Immigration with Labor Mobility Frictions*

Jan Auerbach
University of Exeter

Elisa Keller
University of Exeter

Julian Neira
University of Exeter

Rish Singhania
University of Exeter

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PRELIMINARY

Abstract

How do frictions to mobility across labor markets within the host country affect the economic costs and benefits from immigration? We study immigration in a general equilibrium model that features worker heterogeneity and frictions to labor mobility, both internal and external to the host country. We find that removing barriers to immigration from Mexico to the US increases aggregate output by 12.8%, on average. If the US economy had a frictionless internal labor market, removing barriers to immigration from Mexico increases aggregate output by 6.5%, on average. Intuitively, the gains from immigration are higher in the presence of frictions to internal mobility because immigration alleviates misallocation of native labor.

J.E.L. Codes: J21, J24, O4, E24.
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1 Introduction

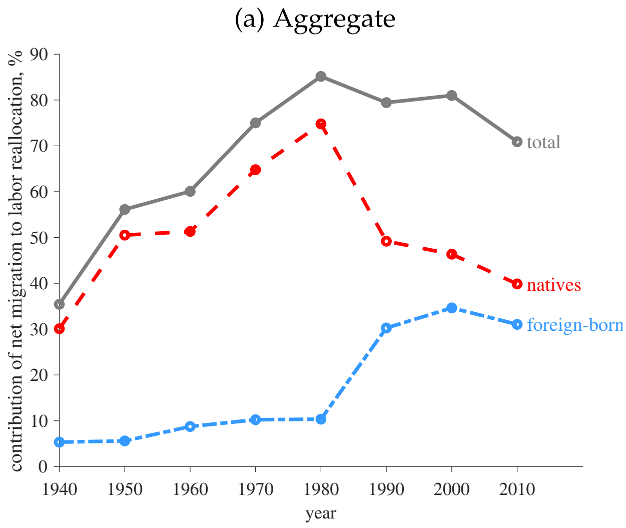
There is a growing concensus that frictions to move across geographic locations within the US are non-trivial (e.g Kennan and Walker, 2011), although the welfare impact of these frictions is less agreed upon (e.g. Desmet and Rossi-Hansberg, 2013; Hsieh and Moretti, 2019). Recent evidence suggests that these frictions persist over the long-run. Abramitzky, Boustan, Jácome and Pérez (2019) find the greater upward income mobility of immigrant families compared to US-born families disappears after controlling for geographic location.[1] This finding naturally raises the question of the role new immigrants play in ameliorating long-run spatial misallocation of native labor. In this paper, we measure these labor mobility frictions and use these measurements to determine the long-run economic costs and benefits from immigration in the presence of these frictions.

A simple accounting exercise highlights the importance of foreign-borns in the reallocation of labor within the US. The changes in the working-age population in a state can be decomposed into demographic changes arising from within the state and net migration into the state. US Census data allows us to conduct this exercise separately for natives and foreign-borns (see Appendix B). The accounting exercise reveals that the contribution of foreign borns to net migration is disproportionately high relative to their population. In 2010, net migration by foreign borns accounted for one-third of the total reallocation of labor across US states. Figure 1 panel *a* shows that the contribution of foreign borns to net migration is only 10pp less than natives. This evidence suggests that foreign borns are more mobile than natives. Figure 1 panel *b* shows interstate migration patterns of natives and foreign borns. There is little correlation between the migration patterns of two groups across states, which further suggests that the two groups face different frictions to mobility.

To measure the labor market frictions US-born and foreign-borns face, we study immigration together with within-country migration in a general equilibrium model. We allow worker heterogeneity by location and education, alongside labor group (foreign-born or native) and labor market heterogeneity by location and occupation to accomodate the rich patterns of complementarity present in the data (Burstein, Hanson, Tian and Vogel, forthcoming). We parameterize a Roy (1951)-type assignment model that builds on Lagakos and Waugh (2013), Hsieh, Hurst, Jones and Klenow (forthcoming), Burstein, Morales and Vogel (2019), and Burstein, Hanson, Tian and Vogel (forthcoming) extended to include labor mobility frictions. This framework allows for framework tractability in spite of high dimensionality. We calibrate the model to US Census data and run counterfactuals that analyze the aggregate and distributional consequences of various immigration policies.

[1] Abramitzky, Boustan, Jácome and Pérez (2019) use administrative and Census data on millions of father-son pairings over 100 years. They find that sons of first-generation immigrants have greater upward income mobility rates than sons of US-born parents. This gap dissapears after controling for geographic location.

Figure 1: Net migration and the reallocation of labor



Panel (a) plots the fraction of the reallocation of labor across states accounted for by net inter-state migration (in grey), separately of natives (in red) and of foreign-borns (in light blue). The reallocation of labor is measured by changes in the share of individuals of the working-age assigned to each US-state between two years. Details on the computation are in Appendix B. Panel (b), in light blue, plots the reallocation of foreign-borns across states against that of natives, and, in blue, the net inter-state migration of foreign-borns. Each point is the figure represents a state between two years over the decades between 1930 and 2010. Source: IPUMS-USA and own computations.

We use the calibrated model to evaluate the effects of reducing barriers to immigration to the US. To understand the interaction between barriers to immigration to the US and barriers to internal migration within the US, we run counterfactuals in which we (i) remove barriers to immigration to the US only, (ii) remove barriers to internal migration only, and (iii) remove barriers to both immigration and internal migration. We use the model to study the impact of policies proposed, and hotly debated since, in the context of a number of bills for comprehensive immigration reform introduced in the US Senate in 2007. First, we consider a policy that reduces frictions to immigration for highly educated workers. To the extent that a merit-based immigration system prioritizes highly skilled individuals, this exercise captures the proposed introduction of such a system. Second, we consider a policy that increases the cost of immigration for people with low levels of educational attainment. To the extent that illegal immigrants are low skilled workers, this exercise captures a proposed increase in border enforcement efforts. The counterfactual analysis allows us to determine the aggregate impact, the role of internal migration, and the winners and losers from these policies.

For a preliminary calibration we allow the labor markets and individuals to only differ by location, which represent US states and other countries. We calibrate the model using Census data for the US and micro-data on 33 countries for 1970 and 2000. These countries represent 56.4% of the flow of immigrants to the US between 1970 and 2000. We run each of the counterfactuals listed above and compare aggregate output in the baseline economy to the counterfactual economies. We find that removing barriers to immigration from Mexico to the US increases aggregate output by 12.8%, on average. If the US economy had a frictionless internal labor market, removing barriers to immigration from Mexico increases aggregate output by 6.5%, on average. Intuitively, the gains from immigration are higher in the presence of frictions to internal mobility because immigration alleviates misallocation of native labor.

Related Literature. Our paper is most closely related to Burstein, Hanson, Tian and Vogel (forthcoming). The authors also use a Roy-model with Fréchet distributions, and show that a key determinant of the labor market impact of immigration is the degree of tradeability of occupations. We extend their framework to include mobility frictions, and use the model-implied measurements of mobility frictions to ask what the impact of such frictions is for the welfare gains of immigration.

