Hence, our findings are unlikely to be influenced by under-enumeration of undocumented migrants, and do not capture effects of immigration restrictions that artificially modify the composition of migrant workers.

To quantify the selectivity of Mexican migration, we use height as a proxy for physical productivity of labor.² Our migrant sample consists of novel historical micro data: individual border crossings registered at nine entrance ports (see Figure A.1 in Annex A). We represent individuals that chose to remain in Mexico using military recruitment records of ordinary soldiers and elite forces, and passport application records. These comparison samples capture the lower, intermediate and upper ranks of Mexico's height distribution, respectively. Our empirical strategy estimates differences in height between migrants and each comparison sample to determine from which part of the height distribution the first migrants were drawn. To obtain the best results possible, we control for the individuals' region and year of birth: factors that may influence height across space and over time. The results show that the first Mexican

²Adult stature is indicative of income, health and returns to strength, especially in contexts where large sectors of the economy are not mechanized (Juif & Quiroga, 2019).

migrants were 2.2 cm taller than the ordinary soldiers; 0.5 cm taller than the military elite forces; and 2.1 cm shorter than the passport holders. Therefore, the beginnings of the Mexico-US migration were characterized by an intermediate or positive selection on the basis of height. We also observe variation in the degree of self-selection across migration regions. In poorer regions, we observe a stronger positive selection relative to the ordinary soldiers.

To evaluate if migrant self-selection patterns can change in the short run, we use the Panic of 1907 as a natural experiment of history. Following [Odell & Weidenmier \(2004\)](#), the Panic of 1907 was determined by the 1906 San Francisco earthquake, and was one of the most severe financial crises in the United States before the Great Depression ([Frydman et al., 2015](#), p. 928; [Moen & Tallman, 1992](#), p. 611; [Odell & Weidenmier, 2004](#), p. 1003). During this nine-month crisis, the credit system of the American economy was severely affected. Banks and financial institutions of many cities limited or suspended their cash payments ([Andrew, 1908](#), p. 497), and around two thousand firms and over one hundred state banks failed ([Markham, 2002](#), p. 32). Although the crisis became a world-wide affair ([Johnson, 1908](#), p. 455), no bank collapsed or went bankrupt, nor losses for bill holders or depositors occurred in Mexico ([Gómez, 2011](#), p. 2095). Therefore, the Panic of 1907 provides us with exogenous variation in height across three periods: pre-Panic, Panic and post-Panic. The results suggest that, in the pre-Panic period, migrants were positively selected relative to the military elite (0.7 cm taller). During the Panic, migrants became negatively selected (0.2 cm shorter), but returned to pre-Panic levels after the crisis.

To explain the observed short-run shifts in self-selection, we examine a historical labor institution involved in the immigration process at that time: the *enganche*. The *enganche* was a system of labor recruiting used by American companies to transport and allocate laborers in the United States. We argue that Mexican migrants became less positively selected during the Panic, partially because the *enganche* was drastically reduced during this period. Indeed, the share of migrants recruited in Mexico went from 36% in the pre-Panic to 1% during the Panic. We provide evidence that American

recruiters systematically chose the tallest laborers, and thus influenced the selection of Mexican migration. On average, *enganche* migrants were 0.9 cm taller than migrants that crossed the US border without using this labor institution. We show that, in the pre-Panic period, the *enganche* effect accounted for 23% of the difference in height between migrants and the military elite. When the Panic of 1907 hit the American financial system, companies were not able to finance the recruitment of laborers. The absence of this labor institution in combination with other factors explain the less positive selection during the Panic. When we control for unobserved factors across states, our results reveal that in the pre-Panic period, the *enganche* effect could have accounted for 46% of the local (state level) self-selection pattern; and that post-Panic migrants became more positively selected relative to their pre-Panic peers.

The contributions of this paper are three-fold. First, we extend our knowledge about the selectivity of Mexican migration to the United States. In contrast to migrants from the European periphery, who were negatively selected in the Age of Mass migration (Abramitzky et al., 2012; Cohn, 1995),³ the first Mexican migrants were positively selected relative to the ordinary soldier or average laborer. This finding aligns with literature that argues Mexican migrants were not drawn from the lower half of the educational, ability or height distribution (Chiquiar & Hanson, 2005; Orrenius & Zavodny, 2005; Kosack & Ward, 2014). In other words, in the beginnings of the twentieth century, Mexico sent its *best* laborers—individuals with greater physical productivity—to the United States, who in fact might have been key for the American Southwest economic expansion (Gratton & Merchant, 2015, p. 528).

Second, to our knowledge, we are the first to show that the selectivity of international migration can change in the short run in the absence of immigration restrictions. The adjustment to unexpected economic factors could be very fast, we observe significant changes in the composition of migrants in a matter of months. Shifts in our measure of selection are greater when controlling for unobserved factors across states. In other words, the effect of the Panic of 1907 operated at the local level. This result

³See Abramitzky & Boustan (2017) for a review.

supports previous research arguing that selection into migration is determined within sub-national environments (Abramitzky & Boustan, 2017; Spitzer & Zimran, 2018), and it suggests that the decision to migrate could be very responsive to unanticipated changes in local conditions.

Third, we provide evidence confirming that institutions sufficiently involved in the immigration process can shape migrant self-selection (Abramitzky & Boustan, 2017, p. 1325). In the particular case of labor-recruiting systems, the direction and degree of self-selection will depend on the intensity and nature of recruiting. We speculate that the persistence of labor institutions reducing migration costs or relaxing liquidity constraints may explain the stickiness of migrant selection patterns over time despite changes in immigration policy. In this sense, Jenkins (1978, p. 526) argues that after the bracero program (1942–64),⁴ Mexican migration was characterized by a contractor system with the same objective as the *enganche*: recruit, transport and allocate Mexican laborers. However, this contractor system was based on undocumented migration. As the early twentieth century recruiters, contractors had the incentive to choose the best laborers.⁵ Therefore, to assess the *quality* of documented and undocumented migrants, we should consider the persistence of private labor institutions, which have shaped the selectivity of Mexican migration for over 100 years.

The remainder of the paper proceeds as follows. We describe the historical context of the research in the next section. In Section 3, we review the drivers of selection into migration, and introduce the shock that allows us to identify short-run shifts in migrant self-selection. In Section 4, we discuss related literature on human stature as a measure of selection. In Sections 5 to 7, we describe the data, empirical strategy and results, respectively. We assess the role of the *enganche* in shaping and adjusting migrant self-selection in Section 8. We conclude in Section 9.

⁴The bracero program was an administrative network of public and private organizations which, between 1942 and 1964, coordinated the seasonal movement of over 6 million Mexican workers for short-term agricultural employment (Jenkins, 1978, p. 525). Like the *enganche*, the program recruited, transported and allocated Mexican braceros or field hands.

⁵Using data of 52 communities in Mexico, Orrenius & Zavodny (2005) argue that undocumented immigrants are not negatively selected with regard to education.

2. Historical background

By the end of the nineteenth century, the United States emerged as the world's leading manufacturing nation and its economy experienced average growth rates of 4.5%–5% (Balke & Gordon, 1989; Romer, 1989; Rhode, 2002). This economic expansion was possible due to the constant and unrestricted supply of labor and capital.

From 1850 to 1913, the United States received a constant labor supply from international migration flows.⁶ About 30 million Europeans migrated to the United States looking for better living conditions (Hatton & Williamson, 1998). Mexicans joined this mass migration from 1880s, but during the 1900s Mexican migration increased sharply and expanded its geographic range of settlement (Gratton & Merchant, 2015, p. 521 & 528).⁷ Diverse factors influenced the mass migration of Mexicans, but certainly it was favored by the immigration policy at the time: Mexicans were not considered immigrants who sought to settle permanently, but temporary aliens who moved back and forth, supplying labor without restrictions (Fogel, 1978, p. 10; Samora, 1982).⁸ Mexican migrants were employed mainly in farms, mines and the construction of railroads across Arizona, New Mexico and Texas (Clark, 1908).⁹ They were mostly unskilled laborers emigrating from the northern states and the central plateau of Mexico. Overall, Mexican migration represented an inexhaustible source of cheap labor for the US economy.

In parallel, the American financial system was expanding rapidly. By 1907, there were 16 thousand financial institutions facilitating capital for the creation of new

⁶This period is known as the Age of Mass Migration.

⁷In 1910, the stock of Mexican migrants in the United States was about 222 thousand, and it doubled by the end of the Mexican Revolution (1910–20) (García y Griego, 1983).

⁸The Immigration Act of 1917 required all immigrants to pass a literacy test and pay an eight dollar head tax. These were the first restrictions imposed to Mexican migration (Kosack & Ward, 2014, p. 1015). However, Mexicans were exempted during wartime, and American employers persuaded the government to extend the exemption beyond the war's end. The open-door policy for Mexican emigration ended effectively in 1921, when the US Secretary of Labor ended the exemptions (Cardoso, 1980, p. 98).

⁹By 1909, Mexican migrants represented 17% of the labor force of the American railway industry (Verduzco, 1995).

firms in all economic sectors (Bruner & Carr, 2007, p. 116).¹⁰ These institutions were small unit banks, fiduciary trust companies, clearing houses and exchange houses that provided financial services at the local level. Most of these financial intermediaries were supported by small companies, the Bank of England or the United States Treasury. However, this fragmented financial system operated without a central bank. The absence of an effective financial regulation and the increasing optimism engendered by the growing economy fueled the tendency of the public to take on more risk and invest in speculative industries such as railways and mining. In this sense, the access to capital was relatively unconstrained for the US economy during this period.

The US economic bonanza was interrupted by a severe financial crisis in 1907, surpassed in severity only by the Great Depression. This crisis occurred during an era of intense and unrestricted migration, allowing us to study how the composition of international migration streams may adjust to changes in the business conditions at the destination.

3. Selection into migration

Migrant self-selection has become a prolific topic since Borjas (1987) formalized the Roy model (Roy, 1951), because it provides a framework to predict the direction of self-selection: it informs our perception about migrant *quality*. Borjas argues that migrants from countries with relatively high earnings inequality—which proxies for the rate of return to skills—will be negatively self-selected: drawn from the lower half of the country-of-origin skill distribution. This is because countries with high earnings dispersion are unattractive to low-earnings workers. Therefore, workers with less-than-average productive skills would have the most to gain from moving to countries with low earnings inequality.

¹⁰To dimension the size of the US financial system at the time, in 2007 existed 7,500 financial institutions.

In addition to earnings distribution, migration costs can explain the direction of self-selection. [Chiquiar & Hanson \(2005\)](#) extend the Roy-Borjas model by considering that in practice migration costs vary by skill level.¹¹ Bureaucratic, transportation, job-search and information costs involved in migration represent fewer hours of work for the more skilled, who can finance migration with no or lower borrowing costs. Hence, migrants should be positively self-selected if migration costs are large enough and credit constraints sufficiently binding. This approach has motivated the assessment of some factors that can shape migrant self-selection by affecting migration costs—for example, migrant networks ([McKenzie & Rapoport, 2007, 2010](#); [Munshi, 2003](#)) and wealth ([Abramitzky et al., 2013](#); [Connor, 2019](#)). Also, in the past and present, guest worker programs, immigrant quotas and skill-based admission systems have been implemented to artificially increase or reduce the supply of workforce ([Clemens et al., 2018](#); [Massey & Pren, 2012](#); [Timmer & Williamson, 1998](#)). These immigration policy interventions modify migration costs or entry requirements, and consequently the skill-composition of migrants as well as the direction (degree) of selection into and return migration (see, for example, [Antecol et al., 2003](#); [Bianchi, 2013](#); [Greenwood & Ward, 2015](#); [Massey, 2016](#); [Mayda et al., 2018](#); [Spitzer & Zimran, 2018](#); [Ward, 2017](#)).

