Mexican Immigration to the US: Selection, Sorting and Matching

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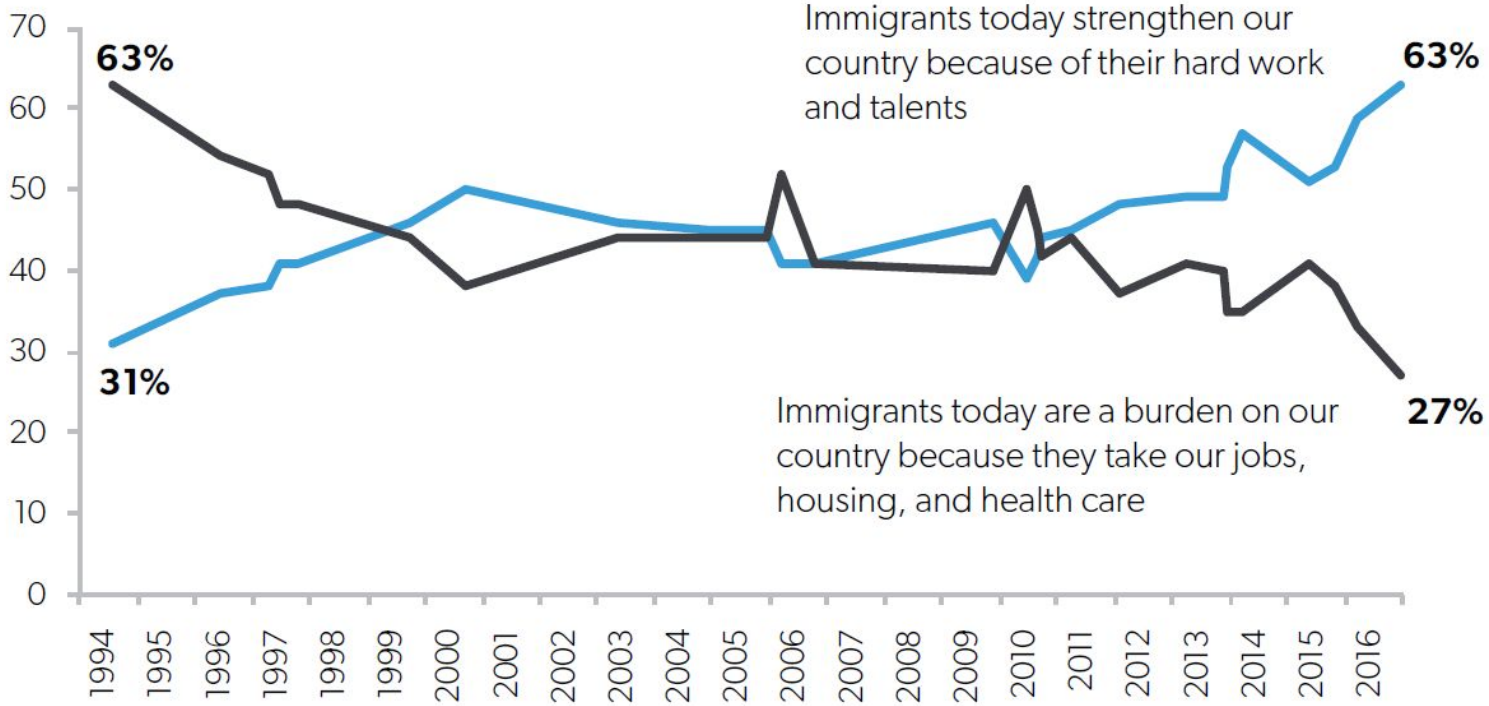
Macrolunch IRES, Université catholique de Louvain, October 31, 2017

Opinions on migration in the US

Q: Which comes closer to your view—even if neither is exactly right . . . ?