The literature on immigration has increasingly recognized the importance of modelling the heterogeneity of workers along a wide set of dimensions (skill, region, sector, occupation and nativity) in a general equilibrium framework (see Peri (2016) for a review). While most of this literature has focused on frictionless frameworks, recent papers have a attempted to model the responses of migrants and natives to immigration by introducing specific types of labor market frictions. For example, Moreno-Galbis and Tritah (2016) and Battisti, Felbermayr, Poutvaara and Peri (2018) introduce search and matching frictions into a model of immigration and find that immigration can attenuate search frictions. Relatedly, the literature on internal migration has introduced different types of frictions – moving cost that depends on location, distance, climate and location size – as in Kennan and Walker (2011) and search frictions as in Schmutz and Sidibé (2018) to explain internal migration patterns. We don't take a stand on the particular type of mobility friction that matters most. Instead, our approach captures mobility frictions in a general way and uses those measurements to perform aggregate counterfactuals.

Our approach of measuring mobility frictions as wedges is similar to that of the literature on spatial misallocation. This literature typically finds substantial mobility frictions, though there is not a concensus on the welfare impact of these frictions (see Desmet and Rossi-Hansberg (2013), Fajgelbaum, Morales, Zidar and Suárez Serrato (2018), Hsieh and Moretti (2019), Herkenhoff, Ohanian and Prescott (2018)). We differ from this literature in that we measure these wedges using a Roy model.

Our paper is also related to a literature that finds an important role of new entrants in labor reallocation. Hobijn, Schoellman and Vindas Q. (2018) and Porzio and Santangelo (2019) show evidence that new cohorts account for a substantial portion of the reallocation of labor across sectors in the US and across countries. Kim and Topel (1995) show similar evidence for Korea and Pérez (2018) for Argentina. Lee and Wolpin (2006) finds substantial mobility costs between sectors. In terms of immigration, Cadena and Kovak (2016) finds that immigrants play an important role in smoothing regional economic fluctuations.

Finally, our paper is related to a literature that identifies how the aggregate benefits of the inflow of a factor of production depend on how efficiently that factor is allocated within the economy. Gopinath, Kalemli-Özcan, Karabarbounis and Villegas-Sanchez (2017), for example, find that financial frictions in Southern Europe together with an inflow of capital at the turn of the century led to significant declines in Total Factor Productivity. Analogously, our paper argues that the aggregate impact of an inflow of labor into a host country depends the (mis)allocation of workers within the host country and how immigrants improve or worsen the allocation of labor across labor markets. Allocation of labor within a country, in turn, depends on labor mobility frictions.

2 The Model

There is a unit-measure continuum of workers indexed by i who maximize their income. Each worker belongs to a group g of workers who share similar characteristics, like age, education, and citizen status and is initially located in one of $\bar{L}$ pairwise disjoint locations indexed by $o \in L \equiv \{1, \ldots, \bar{L}\} = D \cup F$, where D and F collect domestic and foreign locations, respectively. The measure of workers from group g initially located in location o is $q(g, o) > 0$.

Workers can be employed in $\bar{J}$ different occupations indexed by $j \in J \equiv \{1, \ldots, \bar{J}\}$. An occupation j in location d is a labor market $\ell = (d, j) \in \mathcal{L} \equiv \mathcal{D} \cup \mathcal{F}$, where $\mathcal{D} \equiv D \times J$ and $\mathcal{F} \equiv F \times J$, respectively. Worker i from group g draws an idiosyncratic productivity $\epsilon_i(\ell|g)$ for each labor market ℓ from a univariate Fréchet distribution with shape parameter θ and scale parameter $T(g)$. The parameters θ and $T(g)$ govern the dispersion of talent across workers and groups, respectively. The higher θ is, the smaller is the variance; the higher $T(g)$ is, the higher is the group-g mean. The productivity draws do not depend on the worker's initial location and are independent and identically distributed across labor markets and workers. Thus, the matrix of productivities of worker i from group g initially located in location o,

$$\epsilon_i(g) = \begin{pmatrix} \epsilon_i(1,1|g) & \epsilon_i(1,2|g) & \cdots & \epsilon_i(1,\bar{J}|g) \\ \epsilon_i(2,1|g) & \epsilon_i(2,2|g) & \cdots & \epsilon_i(2,\bar{J}|g) \\ \vdots & \vdots & \ddots & \vdots \\ \epsilon_i(\bar{L},1|g) & \epsilon_i(\bar{L},2|g) & \cdots & \epsilon_i(\bar{L},\bar{J}|g) \end{pmatrix},$$

is drawn from a multivariate Fréchet distribution that depends on worker i's group g,

$$F_g(\epsilon_i(g)) = \exp\left[-\sum_{\ell \in \mathcal{L}} T(g)\epsilon_i(\ell|g)^{-\theta}\right]. \tag{1}$$

A representative profit-maximizing firm produces domestic aggregate output Y and sells it at a price p normalized to 1. It employs workers in domestic labor markets $\ell \in \mathcal{D}$ at the prevailing wage rate per efficiency unit, $w(\ell)$. Output in labor market $\ell \in \mathcal{D}$ equals total labor input in labor market ℓ in efficiency units, $n(\ell)$. The firm combines domestic labor market outputs to produce domestic aggregate output according to

$$Y = \left(\sum_{\ell \in \mathcal{D}} \mu(\ell)^{\frac{1}{\sigma}} n(\ell)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}, \tag{2}$$

where σ is the elasticity of substitution across labor markets in domestic aggregate production and $\mu(\ell) \geq 0$ is an exogenous demand shifter for the output of labor market ℓ.

At the outset, workers choose a labor market $\ell = (d, j) \in \mathcal{L}$ to be employed in so as to maximize income. They supply $A(\ell|g)\epsilon_i(\ell|g)$ efficiency units of labor to labor market ℓ, where $A(\ell|g)$ is a productivity factor that scales the average productivity of workers from group g working in labor market ℓ. That is, while $T(g)$ scales the average productivity of workers from group g without distinguishing among labor markets, $A(\ell|g)$ captures differences in average productivity of workers from group g across labor markets. Each efficiency unit earns the wage rate $w(\ell)$. If the labor market is foreign, i.e., if $\ell \in \mathcal{F}$, then this wage rate is exogenous. Due to institutional aspects such as, e.g., occupational licensing, moving between labor markets incurs a moving cost that reduces income proportionally in a deadweight-loss fashion. This cost is captured by the wedge $\tau(\ell|g,o)$. It acts like a tax rate equal to $(1 - \tau(\ell|g,o))$ facing a worker from group g initially located in location o that works in labor market ℓ. That is, letting $\tilde{\tau}(\ell|g,o) \equiv \tau(\ell|g,o)A(\ell|g)$, the income that worker i from group g initially located in location o generates from working in labor market ℓ is

$$y_i(\ell|g,o) = \tau(\ell|g,o)w(\ell)A(\ell|g)\epsilon_i(\ell|g) = \tilde{\tau}(\ell|g,o)w(\ell)\epsilon_i(\ell|g). \tag{3}$$

After all relocation, total labor in efficiency units supplied to labor market $\ell \in \mathcal{L}$ equals

$$n^s(\ell) = \sum_{g,o} q(g,o)\pi(\ell|g,o)A(\ell|g)\mathbb{E}\left[\epsilon_i(\ell|g)|i \text{ from } g \text{ in } o \text{ chooses } \ell\right], \tag{4}$$

where $\pi(\ell|g,o)$ is the probability of a worker from group g initially located in location o choosing to work in labor market ℓ, and the last term is the expected productivity of those workers.