In general, the previous drivers are more or less fixed in the short run ([Chiquiar & Hanson, 2005](#), p. 243). Convergence/Divergence in absolute earnings between origin and destination countries, and changes in earnings inequality are long-run processes. Immigration reforms can also take years or even decades to materialize due the political clout of migrants ([Goldin, 1994](#)). Overall, we know little about the responsiveness of migrant self-selection to short-run changes in the economic environment.

3.1 Short-run shifts in migrant self-selection

To observe short-run changes in the degree or direction of self-selection, some of the drivers outlined previously must be impacted abruptly from the demand or supply

¹¹In the basic Roy-Borjas model migration costs are assumed to be the same for everyone.

side. Severe shocks to the origin or destination economic environment can change the incentives to migrate in the short run. Therefore, one way to study short-run shifts in migrant self-selection is by finding large disruptive events in history.

Previous literature shows that earnings inequality can change precipitously during and after large-scale shocks such as destruction of infrastructure (wars or social conflicts), macroeconomic and financial crises, and fiscal policy reforms (see for example, [Acemoglu et al., 2004](#); [Alvaredo et al., 2018](#); [Piketty & Saez, 2003](#)). [Brewer et al. \(2013\)](#) argue that these events have heterogeneous effects across income groups, suggesting that shocks can modify the composition of the population at risk of migration. Large shocks can also encourage (discourage) migration by impacting factors relaxing migration costs. For instance, the effect of migrant networks could be affected during economic recessions, pricing out the poor from migration ([Ruiz & Vargas-Silva, 2010](#)). In the presence of credit constraints, any short-run shift in the direction or degree of self-selection would depend on the shock's nature and capacity to significantly affect directly or indirectly earnings inequality and migration costs.

To identify short-run shifts in migrant self-selection, we exploit a large but temporary shock that affected unexpectedly the demand of Mexican migrant labor: the Panic of 1907.

3.2 The Panic of 1907: a natural experiment of history

In the early twentieth century, the US economic growth was accompanied by fierce financial speculation. As a sign of this phenomenon, the Dow Jones index doubled from 1904 to 1906, and at the end of 1905, the call money rate was 25% and foreseen to increase up to 60% the following year ([Markham, 2002](#), p. 29). This speculative process occurred during a period of increasing long-term investments. National and state banks increased their bond and stock assets from 50 million in 1892 to 487 million in

1907 (Johnson, 1908, p. 457).¹² This environment made the financial system fragile and limited the liquidity of the economy (Bruner & Carr, 2007, p. 115).

In April 1906, an earthquake devastated the city of San Francisco causing damages equal to more than 1% of the American gross national product (GNP). As a consequence, extraordinarily large amounts of gold flowed from London to the United States, because most of the city's insurance policies were underwritten by British companies. This was followed by defensive measures (increase of discount rates and discrimination against American finance bills) by the Bank of England and other European banks to sharply reduce the flows of gold to the United States (Odell & Weidenmier, 2004, p. 1003 & 1021). This sequence of events along with the increasing fragility of the American financial system made a market crash almost inevitable.

In March 1907, the demand for liquidity produced a wave of panic, leaving losses of 2 billion dollars in stocks. Major players like the railway company Union Pacific saw their shares devalued by 29%.¹³ The panic also caused the temporarily suspension of dividend payments by major mining companies such as the United States Steel Corporation (Markham, 2002, p. 29). To neutralize the panic, companies and city governments increased their bonds' interest rates. However, the wave of selling continued, pushing down stock prices.¹⁴ As the process developed, most fiduciary institutions saw their 10% required reserve deposits reduced. In October, the Knickerbrocker Trust Company, the third largest trustee in New York, went into bankruptcy. This event increased the panic among the public and finally sank the financial market. Throughout August to December 1907, two thousand companies went bankrupt as did 100 state banks and 30 national banks (Markham, 2002, p. 32).

¹²Similarly, trust institutions increased their holdings of debt securities by more than 500%, reaching a value of 785 million dollars in 1907 (Johnson, 1908, p. 457).

¹³In January 1906, the average price of the railroad stock was 138 dollars. In March 1907, the price fell to 98 dollars (Johnson, 1908, p. 456).

¹⁴This phenomenon was recorded by the American press throughout 1907. For instance: "New York. Aug. 12 – The wildest break in the stock market since the present wave of selling occurred today. It carried stocks down from 1 to 17.5 points. In some cases to new low records. About one-half of the entire number of issues dealt on the exchange rate were sold at new low prices for the year." (The Washington Post, 1907).

This financial crisis—known as the Panic of 1907—was one of the most severe financial crises in the United States before the Great Depression (Frydman et al., 2015, p. 928; Moen & Tallman, 1992, p. 611; Odell & Weidenmier, 2004, p. 1003). In fact, contemporaries argued that it was "probably the most extensive and prolonged breakdown of the country's credit mechanism which has occurred since the establishment of the national banking system" (Andrew, 1908, p. 497). The suspension of payments constrained basic transactions in all sectors, and as a consequence some industries curtailed operations and trade was considerably depressed (Frydman et al., 2015, p. 912; Johnson, 1908, p. 454).¹⁵ Full convertibility of deposits by banks was not restored until January 1908 (Frydman et al., 2015, p. 912). Although the crisis became a world-wide affair (Johnson, 1908, p. 455), no bank collapsed or went bankrupt, nor losses for bill holders or depositors occurred in Mexico (Gómez, 2011, p. 2095).

Since the Panic of 1907 was influenced by the 1906 San Francisco Earthquake and did not affect the Mexican financial system, it represents an exogenous shock to the migration decision in Mexico that allows us to identify short-run shifts in migrant self-selection.¹⁶ The Panic of 1907 also enables us to explore the channels through which the selectivity of migration could adjust to short-run changes in the destination's business conditions. Additionally, this crisis occurred in a period when Mexicans could migrate to the United States without restrictions, making it possible to study short-run shifts in self-selection without capturing effects from under-enumeration of undocumented migration or immigration restrictions in place.

4. Selection of Mexican migration in the past and present

Knowing the selectivity of Mexican migration—whether Mexicans tend to come from the bottom or top of the Mexican skill distribution—has important implications in the short and long run. A persistent migration stream composed of less-skilled Mexicans

¹⁵The American industrial production peaked in July 1907 and then fell 30% in the second half of the year (Hansen, 2014, p. 555).

¹⁶Similarly, recent literature shows that the earthquake changed significantly the settlement patterns of migrants in the immediate aftermath (Ager et al., 2019, p. 13).

will tend to reduce the relative scarcity of high-skilled labor in Mexico over time and reduce earnings disparities between high and low-skilled workers. The composition of migrants could also influence remittances sent from abroad, affecting the economic well-being of families in Mexico ([Ibarraran & Lubotsky, 2007](#), p. 160).

There is no consensus about the selectivity of Mexican migration in contemporary times. [Chiquiar & Hanson \(2005\)](#) argue that the negative selection predicted by the Roy-Borjas model does not hold when comparing counterfactual wage densities for migrants and residents of Mexico. They find that under a common price for observable skills, Mexican migration was characterized by an intermediate or positive selection from 1990 to 2000. Similarly, [Orrenius & Zavodny \(2005\)](#) argue that during the 1980s and 1990s undocumented Mexican migrants were drawn from the middle of the educational distribution, and stricter border enforcement was associated with higher average skill levels. [McKenzie & Rapoport \(2010\)](#) observe the same selection pattern in 1997, but only in communities with weak migrant networks: stronger networks influence negative migrant self-selection.

In contrast, using the 2000 Mexican Census, [Ibarraran & Lubotsky \(2007, p. 190\)](#) argue that Mexican migrants tend to be less educated than the average resident in Mexico. In addition, they find that the degree of negative selection is magnified in Mexican municipalities that have relatively higher returns to education. Exploiting Mexican panel data, [Ambrosini & Peri \(2012\)](#), [Kaestner & Malamud \(2014\)](#), and [Fernandez-Huertas \(2011\)](#) find that migrants earned lower wages than their non-migrant peers—that is, they support the negative-selection hypothesis of Borjas. As argued by [Abramitzky & Boustan \(2017\)](#), differences in the observed self-selection patterns may be rooted in the measure of selection used and/or under-enumeration of undocumented Mexican migrants.

Undocumented migration bias could be overcome by studying Mexican migration in the past. Before 1921, Mexican migrants did not have a clear incentive to avoid official entrance ports since they could cross the border without restrictions ([Cardoso,](#)

1980, p. 98). However, the historical character of Mexican migration has not been exploited to study selection into migration. Contrary to nowadays, the United States was slightly more unequal than Mexico in 1910. The Gini index of income was 0.54 in the United States (Lindert & Williamson, 2016, p. 174) and 0.51 in Mexico (Moatsos et al., 2014, p. 206). Therefore, the basic Roy-Borjas model would predict a positive selection of Mexican migrants. The only study for the period is Kosack & Ward (2014), who use height to proxy migrant quality and estimate the self-selection of Mexican migrants into and out of the United States in the 1920s. Their empirical strategy estimates differences in height between migrants and Mexican soldiers controlling for diverse factors that may influence an individual's height. Their findings are in line with the basic Roy-Borjas model prediction: Mexican migrants were positively self-selected. In addition, they link their migrant sample to the 1930 US and Mexican censuses to obtain samples of permanent and return migrants. They argue that return migrants were neutrally selected relative to permanent migrants.

4.1 Height as a measure of selection

There is an increasing body of cliometric literature using height to study migrant self-selection. Spitzer & Zimran (2018) find that Italian migration was negatively selected at the national level from 1907 to 1925. They also show that national-level estimates could mask substantial variation at the local level. In fact, Italian migrants were positively selected at the local level and selection varied systematically within Italy, with more positive local selection from poorer provinces. Blum & Rei (2017) analyze the health human capital of Jewish migrants from 1940 to 1942. They suggest that—on the basis of stature—both refugees and nonrefugees were positively selected. In addition, Humphries & Leunig (2009) and Juif & Quiroga (2019) address the self-selection of internal migrants in England (1844–48) and Spain (1893–1954), respectively. Both studies find that migrants were taller than those who chose to remain.

Average height reflects genetic factors as well as nutritional and health conditions during early childhood and youth. Since wealthier people have better access to

food, hygienic conditions and medical resources, they tend to be taller than the poorer population (see, for example, [Borrescio-Higa et al., 2019](#); [Deaton, 2007](#); [Komlos & Baten, 2004](#); [Komlos & Meermann, 2007](#); [Komlos & A'Hearn, 2019](#); [Steckel, 1995](#)). Hence, human stature is indicative of income, wealth and life chances. Taller individuals also develop better cognitive abilities, reach higher levels of education and earn more as adults ([Case & Paxson, 2008](#); [Ogórek, 2019](#); [Schultz, 2002](#)). Moreover, for some occupations there are returns to strength, which are correlated with height as well ([Juif & Quiroga, 2019](#), p. 116).

Human stature is useful as a measure of selection because for adult migrants it cannot be manipulated in anticipation of or in response to migration ([Spitzer & Zimran, 2018](#), p. 229). In addition, average height is relevant for studying migrant self-selection when wage data are scattered or unreliable, and large sectors of the economy rely on physical productivity of labor. [López-Alonso \(2007\)](#) documents that this was the case of Mexico in the early twentieth century, making human stature the best measure to estimate the initial selection patterns of Mexican migration. Kosack and Ward's research is our closest reference in methodology and time period. However, their results regard to the *Restrictions and Deportations Era (1921–41)*, and their findings may capture persistent effects of the Mexican Revolution (1910–20). Although we also use height as a measure of selection, our research regards to the *Beginnings (1884–1910)* of the migration stream and focuses on the responsiveness of migrant self-selection to short-run changes in the economic environment.¹⁷ In the next section, we describe the sources from where we obtain the anthropometric data for our research.