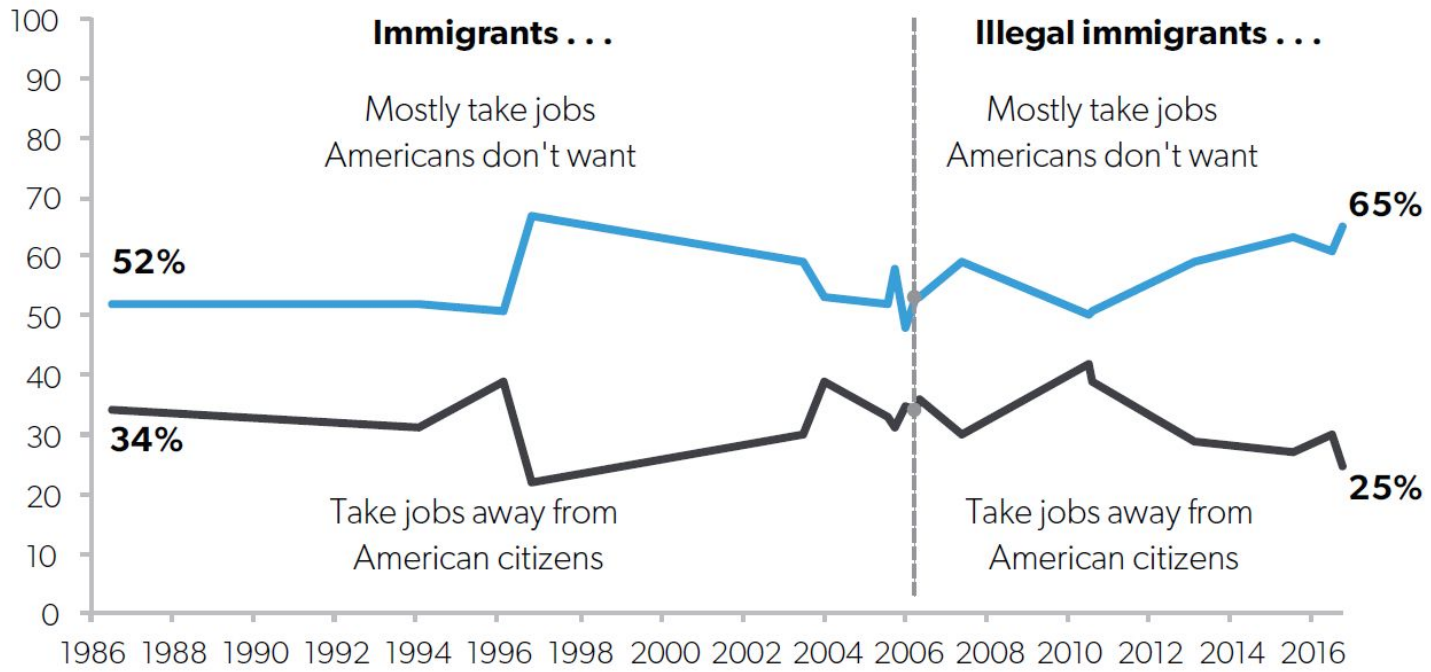


Source: Pew Research Center, latest that of November–December 2016.

source: *Karlyn Bowman, Eleanor O'Neil, Heather Sims, The American Enterprise Institute for Public Policy Research Political Report, February 1, 2017*

Opinions on migration in the US

Q: Do you think illegal immigrants coming to this country today take jobs away from American citizens, or do they mostly take jobs Americans don't want? (April 2006–October 2016)