Finally, after production, incomes are paid out to workers, moving costs are incurred and the remainder is consumed immediately.

3 Equilibrium

Definition 1. *Given shape and scale parameters θ and $\{T(g)\}_g$, the initial distribution of workers $\{q(g,o)\}_{(g,o)}$, the institutions governing migration $\{\tau(\ell|g,o)\}_{(\ell,g,o)}$, demand shifters $\{\mu(\ell)\}_{\ell\in\mathcal{D}}$, productivity factors $\{A(\ell|g)\}_{(\ell,g)}$, and foreign wages $\{w(\ell)\}_{\ell\in\mathcal{F}}$, a competitive equilibrium is an allocation $\{n(\ell)\}_{\ell\in\mathcal{L}}$ and a set of domestic wages $\{w(\ell)\}_{\ell\in\mathcal{D}}$ such that,*

1. *given $\{w(\ell)\}_{\ell\in\mathcal{D}}$, for all i, g, and o, worker i from group g initially located in location o maximizes their income, i.e., they work in labor market ℓ if and only if*

$$y_i(\ell|g,o) > y_i(\ell'|g,o) \quad \forall \ell' \in \mathcal{L}, \ell' \neq \ell; \tag{5}$$

2. *given $\{w(\ell)\}_{\ell\in\mathcal{D}}$, $\{n(\ell)\}_{\ell\in\mathcal{D}}$ solves the firm's problem*

$$\max_{\{n^d(\ell)\geq 0\}_{\ell\in\mathcal{D}}} \quad \left(\sum_{\ell\in\mathcal{D}} \mu(\ell)^{\frac{1}{\sigma}} n^d(\ell)^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}} - \sum_{\ell\in\mathcal{D}} w(\ell)n^d(\ell); \tag{6}$$

3. *all domestic labor markets clear and foreign labor markets absorb remaining labor, i.e.,*

$$n(\ell) = \sum_{g,o} q(g,o)\pi(\ell|g,o)A(\ell|g)\mathbb{E}\left[\epsilon_i(\ell|g)|i \textit{ from } g \textit{ in } o \textit{ chooses } \ell\right] \quad \forall \ell \in \mathcal{L}, \tag{7}$$

where $\pi(\ell|g,o)$ and $\mathbb{E}\left[\epsilon_i(\ell|g)|i \textit{ from } g \textit{ in } o \textit{ chooses } \ell\right]$ are consistent with 1;

4. *aggregate domestic output equals the incomes plus moving costs of domestic workers,*

$$Y = \sum_{\ell\in\mathcal{D}} w(\ell)n(\ell). \tag{8}$$

We collect the equations characterizing the equilibrium and relegate derivations to Appendix A. Using (2), the representative firms' maximization in (6) implies that

$$n(\ell) = w(\ell)^{-\sigma}\mu(\ell)Y \quad \forall \ell \in \mathcal{D}. \tag{9}$$

The probability of a worker from group g initially located in location o choosing to work in labor market ℓ is

$$\pi(\ell|g,o) = \text{Prob}\left(\{\forall \ell' \neq \ell : y_i(\ell|g,o) > y_i(\ell'|g,o)\}\right) = \frac{(\tilde{\tau}(\ell|g,o)w(\ell))^{\theta}}{\sum_{\ell' \in \mathcal{L}}(\tilde{\tau}(\ell'|g,o)w(\ell'))^{\theta}}. \tag{10}$$

That is, all else equal, the higher the wage rate is in labor market ℓ, the higher the productivity factor is for workers from group g in labor market ℓ, or the less costly it is for workers from group g initially located in location o to move to labor market ℓ, the more likely it is that workers from group g initially located in location o choose labor market ℓ.

The expected idiosyncratic productivity of workers from group g initially located in location o and deciding to work in labor market ℓ is

$$\begin{aligned}\mathbb{E}\left[\epsilon_i(\ell|g)|i \text{ from } g \text{ in } o \text{ chooses } \ell\right] &= \mathbb{E}\left[\epsilon_i(\ell|g) \,\middle|\, \forall \ell' \neq \ell : y_i(\ell|g,o) > y_i(\ell'|g,o)\right] \\ &= \left(\frac{T(g)}{\pi(\ell|g,o)}\right)^{\frac{1}{\theta}} \Gamma\left(1 - \frac{1}{\theta}\right). \end{aligned} \tag{11}$$

That is, all else equal, the greater the probability of workers from group g initially located in location o choosing to work in labor market ℓ, the lower is their expected idiosyncratic productivity. Hence, the higher the wage rate is in labor market ℓ, the higher the productivity factor is for workers from group g in labor market ℓ, or the less costly it is for workers from group g initially located in location o to move to labor market ℓ, the lower is the expected idiosyncratic productivity of workers from group g initially located in location o who choose to work in labor market ℓ.

It then follows from (7), using (11) and (10), that for all $\ell \in \mathcal{L}$,

$$\begin{aligned} n(\ell) &= \sum_{g,o} q(g,o)\pi(\ell|g,o)A(\ell|g)\mathbb{E}\left[\epsilon_i(\ell|g)|i \text{ from } g \text{ in } o \text{ chooses } \ell\right], \\ &= \Gamma\left(1 - \frac{1}{\theta}\right)\sum_{g,o} q(g,o)A(\ell|g)T(g)^{\frac{1}{\theta}}\left(\frac{(\tilde{\tau}(\ell|g,o)w(\ell))^{\theta}}{\sum_{\ell' \in \mathcal{L}}(\tilde{\tau}(\ell'|g,o)w(\ell'))^{\theta}}\right)^{1-\frac{1}{\theta}}. \end{aligned} \tag{12}$$

Thus, combining (8), (9), and (12), given θ, $\{T(g)\}_g$, $\{q(g,o)\}_{(g,o)}$, $\{\tau(\ell|g,o)\}_{(\ell,g,o)}$, $\{\mu(\ell)\}_{\ell \in \mathcal{D}}$,

$\{A(\ell|g)\}_{(\ell,g)}$, and $\{w(\ell)\}_{\ell\in\mathcal{F}}$, again letting $\tilde{\tau}(\ell|g,o)=\tau(\ell|g,o)A(\ell|g)$ for all (ℓ,g,o),

$$n(\ell)=\Gamma\left(1-\frac{1}{\theta}\right)\sum_{g,o}q(g,o)A(\ell|g)T(g)^{\frac{1}{\theta}}\left(\frac{(\tilde{\tau}(\ell|g,o)w(\ell))^{\theta}}{\sum_{\ell'\in\mathcal{L}}(\tilde{\tau}(\ell'|g,o)w(\ell'))^{\theta}}\right)^{1-\frac{1}{\theta}}\quad\forall\ell\in\mathcal{L}, \tag{13}$$

$$w(\ell)=\left(\mu(\ell)Yn(\ell)^{-1}\right)^{\frac{1}{\sigma}}\quad\forall\ell\in\mathcal{D}, \tag{14}$$

$$Y=\sum_{\ell\in\mathcal{D}}w(\ell)n(\ell), \tag{15}$$

are $|\mathcal{L}|+|\mathcal{D}|+1$ equations in as many unknowns $(\{n(\ell)\}_{\ell\in\mathcal{L}},\{w(\ell)\}_{\ell\in\mathcal{D}},Y)$.