5. Data

5.1 Migrant sample

The registration of aliens arriving at Mexico-US land border ports began in 1906. American authorities used different types of documents to collect information about

¹⁷See [Durand \(2016, p. 7\)](#) for a periodization of Mexican migration.

these individuals. These documents are known as Mexican Border Crossing Records (MBCRs), and at the time were conducted by the Bureau of Immigration and Naturalization. The migrant sample that we exploit comes from the publication N° A3365.¹⁸ It contains two-sheet manifests reporting rich and diverse information of migrants that crossed the border at nine entrance ports (see [Figure A.1](#) in Annex A). The manifests report individual characteristics such as age, sex, marital status, occupation, ability to read and write, citizenship and race. They also report anthropometric data of the individual (height, complexion and color of eyes and hair), and geographical information regarding his/her birthplace, final destination and last residence. In addition, the manifests provide information regarding the individual's current and previous migration spells.

The sample covers the period from July 1906 to December 1908 and consists of 9,083 Mexican migrants.¹⁹ We exclude data from 1909 onward to capture only labor migrants and not refugees from the Mexican Revolution (1910–20). To estimate the selectivity of Mexican migration, we use the migrant's age, height, birthplace, and occupation. The anthropometric data was recorded by a sworn physician and surgeon, who examined each migrant at the entrance port. The migrant's age, birthplace and occupation were self-reported, and consequently subject to biases.

One caveat is that the sample records only documented migration (crossings at official entrance ports) and may present problems of selection and under-enumeration. However, at the turn of the twentieth century, Mexicans were not considered immigrants who sought to settle permanently, but temporary workers who moved back and forth supplying labor without major restrictions ([Durand, 2016](#); [Fogel, 1978](#)). Hence, it is not clear if the first Mexican migrants had a clear incentive to avoid official entrance ports as in present times. In addition, [Escamilla-Guerrero \(2019\)](#) provides evidence

¹⁸The title of the publication is: Lists of Aliens Arriving at Brownsville, Del Rio, Eagle Pass, El Paso, Laredo, Presidio, Rio Grande City, and Roma, Texas, May 1903-June 1909, and at Aros Ranch, Douglas, Lochiel, Naco, and Nogales, Arizona, July 1906-December 1910. The publication N° A3365 does not report data for years prior 1906 and entrance ports in California.

¹⁹[Escamilla-Guerrero \(2019\)](#) provides a full description of the publication N° A3365 and sampling plan followed to transcribe the micro data.

suggesting that this sample is representative for Mexican migration during the 1900s and may capture an important share of the total border crossings. To our knowledge, it is the only migration data at the individual level available to study Mexican migration before 1910.

5.2 *Comparison samples: military records and passport applications*

We use military recruitment files and passport records to compare migrants with individuals that chose to remain in Mexico. These data are the result of extensive archival work completed by [López-Alonso \(2015\)](#), who uses height to study secular trends of living standards in Mexico from 1850 to 1950.²⁰ We believe that these comparison samples capture different parts of the height (earnings) distribution of the Mexican population, allowing us to identify from which part of the distribution the migrants were drawn.

The military recruitment files consist of two samples that capture two points of the height distribution in Mexico. On the one hand, the federales were average soldiers of the Mexican army (cavalry, infantry, and artillery), who served and retired, lost their lives in the line of duty, or left their service without authorization before the ending of their contracts (deserters). At the time, there were minimum requirements to enlist in the army. Recruits had to be between 18 and 45 years of age, be at least 160 centimeters tall, be able to understand Spanish language, be a Mexican citizen, and other health requirements. While these requirements might have introduced systematic biases to the sample, [López-Alonso \(2015, p. 112\)](#) shows that neither of these requirements were enforced during the period. The sample size is 7,088 males born between 1840 and 1950 that proxy for the average laborer/peasant in Mexico—that is, the lower ranks of the height (earnings) distribution. The source of this data are the archives of the Ministry of National Defense (*Secretaría de la Defensa Nacional*–SEDENA).

On the other hand, the rural police, known as the rurales, was a militia created in 1860 as an armed group loyal to the president. The members of this militia received a

²⁰[López-Alonso \(2015, p. 107\)](#) provides a detailed description of the archival worked involved.

higher salary than the federales and needed to bring their own horses and weapons in the militia's beginnings. The rurales often received additional monetary rewards and political favors to maintain the stability in the country. The sample size is 6,820 individuals born between 1840 and 1900.²¹ This sample covers all the enlistment records of this militia, and the source of this data is the General National Archive, Public Administration Section (*Archivo General de la Nación*–AGN). We considered the rurales sample separately from the federales because clearly the rurales were not representative of the average Mexican soldier. The fact that they received a higher salary and had to bring their own equipment suggests that they might have been relatively richer than the average soldier. Moreover, they received extra monetary and non-monetary rewards for their service. Hence, the rurales could be considered as the military elite of that time, representing the intermediate ranks of the height (earnings) distribution in Mexico (López-Alonso, 2015, p. 156).

Finally, the passport records consist of all the passport applications made from 1910 to 1942 reporting the applicant's height. We believe that this sample represents the upper ranks of the height (earnings) distribution because passport holders must be individuals with the economic means to travel abroad for business, leisure or education purposes (López-Alonso & Condey, 2003). Nevertheless, two important characteristics of these data should be noticed. Firstly, height was self-reported by the applicant. Secondly, the records capture all the issued passports but not all the travel permits issued by regional offices to applicants that could not travel to Mexico City. The sample size is 6,746 male individuals born between 1860 and 1922. The source of these data are the archives of the Ministry of Foreign Affairs (*Secretaría de Relaciones Exteriores*–SRE) (López-Alonso, 2015, p. 121–22).

²¹The desertion rates in this militia were high since its members could sell their equipment at any time and locating deserters was costly López-Alonso (2015, p. 117–21).

5.3 Data refinements and descriptive statistics

To obtain the best results possible, we implement a series of data refinements. We keep only males reporting their town and state of birth in Mexico.²² This allows us to estimate accurately migrant self-selection and capture differences in selection patterns at the region level. In addition, we keep individuals that have reached their terminal height at the moment of registration: individuals between 22 and 65 years old. This avoids capturing growing and shrinkage effects (Spitzer & Zimran, 2018, p. 231).

To minimize capturing effects of the Mexican Revolution present in the comparison samples, we keep military and passport holders that had passed their pubertal growth spurt before the Mexican Revolution regardless of their year of registration: individuals 18 years old or older before 1911. In other words, we keep individuals that had reached their peak growth velocity before the conflict. We decided to apply this partial refinement because keeping only those individuals registered before the revolution (the ideal comparison sample) reduces significantly the sample sizes. Therefore, some effects of the revolution might be captured (for example, time-varying sample selection).

Table 1 presents the main characteristics of the final samples. On average, migrants were 168 cm tall, 3.6 cm taller than the ordinary soldiers, 1.4 cm taller than the military elite, and 2.1 cm shorter than the passport holders. The kernel density estimates confirm that the federales were the shortest individuals (see Figure 1). A lower average height indicates that a group faced worse conditions of health care, nutrition, disease environment and work assignments some 10 to 50 years before being observed (Schneider & Ogasawara, 2018, p. 64).²³ In this sense, differences in height between the federales and the other samples suggest that the ordinary soldiers may have belonged to the lowest social strata in Mexico. Accordingly, migrants and the military elite may have belonged to the intermediate social ranks.

²²We constrain our analysis to males because the military data do not report the birth place for females.

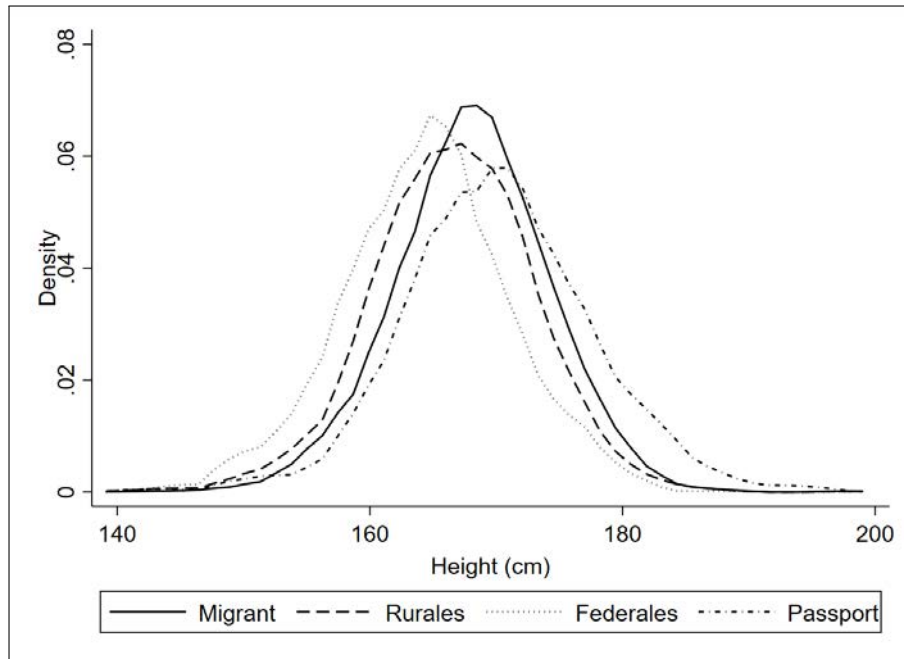
²³Schneider & Ogasawara (2018) argue that disease environment, proxied by infant mortality rates, have economically meaningful effects on child height at ages 6-11.

Table 1: Summary statistics: migrant, military and passports samples (males)

	Migrant	Federales	Rurales	Passport
Average Height (cm)	168.0	164.4	166.6	170.1
Average Age (years)	31.2	35.3	29.7	48.3
Labor Class (%)				
Unskilled	89.1	73.3	47.8	3.7
Skilled	7.7	24.1	49.3	34.2
Professional	2.2	2.6	3.0	61.3
Literacy (%)				
Literate	38.4	45.3	49.5	100.0
Marital Status (%)				
Married	58.9	na	na	na
Single	38.8	na	na	na
Widowed	1.8	na	na	na
Region of Birth (%)				
North	45.5	18.7	2.9	13.4
Bajio	52.5	27.3	60.6	30.0
Center	1.8	42.8	33.0	47.3
South	0.3	11.3	3.5	9.3
Cash on hand–US dollars (median)				
North	10.0	na	na	na
Bajio	1.0	na	na	na
Center	20.0	na	na	na
South	10.0	na	na	na
Observations	3,609	1,249	5,300	1,339

Source: Migrant sample from Mexican Border Crossing Records–Microfilm publication N° A3365. Military and Passport samples from López-Alonso (2015). Note: We classify the regions of birth and occupations following López-Alonso (2015, p. 127 & 128). We limit the sample to males because the military data do not report geographic information for females. We consider individuals that had reached their terminal height at the moment of registration: individuals between 22 and 65 years old.

Figure 1: Kernel density estimates of heights



Source: Migrant sample from Mexican Border Crossing Records–Microfilm publication N° A3365. Military and Passport samples from López-Alonso (2015).

Table 2: Average heights (centimeters) across regions (males)

	North	Bajio	Center	South
Migrant	169.2 (6.0)	167.0 (5.9)	167.9 (7.2)	165.4 (5.4)
Rurales	167.4 (6.39)	166.8 (6.3)	166.0 (6.4)	166.3 (5.7)
Federales	166.8 (6.9)	165.2 (6.6)	163.7 (5.9)	161.3 (5.7)
Passports	171.3 (7.3)	171.1 (7.5)	169.4 (7.3)	168.9 (7.1)
Observations	2,208	5,850	2,978	461

Source: Migrant sample from Mexican Border Crossing Records–Microfilm publication N° A3365. Military and Passport samples from López-Alonso (2015). Note: Standard deviations in parenthesis. We classify the regions of birth following López-Alonso (2015, p. 127). We limit the sample to males because the military data do not report geographic information for females. We consider individuals that had reached their terminal height: individuals between 22 and 65 years old.

However, almost all migrants were unskilled laborers and had the lowest literacy rates among the samples. This may imply that migrants moved to perform activities where brawn relative to brain had a greater value—that is, jobs with high returns to physical productivity. Clark (1908, p. 477 & 486) documents that most Mexican migrants were confined to track maintenance in the railways, and that they were employed as drillers, wood choppers, coke pullers, and surface men (strip mining): occupations requiring physical strength.²⁴ In contrast, 62% of the passport holders self-reported as professionals, confirming that they belonged to the upper social class.