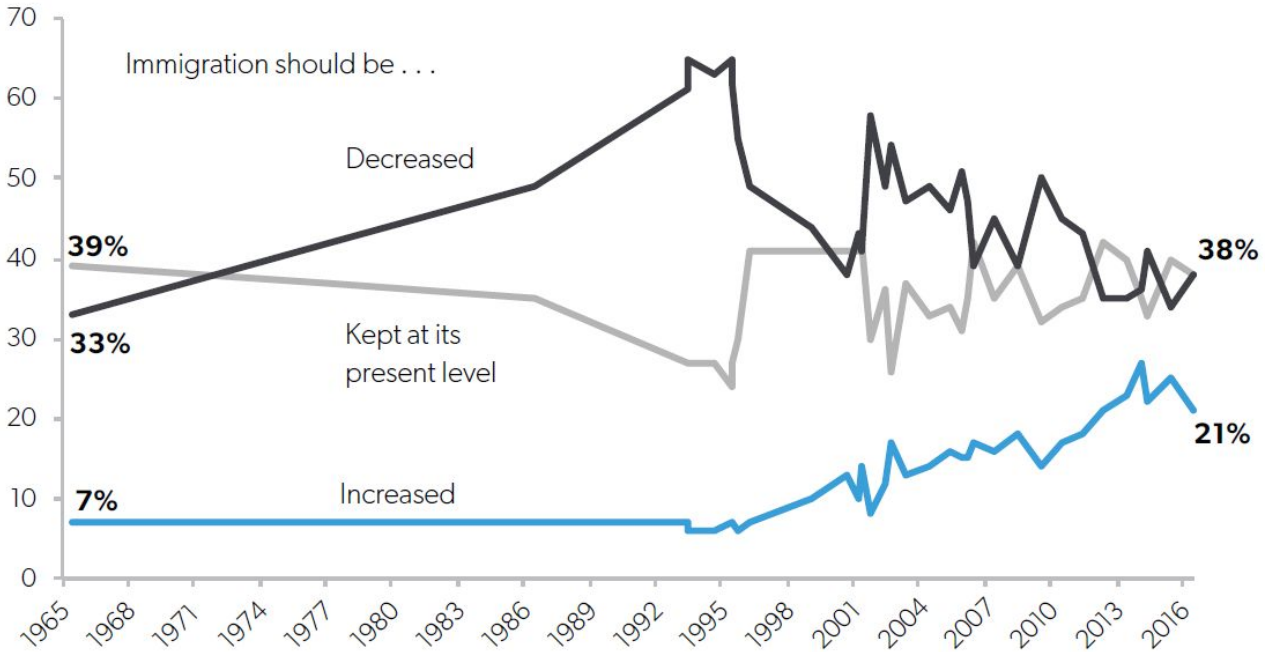


Note: In April 2006, half of the sample was asked about illegal immigrants. Their responses are included in the above graph. The other half of the April 2006 sample was asked the same question about legal immigrants. Of those, 29 percent said legal immigrants take jobs away and 55 percent said they mostly take jobs Americans don't want. The July 2016 survey was of registered voters.
Source: CBS News/*New York Times*, latest that of October 2016.

source: *Karlyn Bowman, Eleanor O'Neil, Heather Sims, The American Enterprise Institute for Public Policy Research Political Report, February 1, 2017*

Opinions on migration in the US

Q: In your view, should immigration be kept at its present level, increased or decreased?



Note: Question wording varied slightly.
Source: The Gallup Organization, latest that of June–July 2016; CBS News/*New York Times* (June 1986, June 1993, September 1994); *New York Times* (September 1995); ABC News (May 1996).

source: *Karlyn Bowman, Eleanor O'Neil, Heather Sims, The American Enterprise Institute for Public Policy Research Political Report, February 1, 2017*

Opinions on migration from Mexico to the US

Q: Do you support or oppose building a wall along the border with Mexico?

	Overall response	Reps.	Dems.	Inds.
Support	42%	76%	11%	43%
Oppose	55	20	88	53

Note: Asked of registered voters.
Source: Quinnipiac University, November 17–20, 2016.

Q: Please tell me whether you support or oppose each item I name . . . .

Building a wall along the US border with Mexico

Support	37%	72%	11%	38%
Oppose	60	24	87	61

Note: Not all items shown.
Source: ABC News/*Washington Post*, January 2017.

source: *Karlyn Bowman, Eleanor O'Neil, Heather Sims, The American Enterprise Institute for Public Policy Research Political Report, February 1, 2017*

Research question

How does migration affect the economic environment in the sending and the destination country?

What is the impact of Mexican immigration for US natives?

Methodology and value added

We formulate a novel theoretical framework to quantify the impact of international migration on natives' well-being.