In equilibrium, then, from (3) and (11) follows that the expected income of a worker from group g initially located in location o and choosing to work in labor market ℓ is

$$\begin{aligned}\bar{y}(\ell|g,o)&=\tilde{\tau}(\ell|g,o)w(\ell)\mathbb{E}\left[\epsilon_i(\ell|g)|i\text{ from }g\text{ in }o\text{ chooses }\ell\right]\\&=\tilde{\tau}(\ell|g,o)w(\ell)\left(\frac{T(g)}{\pi(\ell|g,o)}\right)^{\frac{1}{\theta}}\Gamma\left(1-\frac{1}{\theta}\right).\end{aligned} \tag{16}$$

which, using (10), can also be written as

$$\begin{aligned}\bar{y}(\ell|g,o)&=\tilde{\tau}(\ell|g,o)w(\ell)\left(T(g)\frac{\sum_{\ell'\in\mathcal{L}}(\tilde{\tau}(\ell'|g,o)w(\ell'))^{\theta}}{(\tilde{\tau}(\ell|g,o)w(\ell))^{\theta}}\right)^{\frac{1}{\theta}}\Gamma\left(1-\frac{1}{\theta}\right)\\&=\left(T(g)\sum_{\ell'\in\mathcal{L}}(\tilde{\tau}(\ell'|g,o)w(\ell'))^{\theta}\right)^{\frac{1}{\theta}}\Gamma\left(1-\frac{1}{\theta}\right).\end{aligned}$$

Thus, the expected income of workers from group g initially located in location o is

$$\bar{y}(g,o)=\sum_{\ell\in\mathcal{L}}\pi(\ell|g,o)\bar{y}(\ell|g,o)=\left(T(g)\sum_{\ell'\in\mathcal{L}}(\tilde{\tau}(\ell'|g,o)w(\ell'))^{\theta}\right)^{\frac{1}{\theta}}\Gamma\left(1-\frac{1}{\theta}\right),$$

because $\sum_{\ell\in\mathcal{L}}\pi(\ell|g,o)=1$. That is, the expected income of workers from group g initially located in location o is independent of their destination labor market,

$$\bar{y}(g,o)=\bar{y}(\ell|g,o)=\tilde{\tau}(\ell|g,o)w(\ell)\left(\frac{T(g)}{\pi(\ell|g,o)}\right)^{\frac{1}{\theta}}\Gamma\left(1-\frac{1}{\theta}\right)\quad\forall\ell\in\mathcal{L}. \tag{17}$$

4 Identification

We need to measure (i) the moving costs $\tau(\ell|g,o)$ for each (ℓ,g,o) triplet, (ii) the productivity factor $A(\ell|g)$ for each (ℓ,g) pair, (iii) the scale parameter $T(g)$ for each group g, and

(iv) the wage rate per efficiency unit of labor $w(\ell)$ in each domestic labor market. In the data, we observe migration rates for all (ℓ, g, o) triplets, which equal $\pi(\ell|g, o)$ by the law of large numbers. We construct expected income by group and initial location $\bar{y}(g, o)$ using data on average earnings for all (ℓ, g, o) triplets.

For all workers from group g initially located in location o and working in labor market $\ell = (d, j)$, define $\tilde{w}$ as

$$\tilde{w}(d, j|g, o) = \tilde{\tau}(d, j|g, o)w(d, j)T(g)^{\frac{1}{\theta}}. \tag{18}$$

Using this definition, we can rewrite (17) as

$$\bar{y}(g, o) = \tilde{w}(d, j|g, o)\left(\frac{1}{\pi(d, j|g, o)}\right)^{\frac{1}{\theta}}\Gamma\left(1 - \frac{1}{\theta}\right),$$

which allows us to calculate, for all (d, j, g, o),

$$\tilde{w}(d, j|g, o) = \pi(d, j|g, o)^{\frac{1}{\theta}}\bar{y}(g, o)\Gamma\left(1 - \frac{1}{\theta}\right)^{-1} \tag{19}$$

directly from data on the average earnings for workers from group g initially located in location o and the proportion of those workers working in labor market (d, j).

Knowing $\tilde{w}(d, j|g, o)$ for all (d, j, g, o), we make three identification assumptions.

Assumption 1. *There are no moving costs associated with a worker entering any labor market in their original location, i.e.,*

$$\tau(o, j|g, o) = 1 \quad \forall(o, j, g). \tag{20}$$

Assumption 2. *There is a baseline group g^* for which average productivity is normalized to one in all labor markets, i.e.,*

$$T(g^*) = A(\ell|g^*) = 1 \quad \forall\ell \in \mathcal{L}. \tag{21}$$

Assumption 3. *There is a baseline labor market (d^*, j^*) in which the productivity factor is normalized to one for all groups, i.e.,*

$$A(d^*, j^*|g) = 1 \quad \forall g. \tag{22}$$

Using the definition $\tilde{\tau}(\ell|g, o) = \tau(\ell|g, o)A(\ell|g)$, we operationalize Assumptions 1–3 in two steps. In the first step, we identify $w(d, j)$ for all (d, j), $T(g)$ for all g, and $\tilde{\tau}(d, j|g, o)$

for all (d, j, g, o). In the second step, we then use these $\tilde{\tau}(d, j|g, o)$ to find $\tau(d, j|g, o)$ for all (d, j, g, o) and $A(\ell|g)$ for all (ℓ, g).

Step 1. First, combining (20) and (21), it follows for the baseline group g^* that

$$\tilde{\tau}(o, j|g^*, o) = \tau(o, j|g^*, o)A(o, j|g^*) = 1 \quad \forall(o, j). \tag{23}$$

Second, combining (20) and (22), we have

$$\tilde{\tau}(o^*, j^*|g, o^*) = \tau(o^*, j^*|g, o^*)A(o^*, j^*|g) = 1 \quad \forall g. \tag{24}$$

Next, using the baseline group g^* and one labor market (o, j) at a time, via (21) and (23), (18) identifies the wage rate for all labor markets (d, j):

$$w(o, j) = \tilde{\tau}(o, j|g^*, o)w(o, j)T(g^*)^{\frac{1}{\theta}} = \tilde{w}(o, j|g^*, o). \tag{25}$$