The regional distribution of the samples shows that emigration occurred mostly in the North and Bajio, while military recruitment took place mainly in the Bajio and Center (see Table 1).²⁵ The passports sample concentrates in the Center region, reaffirming that most passport holders may have lived in Mexico City or nearby states. At the time, the Mexican upper social strata resided in these locations, and based on the amount of cash held at the crossing, migrants from the Center were considerably richer than the rest (see Table 1). They reported to have 20 dollars, two times the

²⁴Certainly, Mexicans were employed as cotton pickers during the harvest season. This activity required nimble fingers rather than physical strength (Clark, 1908, p. 482).

²⁵Considering the population levels in 1907, the Bajio states were among the most populated. The states of Guanajuato, Jalisco and Michoacan were more populated than Mexico City. Therefore, the recruitment of soldiers would have been common in this regions.

amount reported by the migrants from the North. Bajio migrants had one dollar at the crossing, and may have been the poorest as argued by [Durand \(2016\)](#).

These initial descriptive statistics suggest the presence of substantial variation in the degree of migrant selection across regions. Indeed, [Table 2](#) shows that differences in height between migrants and ordinary soldiers almost doubles in the Center and South relative to the North. In the next section, we perform a comprehensive analysis to estimate the initial selection patterns of Mexican migration.

6. Empirical strategy

To estimate the selectivity of Mexican migration to the United States, we regress the height of individual i ($height_i$) on a dummy variable that takes the value of 1 if the individual belongs to the migrant sample and zero otherwise ($migrant_i$). We also consider a vector of individual characteristics ($\mathbf{X}_i$) that includes region of birth. Additionally, we control for year of birth fixed effects (α_c):

$$height_i = \beta + \Phi migrant_i + \mathbf{X}_i' \theta + \alpha_c + e_i. \quad (1)$$

We estimate [Equation 1](#) by pooling the migrant sample with each of the comparison samples separately. Hence, the estimated coefficient Φ reflects the average difference in height between migrants and federales, rurales or passport holders, respectively. The region of birth categories (North, Bajio, Center and South) control for environmental factors such as food availability, dietary patterns or presence of diseases that might influence height at the region level.²⁶ The year of birth fixed effects control for any factor influencing height across years, such as structural conditions and idiosyncratic shocks effecting the living standards of the population over time.

The estimated coefficients of [Equation 1](#) are average estimates of the period October 1906–December 1908. However, as mentioned in Section 3.2, from August 1907 to January 1908 the US economy suffered one of the most severe financial crises before

²⁶The regional classification was taken from [López-Alonso \(2015, p. 127\)](#).

the Great Depression (Moen & Tallman, 1992, p. 611).²⁷ To capture shifts in selection into migration as a consequence of this crisis, we extend Equation 1 by interacting the migrant indicator variable with dummy variables for the Panic (*panic*) and post-Panic period (*panic^{post}*):

$$\begin{aligned} height_i = & \beta + \Phi_1 migrant_i + \Phi_2 migrant_i \times panic + \Phi_3 migrant_i \times panic^{post} \\ & + \mathbf{X}_i' \theta + \alpha_c + e_i. \end{aligned} \quad (2)$$

The estimated coefficients Φ_2 and Φ_3 capture the difference in height of individuals that emigrated during the Panic period (August 1907–January 1908) or after the Panic (February 1908–December 1908), respectively. These estimates are relative to those individuals that emigrated before the Panic (October 1906–July 1907). The difference in height between pre-Panic migrants and the different comparison samples (non-migrants) is reflected in Φ_1 . Holding everything else equal, the estimated selection pattern during the Panic of 1907 is $\Phi_1 + \Phi_2$.

7. Results

7.1 Self-selection of Mexican migrants before 1910

Column 1 of Table 3 shows that on average migrants were 2.1 cm taller than the federales. The difference in height between migrants and rurales was 0.5 cm, implying that migrants were slightly taller than the military elite (column 2). Relative to the passport holders, migrants were 3.1 cm shorter (column 3). Given that taller individuals tend to earn more, the results allow us to infer that earnings of migrants were higher than those of an ordinary soldier and very similar to the earnings of the military elite. Therefore, it is unlikely that the first Mexican migrants were negatively self-selected, but drawn primarily from the intermediate or upper ranks of the earnings distribution in Mexico—that is, Mexican migration in the early twentieth century was

²⁷There is no consensus in the literature about the ending month of the crisis. Yet, the scholarship on the matter agree that normalcy in the financial market was restored in January 1908 (Frydman et al., 2015, p. 937).

characterized by an intermediate or positive selection. Moreover, migrants could have unobserved individual-specific factors that reveal even higher human capital accumulation than stayers (Bodenhorn et al., 2017, p. 201).

As a robustness check, we include state of birth fixed effects instead of region dummies in the models for which more disaggregated geographic data is available (rurales and passports). This helps us to rule out that our results are driven by unobserved factors across states of birth. Columns 4–5 of Table 3 show that our initial results hold in significance and magnitude.

Table 3: Unconditional self-selection of Mexican migrants
Dependent variable: height (centimeters)

	1	2	3	4	5
	Federales	Rurales	Passports	Rurales	Passports
Migrant	2.124*** (0.348)	0.522*** (0.178)	-3.173*** (0.401)	0.459** (0.184)	-3.135*** (0.409)
<i>Region of birth</i>					
North	5.497*** (0.533)	2.469*** (0.451)	3.470*** (0.665)		
Bajio	3.334*** (0.527)	0.491 (0.417)	1.459** (0.655)		
Center	2.487*** (0.526)	-0.239 (0.431)	0.744 (0.662)		
Observations	4,858	8,896	4,948	8,896	4,948
R-squared	0.114	0.052	0.056	0.062	0.074
Birth year FE	Yes	Yes	Yes	Yes	Yes
Birth state FE	No	No	No	Yes	Yes

Source: Mexican Border Crossing Records–Microfilm publication N° A3365 and López-Alonso (2015). Notes: * = Significant at 10% level; ** = Significant at 5% level; *** = Significant at 1% level. Robust standard errors in parenthesis. The omitted category is individuals born in the South region.

Assuming that our comparison samples are random, the previous results show unconditional selection patterns revealing the true selectivity of migration. We acknowledge that our military and passport samples may be selected. For example, the federales were not conscripts but volunteers, and it is expected that in a growing economy—like Mexico at the time—the opportunity cost of enlisting increases for productive and tall individuals (Bodenhorn et al., 2017, p. 173). Hence, the federales sample may capture the shortest individuals within the lower ranks of the height distribution. This would lead to imprecise migrant selection estimates resulting from

comparisons with extreme values of the distribution. In addition to business conditions, [Komlos & A'Hearn \(2019, p. 1145\)](#) argue that no-pecuniary factors such as patriotism, recruitment practices and socioeconomic status of soldiers can influence the composition of volunteers enlisting in the military. In this sense, the military could have preferred unskilled over skilled volunteers to minimize desertion of ordinary soldiers.

However, if our comparison samples had major selection problems, we would expect to obtain conflicting unconditional migrant selection estimates across specifications: a negative selection relative to the lower social strata (ordinary soldiers) and a positive selection relative to the upper social strata (passport holders). [Table 3](#) shows that our estimates are consistent across models. Therefore, if any, the sample selection bias of our comparison groups would be minimum. To take into account potential sample selection biases, we control for the individual's skill level (unskilled, skilled and professional). By estimating migrant self-selection conditional on skill, we factor out composition effects resulting from skill-based selection of our comparison samples. Considering that improved conditions in childhood will often result in higher stature and better cognitive abilities ([Bleakley et al., 2014, p. 123](#)), the presence of skill-based selection mechanisms—as military recruitment practices—could bias our migrant self-selection estimations.²⁸

Columns 1–3 of [Table 4](#) show unconditional and conditional migrant self-selection estimates. Year of birth is an explanatory variable in all three models. Column 2 and 3 add region of birth and skill level controls, respectively. Differences between estimates of column 1 and 2 confirm that environmental factors at the region level explain about 34%–67% of the differences in height between migrants and stayers. Results in column 3 (Panels A and B) show no differences in migrant selection when controlling for skill level, suggesting that the skill composition of both military samples are not driving our migrant selection estimates. However, controlling for skill level reduces in

²⁸We assume that skilled and professional occupations at the time demanded more cognitive abilities (training or education) relative to unskilled occupations.

Table 4: Conditional self-selection of Mexican migrants by region
Dependent variable: height (centimeters)

	1	2	3	4	5
	Complete Sample			North	Bajio
<i>Panel A. Federales</i>					
Migrant	3.259*** (0.306)	2.124*** (0.348)	2.209*** (0.350)	1.273** (0.630)	2.490*** (0.609)
Observations	4,858	4,858	4,822	1,848	2,227
R-squared	0.077	0.114	0.117	0.061	0.041
<i>Panel B. Rurales</i>					
Migrant	1.604*** (0.152)	0.522*** (0.178)	0.557*** (0.187)	1.114* (0.608)	0.437** (0.214)
Observations	8,896	8,896	8,860	1,769	5,087
R-squared	0.038	0.052	0.053	0.049	0.033
<i>Panel C. Passports</i>					
Migrant	-1.993*** (0.327)	-3.173*** (0.401)	-2.143*** (0.508)	-2.282* (1.178)	-2.849*** (0.880)
Observations	4,948	4,948	4,901	1,793	2,286
R-squared	0.033	0.056	0.059	0.047	0.080
Region of birth categories	No	Yes	Yes	No	No
Skill level categories	No	No	Yes	Yes	Yes
Birth year FE	Yes	Yes	Yes	Yes	Yes

Source: Mexican Border Crossing Records–Microfilm publication N° A3365 and López-Alonso (2015). Notes: * = Significant at 10% level; ** = Significant at 5% level; *** = Significant at 1% level. Robust standard errors in parenthesis. The omitted categories are individuals born in the South region (columns 2–3) and unskilled workers (columns 3–5).

32% the difference in height between passport holders and migrants (Panel C). This finding shows that comparing like with like—individuals born in the same year and region, and with similar cognitive abilities (skills)—is advisable when the comparison groups may suffer from ambiguous sample selection bias. Hence, we include skill level controls in all subsequent estimation equations.

Did the magnitude of selection vary across regions? To answer this question, we estimate separately Equation 1 for each region. We only present results for the North and Bajío because these regions concentrate 98% of the migrant sample. Columns 4–5 of Table 4 show that there was considerable variation in the degree of regional selection across Mexico. The positive selection relative to the ordinary soldiers was stronger in the Bajío than in the North (Panel A). By 1910, salaries and living standards in the Bajío were considerably lower than elsewhere in Mexico (Rosenzweig, 1965, p. 450; Campos-Vázquez & Vélez-Grajales, 2012, p. 613). Therefore, the poor and short

were priced out from migration in the Bajío. Panel B shows that Bajío migrants were only 0.4 cm taller than the military elite, suggesting that migrants from poorer regions were drawn from the intermediate ranks of the regional height distribution. In the North region, migrants were clearly taller than the military elite—that is, drawn from the upper half of the height distribution (Panel B). We find that migrants were clearly shorter than the passport holders in both regions. This result shows that relative to the upper social strata migrants had lower nutritional and health conditions during their childhood and youth, and hence tend to be shorter, had lower cognitive abilities and earn less.

7.2 The effect of the Panic of 1907

Columns 1–3 of [Table 5](#) show the effect of the Panic of 1907 on migrant self-selection. Individuals that migrated during the crisis were approximately 0.9 cm shorter than their pre-Panic counterparts—that is, migrants became less positively selected during this period. However, the estimated selection during the post-Panic period is close to zero and not statistically significant, meaning that those who migrated after the crisis had a stature similar to pre-Panic migrants.