1. Merger of the **selection model** of Roy (1951) and Borjas (1987) with the **matching model** by Becker (1973) and Sattinger (1979).
2. **Micro-foundations of migration decisions**, migrants' **sorting**, **selection**, and **matching** with firms.
3. **Heterogeneous individuals** characterized by two-dimensional, continuously distributed vector of skills (one skill per country).
4. Matching of workers and **heterogeneous firms**. Non-random, rather: **positive and assortative**.
5. **Supply of firms determined endogenously** through a market process, Hopenhayn (1992), Melitz (2003).

Methodology and value added

The proposed model allows for investigating rich economic effects of migration policies.

1. *wage effect of migration*
   - Any inflow of workers affects the whole distribution of wages through endogenous matching, Costrell and Loury (2004).
   - Similar (different) workers are substitutes (complements).
   - The magnitude depends on skill composition of immigrants, relative to the destination country population.
2. *firms' entry and exit*
   - Inflow of immigrants reduces wages of the most substitutive natives.
   - Entrepreneurs collect higher profits, which triggers new entries.
   - A greater number of firms benefits all workers.
3. market size effect
4. fiscal effect of migration

Methodology and value added

We challenge few assumptions of the quantitative literature on migration:

- Workers are aggregated up into **few discrete worker types** (LS, HS, natives, immigrants); perfect substitutes within a group.
- Low-skilled and high-skilled individuals interact through **a single elasticity of substitution**. In a CES world the wage effects are proportionate to the changes in sizes of employment groups.
- **Skills are uniformly downgraded** across all group-members. Dustmann et al. (2012): non-linear downgrading is a generic pattern.
- All **firms employ a given mass of "skill composite"**, (a nested CES combination of low/high skilled natives/migrants). Evidence on employees' positive sorting on the labor market (PAM), Bartolucci and Devicenti (2012), Eeckhout and Kircher (2016).

The model

Overview:

- Objects of interest: Mexican and American workers and firms.
- Individuals (firms) are heterogeneous with respect to their skill (productivity).
- Mexican workers decide in which country to live, by maximizing their wages net of migration cost.
- Firms hire workers given the surplus function and wages.
- Wages are set to clear both the foreign and domestic markets.

Workers - Mexico

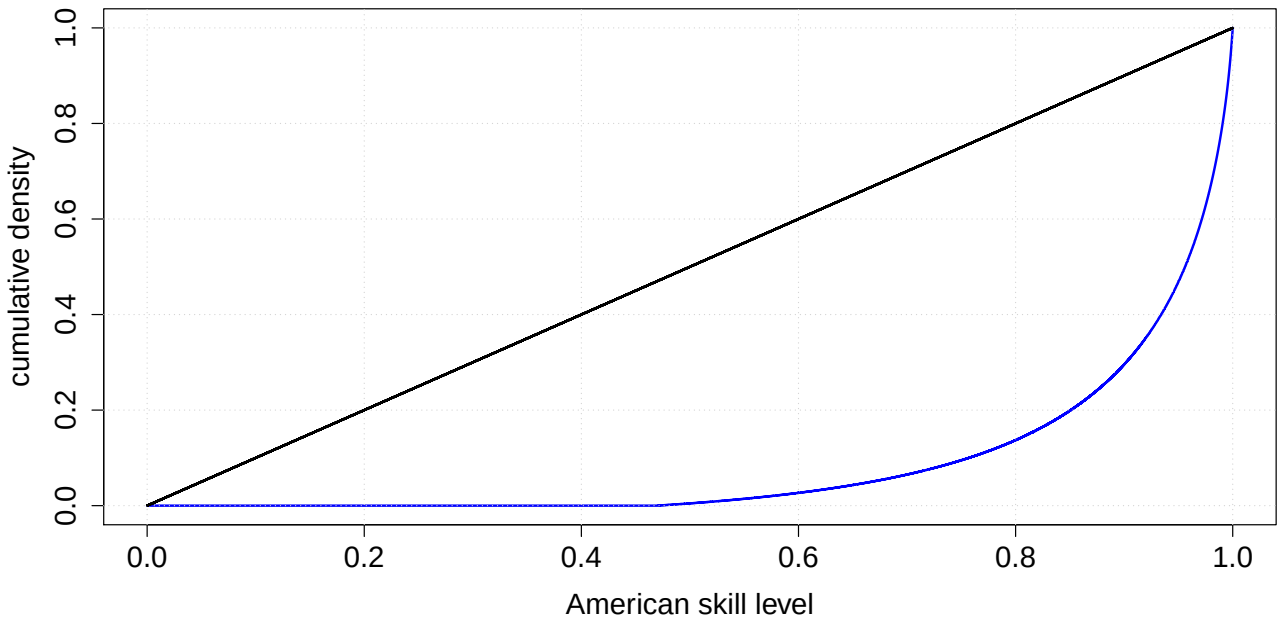
- Unit measure of Mexican workers endowed with a vector of skills $(x_U, x_M) \in [0,1]^2$.
- x_U is a US-specific skill, x_M is a Mexico-specific skill.
- Wlog: marginal distributions of X_U and X_M are standard uniform.
- The joint distribution of X_U, X_M is modeled with a Clayton copula:

$$C(x_U, x_M) = \left(x_U^{-\theta} + x_M^{-\theta} - 1 \right)^{-1/\theta}, \quad \theta > 0,$$

where: θ is a rank correlation measure.
One can show that Kendall's $\tau = \theta/(\theta + 2)$

Workers - US

- A measure $R_U^W > 0$ of US workers.
- US natives cannot move to Mexico, thus they only possess $x_U \in [0, 1]$. Distribution of X_U among Americans: $F(\cdot)$.
- If F first order stochastically dominates standard uniform distribution, then the US population is more proficient in x_U than the Mexicans.



Distribution of American skill (x_U) in Mexican (black) and American (blue) populations.

Firms

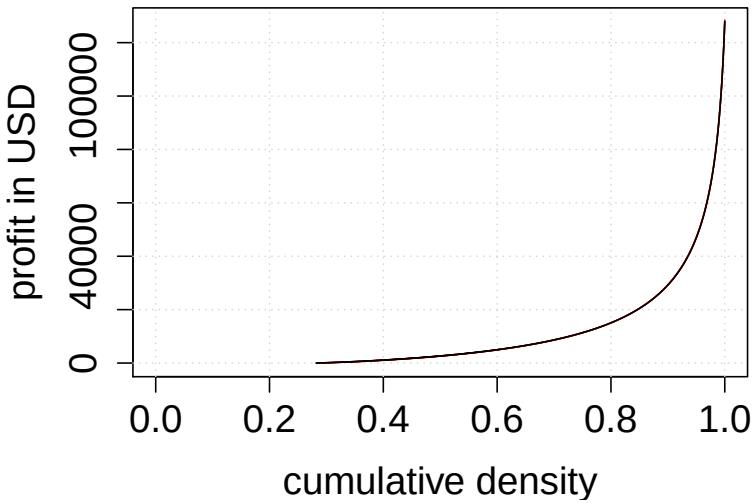
- In each country $i \in \{U, M\}$, there is a measure $R_i^F > 0$ of firms, that entered the market (expected profits outbalanced fixed cost of entry).
- Productivity is randomly drawn.
- Every firm decides whether to stay/exit the market.
- When staying, they optimally choose a worker to hire.
- If a country-i entrepreneur h_i hires a worker with skill x_i, then such a match produces a surplus of: $\pi_i(x_i, h_i)$.
- $\pi_i : [0,1]^2 \to \mathbb{R}$ is strictly increasing in x_i and h_i, and supermodular.