Having the wage rates for all labor markets, using the baseline labor market for one group at a time and (25), via (24), (18) identifies the $T(g)$ for all groups $g \neq g^*$:

$$\begin{aligned} \tilde{w}(o^*, j^*|g, o^*) = \tilde{\tau}(o^*, j^*|g, o^*)w(o^*, j^*)T(g)^{\frac{1}{\theta}} = w(o^*, j^*)T(g)^{\frac{1}{\theta}} = \tilde{w}(o^*, j^*|g^*, o^*)T(g)^{\frac{1}{\theta}} \\ \Rightarrow T(g) = \left(\frac{\tilde{w}(o^*, j^*|g, o^*)}{\tilde{w}(o^*, j^*|g^*, o^*)}\right)^{\theta}. \end{aligned} \tag{26}$$

Then, for every (d, j, g, o), using (25) and (26), (18) identifies the $\tilde{\tau}(d, j|g, o)$ that a worker from group g initially located in location o and working in labor market (d, j) is facing as

$$\tilde{\tau}(d, j|g, o) = \frac{\tilde{w}(d, j|g, o)}{w(d, j)}T(g)^{-\frac{1}{\theta}} = \frac{\tilde{w}(d, j|g, o)}{\tilde{w}(d, j|g^*, d)} \cdot \frac{\tilde{w}(o^*, j^*|g^*, o^*)}{\tilde{w}(o^*, j^*|g, o^*)}. \tag{27}$$

Step 2. Now, knowing $\tilde{\tau}(d, j|g, o)$ for all (d, j, g, o), using (20), for all (o, j, g),

$$A(o, j|g) = \tau(o, j|g, o)A(o, j|g) = \tilde{\tau}(o, j|g, o). \tag{28}$$

Finally, using (28), we have for all (d, j, g, o),

$$\begin{aligned} \tilde{\tau}(d, j|g, o) = \tau(d, j|g, o)A(d, j|g) \\ \Rightarrow \tau(d, j|g, o) = \frac{\tilde{\tau}(d, j|g, o)}{A(d, j|g)} = \frac{\tilde{\tau}(d, j|g, o)}{\tilde{\tau}(d, j|g, d)}. \end{aligned} \tag{29}$$

To summarize, (20) and (29) identify all $\{\tau(\ell|g, o)\}_{(\ell,g,o)}$; (21), (22), and (28) identify all $\{A(\ell|g)\}_{(\ell,g)}$; (21) and (26) identify all $\{T(g)\}_g$; and (25) identifies all $\{w(\ell)\}_\ell$.

5 Quantitative Exercise (Preliminary)

In this section, we quantify the role of frictions to mobility across labor markets within the host country for the economic costs and benefits of immigration. We proceed in two steps. We first calibrate our model economy to match flows across labor market wage in the US economy and the country of immigration in 1970 and 2000. Second, via counterfactual exercises, we evaluate the effects of reducing barriers to immigration to the US in relation to the presence of frictions to mobility across labor markets within the host country.

Calibration. Our calibration strategy follows the identification equations highlighted in Section 2. In particular, we use equation xx to measure frictions for labor to move across labor market and average productivity of labor in each labor market. The model features heterogeneity by location, occupation, education and country of origin. For a preliminary calibration we allow the labor markets to differ by location ℓ, which represent US states and other countries.

We start by giving values to some of the parameters of our accounting framework based on previous literature (see table 1). We borrow the estimates of the parameter that governs the shape of the Frechet distribution from Burstein et al. (2019), $\theta = 1.78$. From the same paper, we borrow the elasticity of substitution between occupational outputs, $\rho = 1.78$.

Parameter	Symbol	Value	Source
Frechet distribution, shape	σ	1.78	Burstein et al. (2019)
Final output prod., elasticity	ρ	1.78	Burstein et al. (2019)

Table 1: Parameters chosen without solving the model.

We measure frictions to labor movement across locations and average labor productivity across locations using Census data for the US and micro-data on 33 countries for 1970 and 2000. In particular, to measure movements across US states and the average wages by state over the last five decades, we rely on the the Census of Populations (Census) in 1970 and the American Community Survey (ACS) in 2000. For a description of wages of immigrant workers and the probability of immigration, we drawn upon three major dataset. We collect data on immigration flows into the US and average wages for 33 countries at different stages of development. Those countries represent 56.4% of the total inflow of immigrants to the US between 1970 and 2010, 39.5% and 45.8% of the stock of immigrants in the US in 1970 and 2000, respectively. For details on our samples and a list of the countries of origin of immigrants we consider see Appendix B.

Counterfactuals. To understand the interaction between barriers to immigration to the US and barriers to internal migration within the US, we run counterfactuals in which we (i) remove barriers to Mexican immigration to the US only, (ii) remove barriers to internal migration only, and (iii) remove barriers to both Mexican immigration and internal migration. We run each of these three counterfactuals and compare aggregate output in the baseline economy to the counterfactual economies. We focus on Mexican immigrants in particular as they represent 40% of the stock of immigrants in the US in 2000.

In presenting our results, we focus on one specific Table report output per worker in the baseline experiment and in each of the counterfactuals. We find that removing barriers to immigration from Mexico to the US increases aggregate output by 12.8%, on average between 1970 and 2010. That is, when we compare output per worker under Counterfactual (i) to that in the baseline, we see an increase of 11.1% in 1970 and an increase of 14.6% in 2000. If the US economy had a frictionless internal labor market, removing barriers to immigration from Mexico increases aggregate output by 6.5%, on average. That is, when we compare output per worker under Counterfactual (iii) to that in Counterfactual (ii), we see an increase of 6.4% in 1970 and an increase of 6.6% in 2000.

Intuitively, our result shows that the gains from immigration are higher in the presence of frictions to internal mobility because immigration alleviates misallocation of native labor.

Table 2: Counterfactual exercises

	1970	2010
Baseline	1.00	1.44
No international barriers	1.15	1.60
No internal barriers	2.04	2.61
No international and internal barriers	2.17	2.78

The table shows output per worker under the baseline calibration (“baseline"), under counterfactual (i) (“No international barriers"), under counterfactual (ii) (“No internal barriers") and under counterfactual (i) (“No international and internal barriers"). Output per worker is normalized to 1 in the baseline calibration in 1970.

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Appendix A Model derivations

In this appendix, we collect derivations we skipped in the main text. Most of these derivations replicate arguments from Hsieh et al. (forthcoming) for our environment.