Table 5: Impact of the Panic of 1907 on migrant self-selection
Dependent variable: height (centimeters)

	1	2	3	4	5
	Federales	Rurales	Passports	Rurales	Passports
Migrant	2.400*** (0.364)	0.731*** (0.204)	-1.953*** (0.518)	0.412* (0.213)	-2.204*** (0.524)
Migrant × Panic	-0.976*** (0.288)	-0.994*** (0.289)	-0.958*** (0.288)	-0.644** (0.291)	-0.675** (0.290)
Migrant × Post-Panic	-0.111 (0.251)	-0.060 (0.246)	-0.092 (0.253)	0.870*** (0.279)	0.622** (0.291)
Observations	4,822	8,860	4,901	8,860	4,901
R-squared	0.119	0.054	0.061	0.065	0.079
Skill level categories	Yes	Yes	Yes	Yes	Yes
Region of birth categories	Yes	Yes	Yes	No	No
Birth year FE	Yes	Yes	Yes	Yes	Yes
Birth state FE	No	No	No	Yes	Yes

Source: Mexican Border Crossing Records–Microfilm publication N° A3365 and [López-Alonso \(2015\)](#). Notes: * = Significant at 10% level; ** = Significant at 5% level; *** = Significant at 1% level. Robust standard errors in parenthesis. The omitted categories are individuals born in the South region and unskilled workers.

Column 1 of [Table 5](#) reveals that before the Panic, migrants were positively selected relative to the average soldier (2.4 cm taller). This pattern changes during the Panic, when migrants were less positively selected (1.4 cm), but it returns to pre-crisis levels afterward. Columns 2–3 show the same "U" pattern relative to the rurales and passports samples. Therefore, the findings suggest that in the beginnings of the twentieth century, when migrants were able to cross the border without restrictions, the composition of Mexican migration adjusted to short-run changes in the demand of migrant workers.

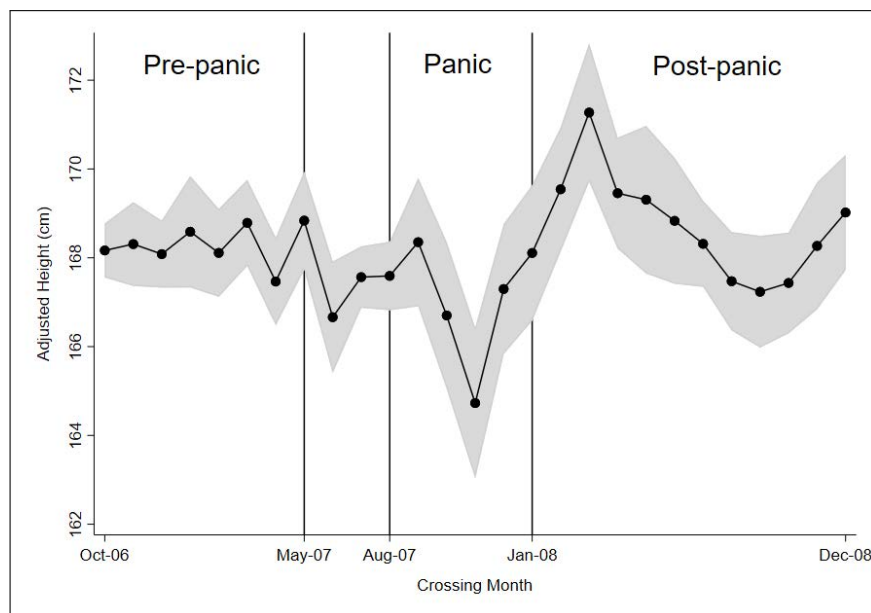
However, when controlling for unobserved factors across states, the estimated self-selection changes in the post-Panic period. Columns 4–5 of [Table 5](#) show that migrants became more positively selected than their pre-Panic peers. This can be appreciated more clearly in [Figure 2](#) that depicts the adjusted height of migrants during the complete period under analysis (October 1906–December 1908). To estimate the adjusted values in each month, we regress the migrants' height on skill level, state of birth, year of birth, year-month of crossing, and entrance port fixed effects. There are two things to note.

First, in March 1907 the first strong drop in stock prices occurred. In the following months, the speculation and uncertainty continued and by May 1907 the US economy had fallen into a short but severe recession ([Odell & Weidenmier, 2004](#), p. 1003). This might explain the fall in the adjusted height from May to August 1907. However, in August 1907 the Secretary of the Treasury announced the deposit of 28 million dollars to banks across the United States for relieving the expected stringency in money supply and bring back confidence to the financial system ([Markham, 2002](#), p. 31). This measure only delayed the financial crash of October, but along with substitutes for legal currency and the creation of "legal holidays", prevented even more bankruptcies during the Panic period ([Andrew, 1908](#), p. 516). These events might explain why the adjusted height slightly increased after August and fell later on.

Second, the adjusted height increased significantly after January 1908, when the payments to depositors of commercial banks were fully restored. After May 1908, the adjusted height returns to pre-crisis levels. The results in columns 4–5 suggest that self-selection adjustments to business conditions could have operated at the local level. We addresses this matter in the following section by identifying a potential adjustment channel.

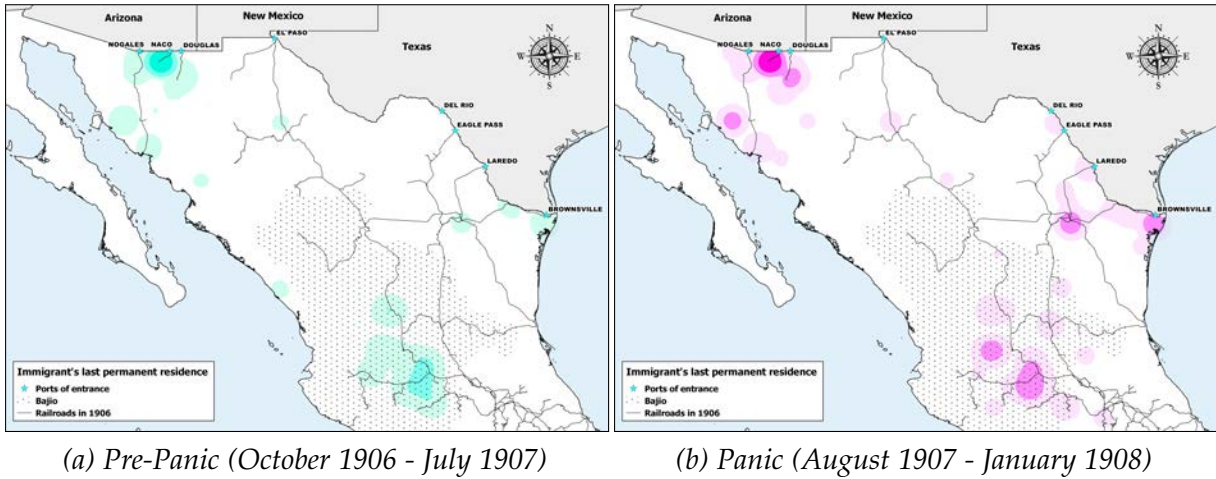
Finally, it may be the case that the observed shifts in migrant self-selection were induced by changes in the migrants' locations of birth during the Panic. [Figure 3](#) shows that in both periods (pre-Panic and Panic), the migrant sample was concentrated in the south of the Bajio (Guanajuato, Jalisco and Michoacan) and in the northern states of Sonora, Nuevo Leon and Tamaulipas (see [Figure A.1](#) in Annex A for guidance). Hence, the less positive selection during the crisis did not arise from changes in the composition of the migrants' birthplace.

Figure 2: Effect of the Panic of 1907. Adjusted heights of migrants



Source: Mexican Border Crossing Records–Microfilm publication N° A3365. Note: We estimate the adjusted values regressing the migrants' height on skill level, state of birth, year of birth, year-month of crossing, and entrance port fixed effects. **May-07:** By May 1907, the US had fallen into a short but severe recession. **Aug-07:** In August 1907, the Secretary of the Treasury announced the deposit of 28 million dollars to banks across the US for relieving the expected stringency in money supply and bring back confidence to the financial system. **Jan-08:** In January 1908, the payments to depositors of commercial banks were fully restored.

Figure 3: Spatial distribution of the migrant sample



Source: Mexican Border Crossing Records–Microfilm publication No. A3365. Note: We consider individuals that had reached their terminal height: individuals between 22 and 65 years old.

8. Short-run adjustment channels of migrant self-selection

We have presented evidence showing that Mexican migration was characterized by an intermediate or positive selection at the beginning of the twentieth century, and that the Panic of 1907 sparked short-run shifts in migrant self-selection. To our knowledge, there is no detailed earnings data for the period, which prevents us from identifying shifts in self-selection derived from changes in US earnings inequality. Also, substitutes for cash were emitted and rationalized to the population to contain the impact of this financial breakdown (Andrew, 1908). This measure could have contributed to keep earnings inequality relatively unaffected until the restoration of the financial system.

For these reasons, we focus on channels affecting the costs of migration. Specifically, we study the role of historical labor institutions in shaping and adjusting migrant self-selection.²⁹ Institutions involved in the immigration process can ease borrowing constraints and relax migration costs (Abramitzky & Boustan, 2017, p. 1325). If labor institutions are sufficiently linked to business cycles, severe shocks can limit their influence, and thus migrant self-selection could change in the short run. In addition,

²⁹The Panic of 1907 could have impacted a number of channels affecting migration costs. For example, migrant networks relaxing credit constraints for low skill-migrants. Since payments and basic transactions were constrained during the crisis, the effect of migrant networks could have been abated pushing toward a positive self-selection.

labor institutions—as an adjustment channel of migrant self-selection—have not been assessed previously, despite historical literature documenting their persistence as an important explanatory force for Mexican mass migration in the early twentieth century.

8.1 *The enganche*

During the nineteenth century, Mexico was characterized by regional mismatches in the demand and supply of labor. To regulate labor markets, the *enganche* was institutionalized as a mechanism to recruit and transport workers to remote locations or with labor shortage (Durand, 2016, p. 50–1). Recruiters “hooked” workers by offering wages in advance in exchange of future labor service, creating a relationship of indebtedness that kept workers at the destination until the debt was cleared (Brass, 1990, p. 74). This labor-recruiting system was mainly practiced in regions characterized by population pressures and low salaries (Rosenzweig, 1965, p. 448).

At the beginning of the twentieth century, American companies and labor contractors adopted the *enganche* to satisfy the increasing demand of workers in the American Southwest and other regions. The internationalization of this labor institution was possible due to the expansion of the Mexican railways network and its connection to the US rail lines from 1884. Indeed, recruiters used railways for traveling south into Mexico and transporting workers north to the United States (Woodruff & Zenteno, 2007, p. 512). However, the recruitment of workers was not confined to places with railway access. Clark (1908, p. 475) argues that Mexican workers also arrived at border towns where they met representatives of large labor contracting companies or *enganche* agencies. Once recruited, the workers crossed the border and received transportation to the destination and a subsistence allowance, both discounted from their future wage. In sum, the *enganche* was search-matching labor institution used to transport and allocate laborers across the United States (Clark, 1908; Durand, 2016; Gamio, 1930).

This system of labor recruiting induced Mexican mass migration by eliminating transportation and job-search costs. However, it was also characterized by the breach of contracts (changes in agreed work locations, labor tasks and wages) once the workers arrived to the United States (Durand, 2016, p. 61). The indebtedness entailed to the *enganche* also prevented immigrants from job turnover and reduced their bargaining power over working conditions. Although this labor institution was probably not attractive for everyone willing to migrate to the United States, it could have been the only option to emigrate for the poor or those facing credit or liquidity constraints. Durand & Arias (2000) document that the *enganche* system took advantage of the precarious social conditions and limited labor options in some Mexican regions.