Derivation of $\pi(\ell|g,o)$ as given by Equation (10):

$$\begin{aligned}
\pi(\ell|g,o) &= \text{Prob}\left(\{\forall \ell' \neq \ell : y_i(\ell|g,o) > y_i(\ell'|g,o)\}\right) \\
&= \text{Prob}\left(\left\{\forall \ell' \neq \ell : \epsilon_i(\ell'|g) < \frac{\tilde{\tau}(\ell|g,o)w(\ell)}{\tilde{\tau}(\ell'|g,o)w(\ell')}\epsilon_i(\ell|g)\right\}\right) \\
&= \int F_{g,\ell}\left(\frac{\tilde{\tau}(\ell|g,o)w(\ell)}{\tilde{\tau}(1,1|g,o)w(1,1)}\epsilon_i(\ell|g), \ldots, \epsilon_i(\ell|g), \ldots, \frac{\tilde{\tau}(\ell|g,o)w(\ell)}{\tilde{\tau}(\bar{L},\bar{J}|g,o)w(\bar{L},\bar{J})}\epsilon_i(\ell|g)\right) d\epsilon_i(\ell|g) \\
&= \int F_{g,\ell}\left(\alpha(1,1)\epsilon_i(\ell|g), \ldots, \epsilon_i(\ell|g), \ldots, \alpha(\bar{L},\bar{J})\epsilon_i(\ell|g)\right) d\epsilon_i(\ell|g), \qquad (30)
\end{aligned}$$

where $F_{g,\ell}$ is the partial derivative of F_g with respect to its ℓth argument and

$$\alpha(d,j) \equiv \frac{\tilde{\tau}(\ell|g,o)w(\ell)}{\tilde{\tau}(d,j|g,o)w(d,j)}.$$

From (1) follows that

$$F_{g,\ell}(\epsilon_i(g)) = T(g)\theta\epsilon_i(\ell|g)^{-\theta-1}\exp\left[-\sum_{\ell'\in\mathcal{L}} T(g)\epsilon_i(\ell'|g)^{-\theta}\right],$$

so that

$$\begin{aligned}
&F_{g,\ell}\left(\alpha(1,1)\epsilon_i(\ell|g), \ldots, \epsilon_i(\ell|g), \ldots, \alpha(\bar{L},\bar{J})\epsilon_i(\ell|g)\right) \\
&= T(g)\theta\epsilon_i(\ell|g)^{-\theta-1}\exp\left[-\sum_{\ell'\in\mathcal{L}} T(g)\alpha(\ell')^{-\theta}\epsilon_i(\ell|g)^{-\theta}\right] \\
&= T(g)\theta\epsilon_i(\ell|g)^{-\theta-1}\exp\left[-T(g)\epsilon_i(\ell|g)^{-\theta}\sum_{\ell'\in\mathcal{L}} \alpha(\ell')^{-\theta}\right] \\
&= T(g)\theta\epsilon_i(\ell|g)^{-\theta-1}\exp\left[-T(g)\bar{\alpha}\epsilon_i(\ell|g)^{-\theta}\right],
\end{aligned}$$

where $\bar{\alpha} \equiv \sum_{\ell' \in \mathcal{L}} \alpha(\ell')^{-\theta}$. Then, evaluating (30),

$$\begin{aligned}
\pi(\ell|g,o) &= \frac{1}{\bar{\alpha}} \int T(g)\bar{\alpha}\theta\epsilon_i(\ell|g)^{-\theta-1} \exp\left[-T(g)\bar{\alpha}\epsilon_i(\ell|g)^{-\theta}\right] d\epsilon_i(\ell|g) \\
&= \frac{1}{\bar{\alpha}} \int d\hat{F}_g(\epsilon_i(\ell|g)) \\
&= \frac{1}{\sum_{\ell' \in \mathcal{L}} \alpha(\ell')^{-\theta}} \\
&= \frac{(\tilde{\tau}(\ell|g,o)w(\ell))^\theta}{\sum_{\ell' \in \mathcal{L}} (\tilde{\tau}(\ell'|g,o)w(\ell'))^\theta},
\end{aligned} \tag{31}$$

where $\hat{F}_g$ is a univariate Fréchet distribution with shape parameter θ and scale parameter $T(g)\bar{\alpha}$.

Derivation of $\mathbb{E}\left[\epsilon_i(\ell)|i \text{ from } g \text{ in } o \text{ chooses } \ell\right]$ as given in Equation (11): Rewrite $y_i(\ell|g,o) = \hat{w}(\ell|g,o)\epsilon_i(\ell|g)$, where $\hat{w}(\ell|g,o) \equiv \tilde{\tau}(\ell|g,o)w(\ell)$ is the "net wage rate per unit of idiosyncratic productivity" worker i from group g initially located in location o can earn in labor market ℓ, and let $y_i^*(g,o)$ be the highest income among those incomes. Then,

$$\begin{aligned}
\text{Prob}[y_i^*(g,o) < z] &= \text{Prob}\left(\{\forall \ell : y_i(\ell|g,o) < z\}\right) \\
&= \text{Prob}\left(\{\forall \ell : \hat{w}(\ell|g,o)\epsilon_i(\ell|g) < z\}\right) \\
&= \text{Prob}\left(\left\{\forall \ell : \epsilon_i(\ell|g) < \frac{z}{\hat{w}(\ell|g,o)}\right\}\right) \\
&= F_g\left(\frac{z}{\hat{w}(1,1|g,o)}, \ldots, \frac{z}{\hat{w}(\bar{L},\bar{J}|g,o)}\right) \\
&= \exp\left[-\sum_{\ell \in \mathcal{L}} T(g)\left(\frac{z}{\hat{w}(\ell|g,o)}\right)^{-\theta}\right] \\
&= \exp\left[-T(g)z^{-\theta}\sum_{\ell \in \mathcal{L}} \hat{w}(\ell|g,o)^\theta\right].
\end{aligned}$$

Let $\hat{w}_i^*(g,o)$ and $\epsilon_i^*(g,o)$ be the net wage rate per unit of idiosyncratic productivity and the idiosyncratic productivity worker i from group g initially located in location o faces in the labor market of their choice, respectively, so that $y_i^*(g,o) = \hat{w}_i^*(g,o)\epsilon_i^*(g,o)$. It then follows that the distribution of the idiosyncratic productivity of worker i from group g initially located in location o in the labor market of their choice, $\epsilon_i^*(g,o)$, satisfies

$$
\begin{aligned}
G(x) \equiv \text{Prob}[\epsilon_i^*(g,o) < x] = \text{Prob}[y_i^*(g,o) < \hat{w}_i^*(g,o)x] \\
&= \exp\left[-T(g)\hat{w}_i^*(g,o)^{-\theta}x^{-\theta}\sum_{\ell\in\mathcal{L}}\hat{w}(\ell|g,o)^{\theta}\right] \\
&= \exp\left[-T(g)\sum_{\ell\in\mathcal{L}}\left(\frac{\hat{w}(\ell|g,o)}{\hat{w}_i^*(g,o)}\right)^{\theta}x^{-\theta}\right].
\end{aligned}
$$

Therefore, the expected idiosyncratic productivity of a workers i from group g initially located in location o and working in their chosen labor market is

$$
\begin{aligned}
\mathbb{E}\left[\epsilon_i^*(g,o)\right] &= \int_0^{\infty}\epsilon_i^*(g,o)dG(\epsilon_i^*(g,o)) \\
&= \int_0^{\infty}T(g)\theta\sum_{\ell\in\mathcal{L}}\left(\frac{\hat{w}(\ell|g,o)}{\hat{w}_i^*(g,o)}\right)^{\theta}\epsilon_i^*(g,o)^{-\theta}\exp\left[-T(g)\sum_{\ell\in\mathcal{L}}\left(\frac{\hat{w}(\ell|g,o)}{\hat{w}_i^*(g,o)}\right)^{\theta}\epsilon_i^*(g,o)^{-\theta}\right]d\epsilon_i^*(g,o) \\
&= \int_0^{\infty}\theta\kappa\epsilon_i^*(g,o)^{-\theta}\exp\left[-\kappa\epsilon_i^*(g,o)^{-\theta}\right]d\epsilon_i^*(g,o), \quad \text{where} \quad \kappa\equiv T(g)\sum_{\ell\in\mathcal{L}}\left(\frac{\hat{w}(\ell|g,o)}{\hat{w}_i^*(g,o)}\right)^{\theta}.
\end{aligned}
$$