8.2 Identification of *enganche* migrants

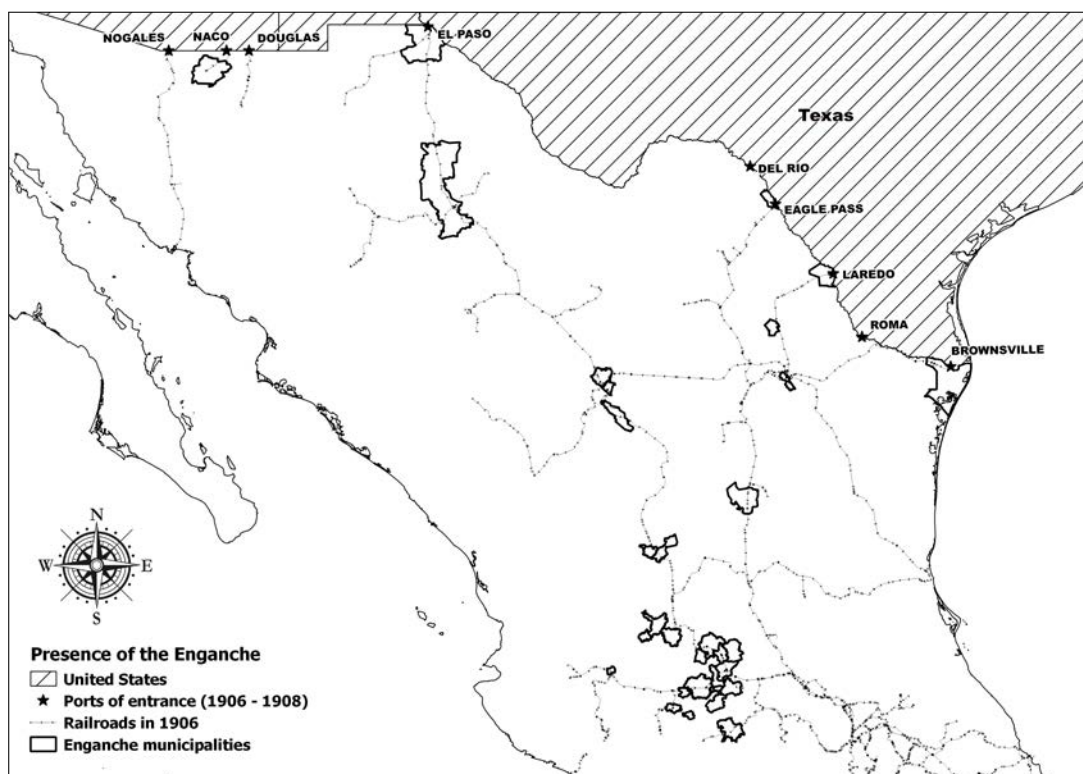
The manifests in the publication N° A3365 do not identify directly migrants using the *enganche* to cross the border. Therefore, we design a methodology to identify *enganche* migrants based on the characteristics of this system of labor recruiting.

From the recruiters perspective, the *enganche* profitability depended on the number of workers delivered and transportation efficiency. Therefore, they recruited large numbers of workers and transported them using railways. Previous literature suggests that recruiters commonly transported between 30 and 400 workers depending on the nature of the jobs and season of the year (Clark, 1908, p. 470 & 476; Durand, 2016, p. 56 & 63). We search for *enganche* advertisements in Mexican and American newspapers of the period to validate this information. We find twenty advertisements covering the period from 1902 to 1909 and diverse destinations in the American Southwest. The number of vacancies advertised range from 50 to 600, which match well the figures suggested by historical literature.

In this sense, recruited workers can be identified in the manifests as groups of migrants who crossed the border the same day and reported the same origin and destination. To identify *enganche* migrants in the sample, we first quantify the number of migrants in each migration flow—that is, number of individuals reporting the same

entrance port, year-month of crossing, location of origin (Mexican municipality) and location of destination (American county).³⁰ Second, we standardize the size of each migration flow using the mean and standard deviation of each migration corridor (municipality-port-county combination). By estimating z-scores for each migration flow, we are able to identify unusual monthly-crossing peaks in each migration corridor. Finally, we consider as *enganche* migrants those individuals belonging to a group (migration flow) of at least 30 migrants registered at the same entrance port, in the specific month, reporting the same origin and destination; and which size was at least one standard deviation above the average size of the flows in the same migration corridor. This criteria allows us to identify groups of crossings that were actually different in size, which proxies for the presence of *enganche*. We present a formal expression of this methodology in Annex B.

Figure 4: Spatial distribution of the *enganche* (1906–08)



Source: Mexican Border Crossing Records–Microfilm publication N° A3365. Note: The polygons display the municipalities with presence of the *enganche*, a system of labor recruiting that reduced migration costs. Recruiters or *enganchadores* covered the transportation costs of the migrant in exchange of future labor service.

³⁰We use the month of crossing because the manifests do not report the day.

Figure 4 displays the spatial distribution of the municipalities where this system of labor recruiting was practiced. All the municipalities have direct access to railways, which was a necessary condition for the presence of the *enganche*. The micro data also support the argument that *enganche* agencies were present at border towns. Finally, the presence of the *enganche* in the central plateau of Mexico corroborates that this labor institution was practiced in locations with labor market pressures. At the time, this region was the most populated in the country and offered the lowest salaries.

8.3 Labor recruiting and migrant self-selection

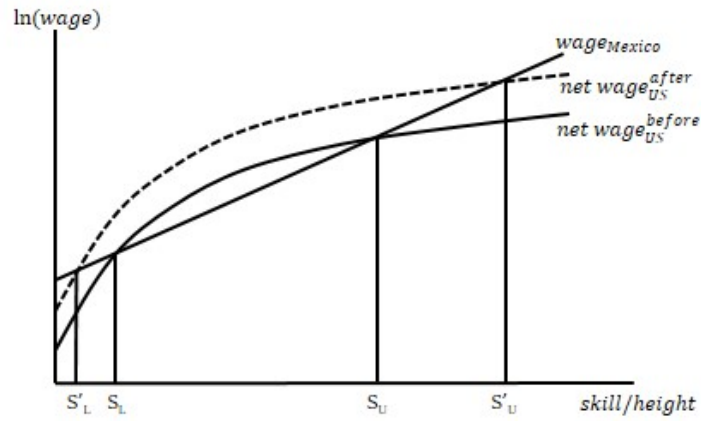
We use the model of Chiquiar & Hanson (2005), where time-equivalent migration costs are decreasing in observable skills and are large, to address the effects of labor recruiting on self-selection patterns.³¹ This framework considers a nonlinear relationship between US net wages (US wages minus migration costs, $net\ wage_{US}$) and skill. As a result, individuals with skill in the interval (S_L, S_U) migrate to the United States, and those with skill outside this interval remain in Mexico. The direction of self-selection (negative, positive or intermediate) depends on the size of migration costs and the shape of the skill distribution in Mexico. If the support for the skill distribution goes from some value between S_L and S_U to some value greater than S_U , migrants will have low skills relative to those who remain in Mexico (negative selection). If the support of the skill distribution range from some value below S_L to some value between S_L and S_U , migrants will have relatively high levels of skill (positive selection). Alternatively, if the support of the skill distribution runs from some value below S_L to some value above S_U , migrants will have intermediate levels of skills (intermediate selection). This is because high migration costs and binding credit constraints preclude low-skill migration, and high returns to skill in Mexico discourage high-skill migration (see Panel A of Figure 5).

Systems of labor recruiting can alter the skill-composition of migrants through two channels. First, by systematically changing the migrants' origin. Migrants

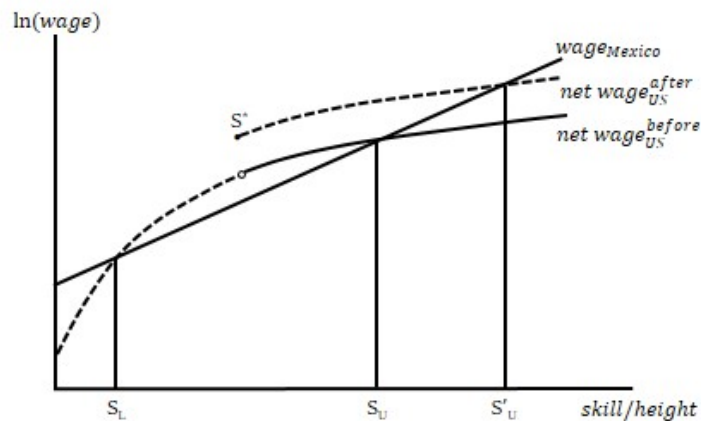
³¹Consistent with skill scarcity in Mexico, the model considers that returns to skill are greater in Mexico relative to the United States. This was also true in early twentieth century.

from locations where labor recruiting is practiced could be over-represented in the migration stream, and thus modify the skill-composition of migrants. Second, by affecting migrant self-selection at the local level. That is, systems of labor recruiting can modify the expected discounted net return of migrating ($net\ wage_{US}$) for individuals with access to recruiting systems.³² The effect of labor-recruiting systems toward a positive or negative self-selection depends on the intensity and nature of recruiting. If it is implemented in low scale, then the overall skill-composition of migrants may not change. However, if labor recruiting is importantly involved in the immigration process, then its effect depends on both the skill distribution in Mexico and how migrant workers are recruited.

Figure 5: Systems of labor recruiting and changing migration costs



(a) Random recruiting



(b) Assortative recruiting

Note: Adapted from Chiquiar & Hanson (2005) and Massey (2016).

³²Massey (2016, p. 25) shows that the effect of immigration quotas operate through the same channels.

As the *enganche*, systems of labor recruiting decrease migration costs in general. If individuals willing to migrate are randomly chosen by recruiters, a decrease in migration costs—from $net\ wage_{US}^{before}$ to $net\ wage_{US}^{after}$ —results in more individuals migrating from both ends of the skill distribution. In this case, changes in the direction (degree) of self-selection will depend on the distance between S_L and S'_L , the distance between S_U and S'_U , and the density of the skill distribution (see Panel A of Figure 5). On the other hand, individuals willing to migrate can be sorted and recruited based on observable skills. Assortative recruiting generates a discontinuity in the expected US net wages by decreasing migration costs for only some individuals. In this second case, changes in the direction (degree) of self-selection would depend primarily on the chosen recruitment threshold (S^*): preferences of employers. Panel B of Figure 5 depicts an scenario where recruiters choose individuals with $skill > S^*$ —that is, drawn from the upper ranks of Mexico's skill distribution.

In contrast to immigration policies, labor-recruiting systems are more flexible and sensitive to changes in the demand of migrant workers. Since labor recruiting affects migration costs directly and is intertwined with the destination's business cycle, it represents a feasible adjustment channel of migrant self-selection in the short run. We acknowledge that short-run shifts and adjustment channels of migrant self-selection may be only identified in the absence of immigration restrictions. Barriers to immigration aim to keep the skill-composition of migrants and/or the size of migration constant in the short run.

In the following section, we provide evidence suggesting that the share of *enganche* migrants was significant and that recruiters chose the tallest workers. Thus, the *enganche* was a labor recruiting institution that pushed toward a positive migrant self-selection.

8.4 The *enganche* effect

To test if the *enganche* influenced selection into migration, we first expand Equation 1 as follows:

$$height_i = \beta + \Phi_1 migrant_i + \Phi_2 enganche_i + \mathbf{X}_i' \theta + \alpha_c + e_i. \quad (3)$$

Where $enganche_i$ is a dummy variable that takes the value of 1 if the migrant crossed the border through the *enganche* and zero otherwise. The estimated coefficient Φ_2 captures the difference in height between *enganche* and *non-enganche* migrants. Column 2 of Table 7 shows that American recruiters chose the tallest laborers among those willing to emigrate: on average, *enganche* migrants were 0.6 centimeters taller than migrants that crossed the US border without using this labor institution. The estimated coefficient Φ_1 is the difference in height between *non-enganche* migrants and each comparison sample. For example, column 2–Panel B of Table 7 shows that *non-enganche* migrants were 0.3 centimeters taller than the military elite (neutrally selected), while *enganche* migrants were 1 centimeter taller ($\Phi_1 + \Phi_2$)—that is, positively selected. These results hold when including state-fixed effects (column 6), suggesting that this labor institution had the potential to influence selection into migration at the local level.

However, the previous results are average estimates for the complete period of the sample (October 1906–December 1908). Table 6 shows the migrants' characteristics in the pre-Panic (October 1906–July 1907), Panic (August 1907–January 1908) and post-Panic (February 1908–December 1908) periods. We can observe that the *enganche* was almost not practiced during the Panic of 1907. The share of migrants recruited in Mexico went from 36 percent in the pre-Panic period to one percent during the Panic and partially recovers in the post-Panic period.

To practice the *enganche*, American companies and labor contracting agencies needed constant liquidity to pay train tickets, subsistence allowances and wages in

advance for tens or hundreds of recruited workers. When the Panic of 1907 hit the US financial system, American companies were not able to cover the costs associated to the *enganche* because banks and financial institutions limited or suspended cash payments—that is, companies did not have liquidity to finance the recruitment of Mexican workers. As the crisis developed, thousands of firms and over one hundred banks failed (Markham, 2002, p. 32). Therefore, the demand for immigrant workers was severely reduced and the *enganche* almost suspended. Only 1.2 percent of the migrants that crossed the border during the Panic used this labor institution. The crisis particularly affected major railway companies such as Union Pacific, who limited their operations during this period (Johnson, 1908, p. 456). Therefore, the transportation of workers within the United States was constrained as well. In sum, during the Panic of 1907 the recruitment of laborers with higher physical productivity stopped, and consequently the *enganche* effect toward a positive selection.

To assess the effect of the *enganche* on selection patterns across periods, we expand Equation 2 as follows:

$$\begin{aligned} height_i = & \beta + \Phi_1 migrant_i + \Phi_2 migrant_i \times panic + \Phi_3 migrant_i \times panic^{post} \\ & + \Phi_4 enganche_i + X_i' \theta + \alpha_c + e_i. \end{aligned} \quad (4)$$

Where $enganche_i$ is the same indicator variable previously defined. Equation 4 controls for the *enganche* effect (Φ_4) and provides estimates of Φ_1 , Φ_2 and Φ_3 for *non-enganche* migrants. Basically, the estimated coefficient Φ_4 is the average difference in height between *enganche* and *non-enganche* migrants in the pre-Panic and post-Panic, because the share of *enganche* migrants was very small during the Panic.

Column 3–Panel B of Table 7 shows that migrants were 0.7 centimeters taller than the rurales in the pre-Panic period. When controlling for the *enganche* migrants, who were the tallest individuals in the migrant sample, we observe a less positive selection

Table 6: Composition of Mexican emigration across periods

	Pre-Panic Oct 1906–Jul 1907	Panic Aug 1907–Jan 1908	Post-Panic Feb 1908–Dec 1908
<i>Panel A. Complete Sample</i>			
Average Height (cm)	168.1	167.3	168.4
Average Age (years)	30.5	31.8	32.3
<i>Labor Class (%)</i>			
Unskilled	91.6	88.3	83.8
Skilled	5.4	7.8	12.8
Professional	2.0	2.8	2.6
Enganche (%)	36.2	1.2	13.2
Observations (%)	58.0	16.0	25.8
<i>Panel B. Bajio</i>			
Average Height (cm)	166.9	166.6	167.6
Average Age (years)	30.5	31.5	31.7
<i>Labor Class (%)</i>			
Unskilled	96.7	94.3	86.9
Skilled	2.2	3.6	10.7
Professional	0.7	1.4	2.1
Enganche (%)	42.7	0.7	10.2
Observations (%)	64.9	14.8	20.1
<i>Panel C. North</i>			
Average Height (cm)	169.8	168.2	168.9
Average Age (years)	30.4	32.1	32.8
<i>Labor Class (%)</i>			
Unskilled	86.2	85.0	82.6
Skilled	9.5	11.1	14.0
Professional	2.5	2.2	2.1
Enganche (%)	27.3	1.8	15.5
Observations (%)	50.0	17.0	32.5

Source: Mexican Border Crossing Records–Microfilm publication N° A3365. Note: We classify the regions of birth following López-Alonso (2015, p. 127). We consider individuals that had reached their terminal height: individuals between 22 and 65 years old.

relative to the military elite (column 4–Panel B).³³ This effect accounts for 23 percent of the average difference in height between migrants and rurales. A similar pattern is observed with the other comparison samples as well. Therefore, we can argue that the *enganche* influenced the selection into migration in the pre-Panic period.

During the Panic of 1907, the *enganche* effect toward a more positive selection is lost, because there were very few *enganche* migrants. Column 4 of Table 7 shows that *non-enganche* migrants became less positively selected: they were 0.8 centimeters shorter than their pre-Panic counterparts. This result reveals that unobserved forces

³³Using the estimated coefficient Φ_4 to approximate the selection pattern of *enganche* migrants in each period would be inaccurate, because the share of *enganche* migrants varies across periods.

Table 7: Impact of the *enganche* on self-selection patterns.
Dependent variable: height (centimeters)

	1	2	3	4	5	6	7	8
<i>Panel A. Federales</i>								
Migrant	2.209*** (0.350)	2.065*** (0.354)	2.400*** (0.364)	2.235*** (0.375)				
Migrant $\times$ Panic			-0.976*** (0.288)	-0.822*** (0.300)				
Migrant $\times$ Post Panic			-0.111 (0.251)	-0.007 (0.258)				
Enganche		0.631*** (0.236)		0.474* (0.249)				
Observations	4,822	4,822	4,822	4,822				
R-squared	0.117	0.119	0.119	0.120				
<i>Panel B. Rurales</i>								
Migrant	0.557*** (0.187)	0.394** (0.198)	0.731*** (0.204)	0.562** (0.226)	0.514*** (0.194)	0.373* (0.205)	0.412* (0.213)	0.219 (0.234)
Migrant $\times$ Panic			-0.994*** (0.289)	-0.841*** (0.301)			-0.644** (0.291)	-0.474 (0.302)
Migrant $\times$ Post Panic			-0.060 (0.246)	0.040 (0.253)			0.870*** (0.279)	0.978*** (0.285)
Enganche		0.617*** (0.234)		0.457* (0.247)		0.513** (0.236)		0.513** (0.247)
Observations	8,860	8,860	8,860	8,860	8,860	8,860	8,860	8,860
R-squared	0.053	0.054	0.054	0.055	0.063	0.064	0.065	0.066
<i>Panel C. Passports</i>								
Migrant	-2.143*** (0.508)	-2.252*** (0.509)	-1.953*** (0.518)	-2.096*** (0.523)	-2.103*** (0.513)	-2.216*** (0.514)	-2.204*** (0.524)	-2.381*** (0.528)
Migrant $\times$ Panic			-0.958*** (0.288)	-0.807*** (0.299)			-0.675** (0.290)	-0.486 (0.300)
Migrant $\times$ Post Panic			-0.092 (0.253)	0.010 (0.260)			0.622** (0.291)	0.740** (0.296)
Enganche		0.618*** (0.237)		0.466* (0.249)		0.627*** (0.241)		0.594** (0.251)
Observations	4,901	4,901	4,901	4,901	4,901	4,901	4,901	4,901
R-squared	0.059	0.060	0.061	0.062	0.077	0.078	0.079	0.080
Skill level categories	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region of birth categories	Yes	Yes	Yes	Yes	No	No	No	No
Birth year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth state FE	No	No	No	No	Yes	Yes	Yes	Yes

Source: Mexican Border Crossing Records–Microfilm publication N° A3365 and López-Alonso (2015).
Notes: * = Significant at 10% level; ** = Significant at 5% level; *** = Significant at 1% level. Robust standard errors in parenthesis.

in combination with the absence of the *enganche* effect could explain the less positive selection observed during the Panic. In addition, the estimated coefficient Φ_3 remains insignificant, implying that the *enganche* did not influence the selection of migrants in the post-Panic. While the share of *enganche* migrants increased in the post-Panic period (from 1 to 13 percent), it was far from pre-Panic levels (36 percent). This suggests that the reimplementa-tion of this labor institution might have been gradual and thus, its influence was not significant in the short-run after the Panic.

We regress [Equation 4](#) including state of birth fixed effects to control for unobserved factors across states that might have influenced these shifts in selection into migration. Column 8-Panel B shows that the *enganche* effect remains strong and statistically significant. Although the estimates for the pre-Panic period are not statistically significant, the coefficients' size suggest that the *enganche* accounted for 46 percent of the average difference in height between migrants and the military elite. The results also confirm that in the post-Panic period, migrants became more positively selected than their pre-Panic peers (column 7). This difference of about 0.6 to 0.8 cm is captured in [Figure 2](#). In Annex C, we provide evidence suggesting that the presence of regional droughts may have driven this shift.

9. Conclusion

Using a unique data set consisting of individual border crossings, military recruitment records and passport applications, we estimate the selectivity of Mexican migration in the beginnings of the flow (1906–08). We find that the first Mexican migrants were not drawn from the lowest ranks of the Mexican population height distribution. On the contrary, Mexico sent relatively tall and physically productive laborers to the United States. This positive selection relative to the Mexican working class continued in the 1920s ([Kosack & Ward, 2014](#)). Consequently, the persistent drain of high quality laborers arises as a key element to understand the economic expansion of the American Southwest in the early twentieth century ([Gratton & Merchant, 2015](#), p. 528).

Although structural changes in the national economies would predict shifts in self-selection patterns over time, we show that random shocks can modify the selectivity of migration very fast. Particularly, we provide evidence of the impact of the most severe financial crisis in the United States before the Great Depression: the Panic of 1907. The period under analysis was characterized by the absence of legal immigration restrictions for Mexican citizens. Hence, from a policy perspective, more open borders may allow the composition of migration to adjust to short-run changes in business

conditions. Whether this can reduce (increase) frictions in the labor market remains an open question.

As in many contexts today, migration costs were high for the first Mexican migrants. This condition favored the involvement of preexisting labor customs in the immigration process which neutralized mobility and job-search costs. We show that the *enganche*—a system of labor recruiting adopted by American companies to transport workers from Mexico to United States—influenced the positive selection of Mexican migrants, and its absence—produced by the financial crisis—was associated with a less positive selection. Thus, we confirm that labor institutions intertwined with the business cycle have the potential to adjust migrant self-selection in the short-run ([Abramitzky & Boustan, 2017](#), p. 1325). The persistence of institutions like the *enganche* may have unpredictable long-lasting effects on labor markets and the economic development of both sending and destination countries. We believe this is a crucial area of future research.

The adjustment channel that we examine operated at the local level, confirming that the decision to migrate is influenced by local conditions ([Spitzer & Zimran, 2018](#)). We highlight that to understand accurately migrant self-selection, we must evaluate the quality of migrants relative to their local context and short-run economic environment.

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Annex A

Maps for Guidance

Figure A.1: Mexican Regions and Entrance Ports (1906–08)



Source: We classify the regions of birth following López-Alonso (2015, p. 127).

Annex B

Identification of the Enganche

To identify the *enganche*, we quantify the number of migrants (i) by port of entrance (p), year-month of crossing (t), municipality of origin (o), and county of destination (d):

$$w_{ptod} = \sum i_{ptod}. \quad (5)$$

We standardize the size of each migration flow (w_{ptod}) using the mean (μ_{pdo}) and standard deviation (σ_{pdo}) of the corridor (w_{pdo}) to which the flow belongs:

$$z_{ptod} = (w_{ptod} - \mu_{pdo}) / \sigma_{pdo}. \quad (6)$$

The *z-scores* (z_{ptod}) allow us to identify unusual monthly crossing peaks in each migration corridor. Following [Clark \(1908\)](#) and [Durand \(2016\)](#), American recruiters commonly hired between 30 and 400 migrants depending on the nature of the jobs and season of the year. Therefore, we identified the *enganche* flows with the following criteria:

$$enganche_{ptod} = \begin{cases} 1 & \text{if } w_{ptod} \geq 30 \text{ and } z_{ptod} \geq 1 \\ 0 & \text{if otherwise.} \end{cases} \quad (7)$$

We identify flows of at least 30 migrants registered at the same port of entrance, in the same specific month, reporting the same origin (Mexican municipality) and destination (US county) locations; and which size was at least one standard deviation above the average size of the flows in each migration corridor. Finally, we match the identified *enganche* flows with the final migrant sample: all individuals belonging to an *enganche* flow are considered *enganche* migrants.