Using the change-of-variable $y \equiv \kappa\epsilon_i^*(g,o)^{-\theta}$ and the Gamma function $\Gamma(x) \equiv \int_0^{\infty} y^{x-1}\exp[-y]dy$,

$$
\begin{aligned}
\mathbb{E}\left[\epsilon_i^*(g,o)\right] &= \int_{\infty}^{0}\theta y\exp\left[-y\right]\left(-\frac{1}{\theta}\right)\kappa^{\frac{1}{\theta}}y^{-\frac{1}{\theta}-1}dy \\
&= \kappa^{\frac{1}{\theta}}\int_0^{\infty}y^{-\frac{1}{\theta}}\exp\left[-y\right]dy \\
&= \left(T(g)\sum_{\ell'\in\mathcal{L}}\left(\frac{\hat{w}(\ell'|g,o)}{\hat{w}_i^*(g,o)}\right)^{\theta}\right)^{\frac{1}{\theta}}\Gamma\left(1-\frac{1}{\theta}\right).
\end{aligned}
$$

Therefore, in the labor market ℓ of choice of a worker i from group g initially located in location o, using $\hat{w}_i^*(g,o) = \hat{w}(\ell|g,o)$, their expected idiosyncratic productivity is

$$
\begin{aligned}
\mathbb{E}\left[\epsilon_i(\ell|g)|i \text{ from } g \text{ in } o \text{ chooses } \ell\right] &= \mathbb{E}\left[\epsilon_i(\ell|g)\;\middle|\;\forall\ell'\neq\ell: y_i(\ell|g,o) > y_i(\ell'|g,o)\right] \\
&= \left(T(g)\sum_{\ell'\in\mathcal{L}}\left(\frac{\hat{w}(\ell'|g,o)}{\hat{w}(\ell|g,o)}\right)^{\theta}\right)^{\frac{1}{\theta}}\Gamma\left(1-\frac{1}{\theta}\right) \\
&= \left(T(g)\frac{\sum_{\ell'\in\mathcal{L}}(\tilde{\tau}(\ell'|g,o)w(\ell'))^{\theta}}{(\tilde{\tau}(\ell|g,o)w(\ell))^{\theta}}\right)^{\frac{1}{\theta}}\Gamma\left(1-\frac{1}{\theta}\right) \\
&= \left(\frac{T(g)}{\pi(\ell|g,o)}\right)^{\frac{1}{\theta}}\Gamma\left(1-\frac{1}{\theta}\right), \qquad (32)
\end{aligned}
$$

where the second-to-last equality follows from the definition of $\hat{w}(\ell|g,o)$ and the last equality follows from (31).

Derivation of $n(\ell)$ as given in Equation (12): Using (32) and (31) in (7), for all $\ell \in \mathcal{L}$,

$$
\begin{aligned}
n(\ell) &= \sum_{g,o} q(g,o)\pi(\ell|g,o)A(\ell|g)\mathbb{E}\left[\epsilon_i(\ell|g)|i \text{ from } g \text{ in } o \text{ chooses } \ell\right] \\
&= \Gamma\left(1-\frac{1}{\theta}\right)\sum_{g,o} q(g,o)A(\ell|g)T(g)^{\frac{1}{\theta}}\pi(\ell|g,o)^{1-\frac{1}{\theta}} \\
&= \Gamma\left(1-\frac{1}{\theta}\right)\sum_{g,o} q(g,o)A(\ell|g)T(g)^{\frac{1}{\theta}}\left(\frac{(\tilde{\tau}(\ell|g,o)w(\ell))^{\theta}}{\sum_{\ell'\in\mathcal{L}}(\tilde{\tau}(\ell'|g,o)w(\ell'))^{\theta}}\right)^{1-\frac{1}{\theta}}.
\end{aligned}
$$

Appendix B Data

B.1 US sample

Sample. We use the 1% Census of Populations (Census) for the year 1970 and the 5% American Community Survey (ACS) for the year 2010. Observations are weighted by CPS sampling weights. We restrict the sample to individuals in the labor force, between the age of 16 and 65. We exclude self-employed workers, unpaid family workers and institutional group quarters. We disregard workers with missing information on hours worked, weeks workers, earnings, current location and location 5-year prior. Our 1970 sample covers more than 800,000 observations in 1970 and about 7,000,000 in 2000.

Schooling. Our measure of schooling attainment is the IPUMS variable EDUC. It indicates the highest year of school or degree completed by the respondent. We focus on four main education groups: *less than high school* (up to 11th grade of high school), *high school* (12th grade of high school, with or without graduation), *college* (bachelor degree or more).

Occupation. We use the occupational classification of Acemoglu and Autor (2011), based on the IPUMS variable OCC1990. We grouped occupations in the following groups, based on the OCCISCO classification: Legislators, senior officials and managers, Professionals, Technicians and associate professionals, Clerks, Service workers and shop and market sales, Skilled agricultural and fishery workers, Crafts and related trades workers, Plant and machine operators and assemblers and Elementary occupations.

Migration. We measure migration across states in the USA by comparing current location (as measured by STATEICP and location 5-year prior (as measured by MIGPLACE5). An alternative way to measure cross-location migration is to follow the method proposed by Molloy et al. (2011). They determines migration based on children aged 4-5 years living in the household that have a different birth state than state of current residence. When using this method, we restrict the sample to households with children between the age of 4 and 5. The final sample size is of more than 80,000 observations in 1970 and more than 500,000 in 2000.

Wages. Our measure of wages is the IPUMS variable INCWAGE. It reports total pre-tax wage and salary income, i.e. money received as an employee for the previous calendar year, as midpoints of intervals (instead of exact dollar amounts). We deflate our wage series to 2008 US dollars using the Personal Consumption Expenditure Deflator produced by the US Bureau of Economic Analysis. To compute hourly wages, we measure annual working hours by combining information on weekly working hours and number of week worked in a year. We use the variable HRSWORK2 for weekly working hours in 1970 and UHRSWORK in 2000. HRSWORK2 reports the total number of hours the respondent was at work during the previous week. UHRSWORK reports the total number of hours that the respondent usually worked during the previous year. Our measure of the annual weeks worked is the IPUMS variable WKSWORK2. WKSWORK2 reports the number of weeks that the respondent worked for profit, pay, or as an unpaid family worker during the previous year. Finally, we dropped of below $67/week in 1982 dollars ($136/week in 2008 dollars) are dropped.

B.2 International sample

Sample. We collect information for 33 countries in 1970 and 2010. For each country, we use Census data from IPUMS International to describe the distribution of workers by education and occupation. We complement this dataset with wage information contained in the NBER "Occupational wages around the world" dataset (OWW). The list of countries is in Table 3.