Annex C

Shocks from the supply side: droughts in Mexico

Results in [Table 7](#) show that the selection of Mexican migration changed after the Panic of 1907, and that this shift arose from unobserved factors across states. The forces explaining why migrants became more positively selected in the post-Panic period could come from either demand or supply side. On the one hand, as a result of the shock, the post-Panic labor demand in the United States could have changed, and thus the required migrant profile. On the other hand, factors in Mexico might have pushed taller individuals to emigrate during the post-panic period. We explore the latter scenario looking at climate shocks that might have influenced migrant self-selection after the Panic of 1907. [Contreras \(2005, p. 123\)](#), [Clark \(1908, p. 473\)](#), and [Mayet et al. \(1980, p. 757\)](#) document that the states of Chihuahua, Nuevo León, Querétaro, San Luis Potosí and Zacatecas experienced droughts in 1907 and 1908, causing important crop losses in some areas ([Cardoso, 1980, p. 12](#)). Moreover, [Figure C.1](#) shows that migrants came disproportionately from these states during the post-Panic period.

We identify the presence of droughts at the municipality level using the Mexican Drought Atlas ([Stahle et al., 2016](#)). It provides reconstructions of a self-calibrating Palmer Drought Severity Index (PDSI) on a 0.5° latitude/longitude grid centered over Mexico from AD 1400-2012. We consider that a municipality experienced droughts if the estimated PDSI was -2.0 or lower. According to [Wells et al. \(2004\)](#), these values represent moderate to severe droughts.³⁴

[Figure C.2](#) shows that droughts affected specific states within regions: the northern Bajío, the eastern states of the North region and the Yucatan peninsula. The PDSI estimates confirm the presence of droughts in the states mentioned by the historical

³⁴The Palmer Drought Severity Index (PDSI) uses temperature and precipitation data to estimate relative dryness. It is a standardized index that spans from -6 (dry) to +6 (wet). However, values below -4.0 represent extreme droughts while values above +4.0 represent extreme wet spells ([Wells et al., 2004](#)).

literature except for Queretaro.³⁵ The PDSI also captures that municipalities of Coahuila, Durango, Sinaloa and Tamaulipas were affected by these climate shocks. Precisely, the municipality level estimates allows us to identify droughts accurately within regions.

To test if droughts influenced the selection into migration, we expand Equation 2 as follows:

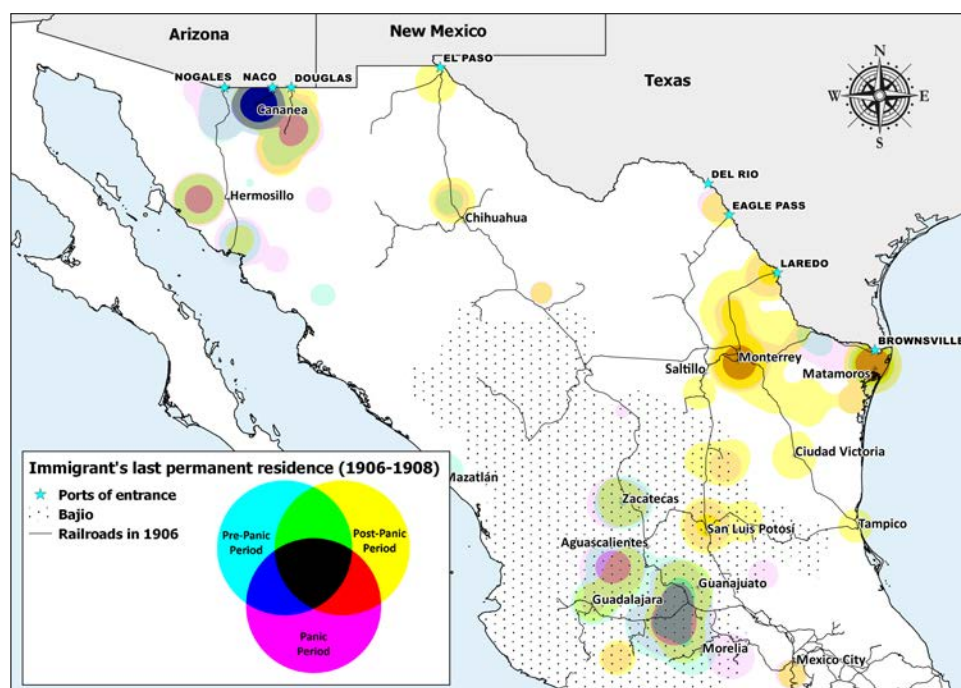
$$\begin{aligned} height_i = & \beta + \Phi_1 migrant_i + \Phi_2 migrant_i \times panic + \Phi_3 migrant_i \times panic^{post} \\ & + \Phi_4 migrant_i \times panic^{post} \times drought + \Phi_5 enganche_i + X_i' \theta \\ & + \alpha_c + \gamma_s + e_i. \end{aligned} \quad (8)$$

Where *drought* is a dummy variable that takes the value of 1 if the migrant's location of last residence (municipality) experienced droughts (PDSI values of -2.0 or lower) and zero otherwise. Since the *enganche* was restored after the Panic, we include an indicator variable for migrants that crossed the border through this labor institution (*enganche_i*). Equation 8 includes state of birth fixed effects (γ_s) instead of birth region categories, because droughts did not affect states homogeneously. Moreover, large states were partially affected, thus we want to capture the effect of droughts on local selection into migration. Everything else equal, the estimated selection pattern in the locations experiencing droughts during the post-Panic period is $\Phi_1 + \Phi_3 + \Phi_4$.

Table C.1 shows that migrants from municipalities experiencing droughts were taller (at least 0.7 cm) than their counterparts from non-drought municipalities (estimated coefficient Φ_4): they were more positively selected relative to the comparison samples. We can see that post-Panic migrants were 0.8 cm taller than their pre-Panic peers (column 1), but when controlling for the droughts effect the coefficient size reduces (column 2). In other words, the presence of droughts accounts for 28% of the differences in height between pre-Panic and post-Panic migrants. Additionally, we

³⁵The municipalities belonging to the states of San Luis Potosi and Zacatecas present PDSI estimates close to our threshold, and thus we considered them as municipalities that experienced droughts. However, the municipalities of Queretaro present a positive estimates (1.4), which imply the presence of mild wet spells.

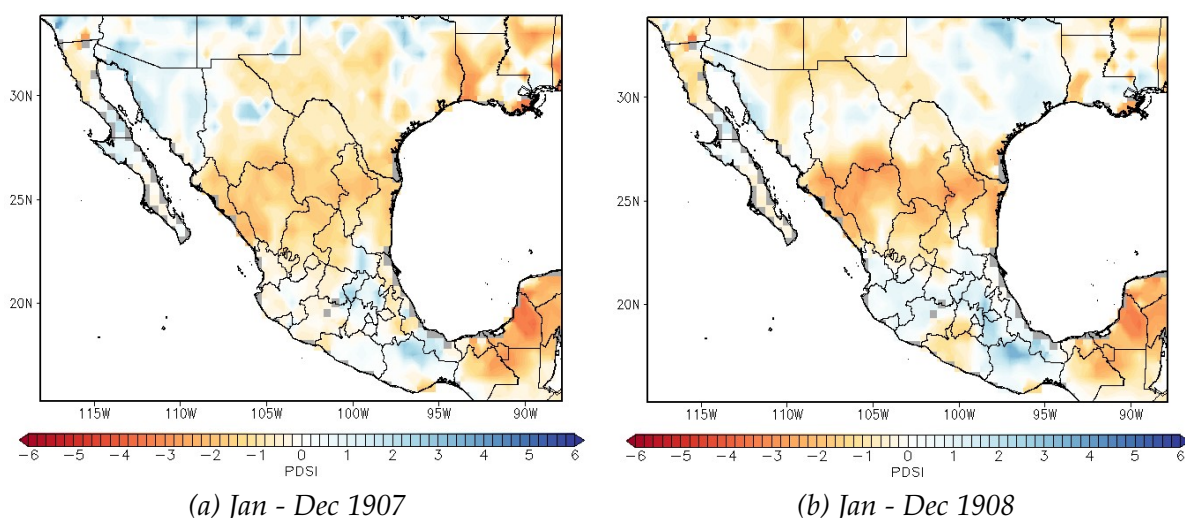
Figure C.1: Spatial distribution of the immigrant sample (last permanent residence)



Source: Mexican Border Crossing Records–Microfilm publication N° A3365.

Note: We consider individuals that had reached their terminal height: individuals between 22 and 65 years old. Pre-Panic (Oct 1906 - Jul 1907), Panic (Aug 1907 - Jan 1908) and Post-Panic (Feb 1908 - Dec 1908).

Figure C.2: Droughts in Mexico (1907–08) based on the PDSI



Source: [Stahle et al. \(2016\)](#). Note: The Palmer Drought Severity Index (PDSI) uses temperature and precipitation data to estimate relative dryness. It is a standardized index that spans from -6 (dry) to +6 (wet). However, values below -2.0 represent moderate droughts while values above +2.0 represent moderate wet spells. The panel shows the presence of regional droughts in 1907 and continues in 1908. The average drought severity index (at the state level) in 1908 was -2.7 (Chihuahua), -2.3 (Coahuila), -2.4 (Durango), -2.4 (Nuevo León), 1.4 (Querétaro), -0.9 (San Luis Potosi), -2.3 (Sinaloa), -2.2 (Tamaulipas), -0.8 (Zacatecas).

Table C.1: Impact of droughts on self-selection patterns.
Dependent variable: height (centimeters)

	1	2	3	4	5	6
	Rurales	Rurales	Rurales	Passports	Passports	Passports
Migrant	0.412* (0.213)	0.409* (0.213)	0.224 (0.234)	-2.204*** (0.524)	-2.212*** (0.523)	-2.382*** (0.528)
Migrant $\times$ Panic	-0.644** (0.291)	-0.627** (0.291)	-0.465 (0.302)	-0.675** (0.290)	-0.656** (0.290)	-0.475 (0.300)
Migrant $\times$ Post-Panic	0.870*** (0.279)	0.620** (0.314)	0.736** (0.321)	0.622** (0.291)	0.396 (0.321)	0.524 (0.327)
Migrant $\times$ Post-Panic $\times$ Drought		0.826** (0.410)	0.789* (0.412)		0.785* (0.420)	0.736* (0.422)
Enganche			0.492** (0.248)			0.574** (0.252)
Observations	8,860	8,860	8,860	4,901	4,901	4,901
R-squared	0.065	0.066	0.066	0.079	0.080	0.081
Skill level categories	Yes	Yes	Yes	Yes	Yes	Yes
Region of birth categories	No	No	No	No	No	No
Birth year FE	Yes	Yes	Yes	Yes	Yes	Yes
Birth state FE	Yes	Yes	Yes	Yes	Yes	Yes

Source: Mexican Border Crossing Records–Microfilm publication N° A3365 and López-Alonso (2015). Notes: * = Significant at 10% level; ** = Significant at 5% level; *** = Significant at 1% level. Robust standard errors in parenthesis. The omitted categories are unskilled workers and locations without droughts.

control for the *enganche* effect to obtain the net effect: droughts accounted for 15% of the stronger positive selection observed after the Panic of 1907. The same pattern holds relative to the passport holders, however the estimates are not statistically significant, potentially due to sample size constraints.

Since droughts impact homogeneously the population of an affected location, it is likely that individuals relatively taller than pre-Panic migrants were pushed to emigrate during the post-Panic due to poor harvests. Hence, the observed positive selection might be a result of two overlapping forces: the reactivation of the American financial system and the persistence of regional droughts in Mexico.

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