Schooling. We use the variable EDATTAN in the Census data from IPUMS international to measure schooling. We group schooling in categories equivalent to the one we use for the US sample.

Occupation. We use the variable OCCISCO in the Census data from IPUMS international to measure occupational choice.

Wages. We measure average wages by occupation and schooling levels by combining the information of distribution of workers across occupations and education categories and the OWW dataset on average wages by occupation. Wages are converted in international dollars using the Penn World Tables.

Table 3: International sample

Country	**% of flow 1970-2000**	**% total 1970**	**% total 2000**
Mexico	36.9%	7.8%	18.5%
Vietnam	4.5%	0.1%	2.0%
India	4.3%	0.6%	1.9%
Puerto Rico	2.2%	7.9%	5.8%
Jamaica	2.2%	0.7%	1.3%
Colombia	2.0%	0.7%	1.2%
Ecuador	1.1%	0.4%	0.6%
Brazil	0.8%	0.3%	0.4%
Thailand	0.8%	0.0%	0.4%
Panama	0.5%	0.2%	0.4%
Venezuela	0.5%	0.1%	0.2%
Indonesia	0.3%	0.0%	0.2%
Argentina	0.3%	0.5%	0.4%
France	0.3%	1.0%	0.8%
Portugal	0.3%	1.2%	0.9%
Chile	0.3%	0.2%	0.2%
Malaysia	0.2%	0.0%	0.1%
Spain	0.2%	0.6%	0.5%
Kenya	0.2%	0.0%	0.1%
Morocco	0.2%	0.0%	0.1%
Turkey	0.1%	0.5%	0.4%
Fiji	0.1%	0.0%	0.1%
Uruguay	0.1%	0.1%	0.1%
Cameroon	0.1%	0.0%	0.0%
Malawi	0.0%	0.0%	0.0%
Mali	0.0%	0.0%	0.0%
Burkina Faso	0.0%	0.0%	0.0%
Switzerland	0.0%	0.5%	0.3%
Canada	-0.1%	8.1%	5.0%
Greece	-0.1%	1.8%	1.0%
Hungary	-0.5%	1.8%	0.9%
Ireland	-0.6%	2.5%	1.3%
Austria	-0.8%	2.1%	0.9%
Total	56.4%	39.5%	45.8%

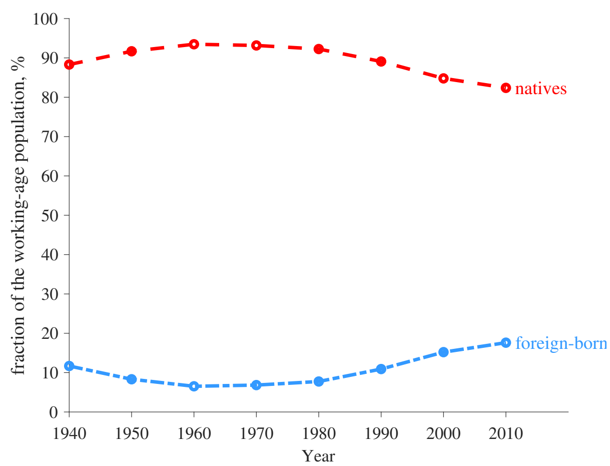
The table lists the countries we consider as origin of immigrants to the US. Column (2) shows the contribution of immigrants from a country to the total inflow of immigrants between 1970 and 2010. Columns (2) and (3) show the fraction of immigrants from a country out of the stock of immigrants in 1970 and 2010, respectively. Source: the World Bank.

B.3 Accounting for changes in the geographical allocation of labor

We measure the contribution of net inter-state migration to changes in the allocation of labor across US states. We further decompose the total contribution into the contribution of native net inter-state migration and foreign-born net inter-state migration.

Our focus is on the US between 1930 and 2010. We use decennial Census data on location, nativity, and age of individuals. We measure labor from the size of the working-age population and so the allocation of labor across US states from the fraction of the US working-age population assigned to each state. Foreign born are persons residing in the United States who were not U.S. citizens at birth. Specifically, they were born outside the United States (or one of its outlying areas such as Guam or Puerto Rico), and neither parent was a U.S. citizen. The foreign-born population includes legally-admitted immigrants, refugees, temporary residents such as students and temporary workers, and undocumented immigrants. Figure 2 shows the composition of the working-age population by nativity in the US between 1930 and 2010.

Figure 2: Composition of the working-age population by nativity



The figure shows the share of natives (in red) and foreign born (in light blue) in the US working-age population. Source: IPUMS-USA and own calculations.

Indicate by n_{st} the size of the working-age population in state s in year t and by S the set of states in the US. The change in the allocation of labor between year t and year $t+10$ is described by:

$$a_{st+10} = \frac{n_{st+10}}{n_{t+10}} - \frac{n_{st}}{n_t} \quad \forall \{s \in S\}$$

We decompose each of the a_{st}'s in two components: one that relates to demographics and one that relates to net-migration. We measure the demographic component by using the age distribution in year t to compute the size of the working age-population we should have observed in year $t+10$ had there been zero net-migration to the state. We measure the net-migration component residually, from the change in the allocation of labor net of the demographic component. Indicate by $\tilde{n}_{st+10}$ the size of the working-age population in state s at time $t+10$ had there been zero net-migration to the state between t and $t+10$. The net-migration component for state s between year t and year $t+10$, m_{st+10}, is:

$$m_{st+10} = a_{st+10} - \underbrace{\frac{\tilde{n}_{st+10}}{\tilde{n}_{t+10}} - \frac{n_{st}}{n_t}}_{\text{demographic comp.: } d_{st+10}}.$$

Similarly, we compute the change in the allocation of labor and its two components, separately for natives l and foreign-born f:

$$m^g_{st+10} = \underbrace{\frac{n^g_{st+10}}{n_{t+10}} - \frac{n^g_{st}}{n_t}}_{\text{total change: } a^g_{st+10}} - \underbrace{\frac{\tilde{n}^g_{st+10}}{\tilde{n}_{t+10}} - \frac{n^g_{st}}{n_t}}_{\text{demographic comp.: } d^g_{st+10}}. \qquad \text{for: } g \in \{l, f\}.$$

With the above data at hand, we decompose the change in the share of labor allocated to a state in four components:

$$a_{st+10} = \underbrace{d^l_{st+10} + d^f_{st+10}}_{\text{demographic comp.}} + \underbrace{m^l_{st+10} + m^f_{st+10}}_{\text{net migration comp.}} \tag{33}$$

A labor group contributes to the changing share of labor allocated to a state with its demographics, d^f, and with its next migration, m^f. To summarize the contribution of a labor group to the changing allocation of labor across all US states in its two channels, we use an absolute value sum. The contribution of foreign-born net migration to the change in labor allocation between year t and $t+10$ is:

$$\frac{\sum_{s \in S} |m^f_{st+10}|}{\sum_{s \in S} |a_{st+10}|}.$$

Similarly, one can compute the contribution of net migration of natives as well as the total contribution (net migration and demographics) for both groups. Figure 2 in Section 1 plots the contribution of net migration (in grey), separately for natives (in red) and foreign-born (in light blue).