Firms - profit cumulative distributions

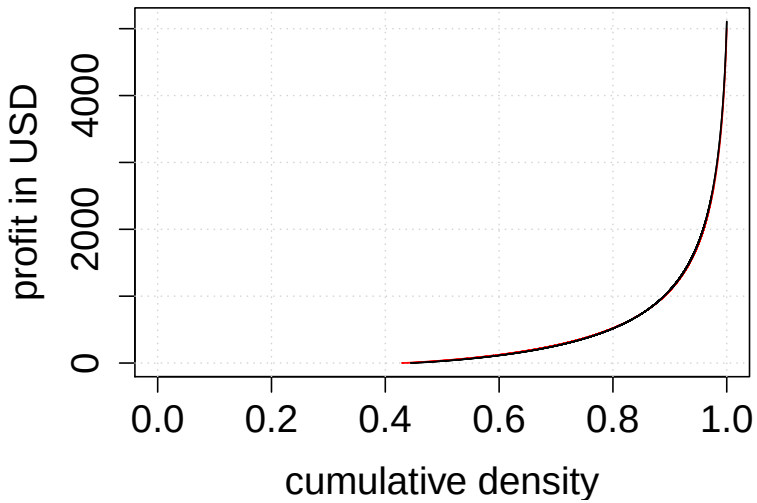
- Assume that the surplus function in country i takes the form of:

$$\pi_i(x_i, h_i) = k_i \Phi_i^{-1}(x_i, t_1)(1 - t_2 \cdot h_i)^{-\gamma_i} + k_i^0, \quad i \in \{U, M\},$$

$k_i > 0$ is a multiplicative constant, k_i^0 is a normalization constant,
$\Phi_i^{-1}(\cdot)$ is an inverse log-normal mapping from skills to surplus,
t_1: log-N truncation, t_2: Pareto truncation,
γ_i is the inverse of Pareto shape parameter.



(a) Distribution of firms' profits, US



(b) Distribution of firms' profits, Mexico

Supplies of skills

Optimal matching between workers and firms:

$$x_i^*(h_i) \in \underset{x_i \in [0,1]}{\arg\max}\ \pi_i(x_i, h_i) - w_i(x_i) \quad \leftrightarrow \quad h_i^*(x_i) = 1 - S_i(x_i)/R_i^F,$$

R_i^F is the mass of firms,
$S_i(x_i)$ is the CDF of supply of skills.

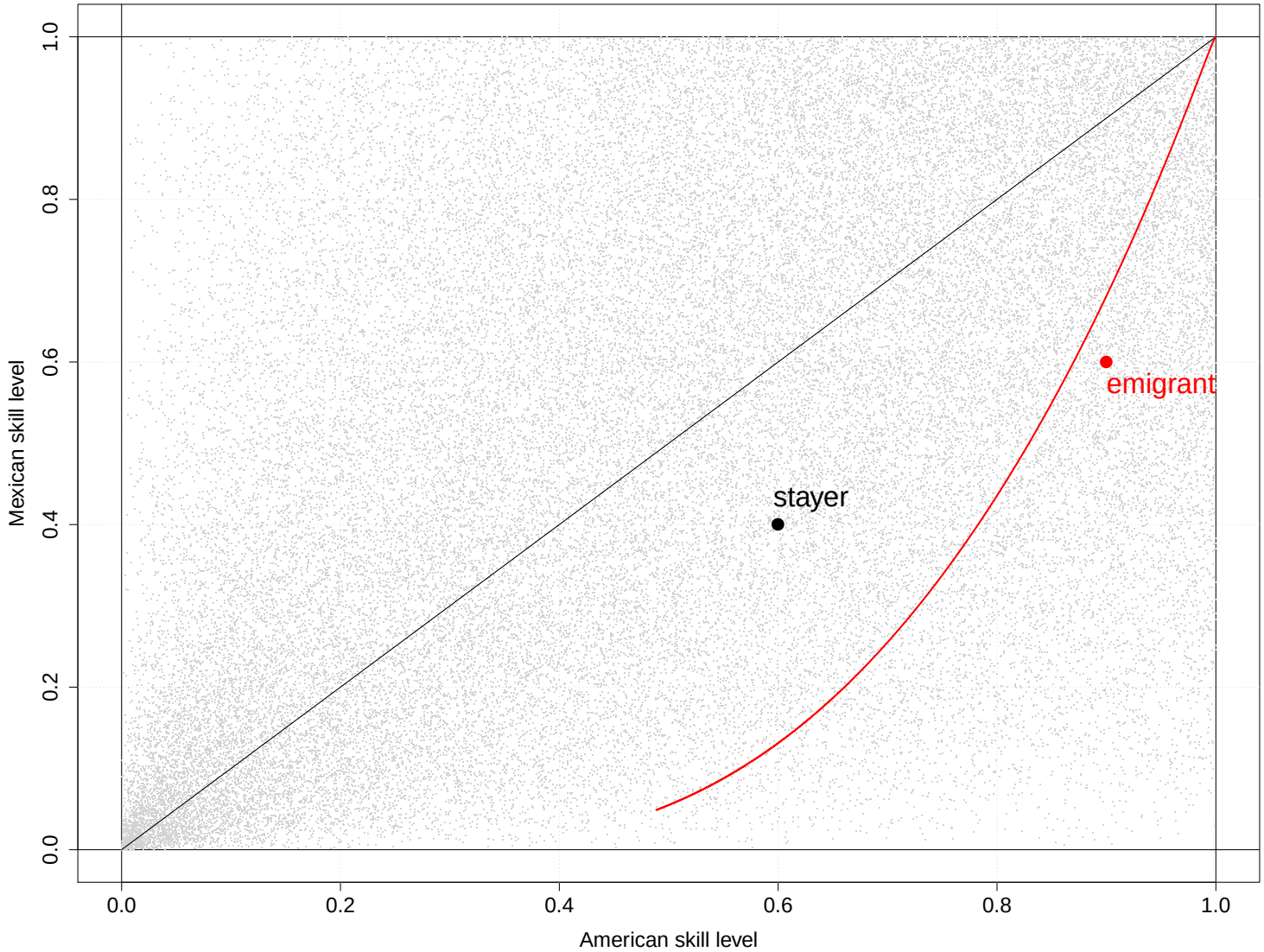
No-arbitrage condition in Mexicans' sorting into two labor markets:

A Mexican worker (x_U, x_M) migrates to the US if and only if:

$$(1 - \delta_1) w_U(x_U) - \delta_0 \geq w_M(x_M),$$

δ_1 is a multiplicative cost of moving from Mexico to the US,
δ_0 stands for an additive migration cost.

Supplies of skills - Mexican' sorting



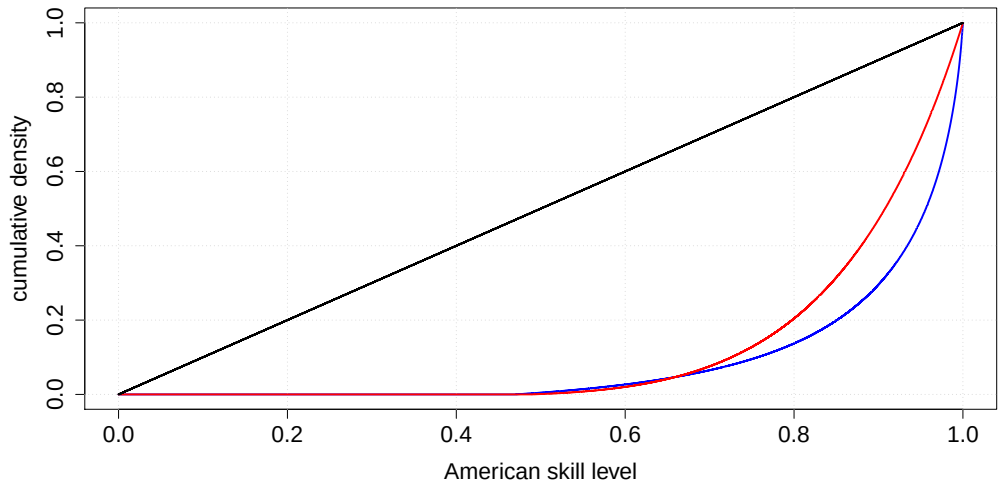
The separation function (red), and Mexicans' sorting into Mexican and US labor markets.

Supplies of skills - migrants' selection and downgrading

(a) Selection wrt Mexican skill

(b) Selection wrt American skill

Mexican natives' (black) and Mexican immigrants' (red) in Mexico (left) and in the US (right)

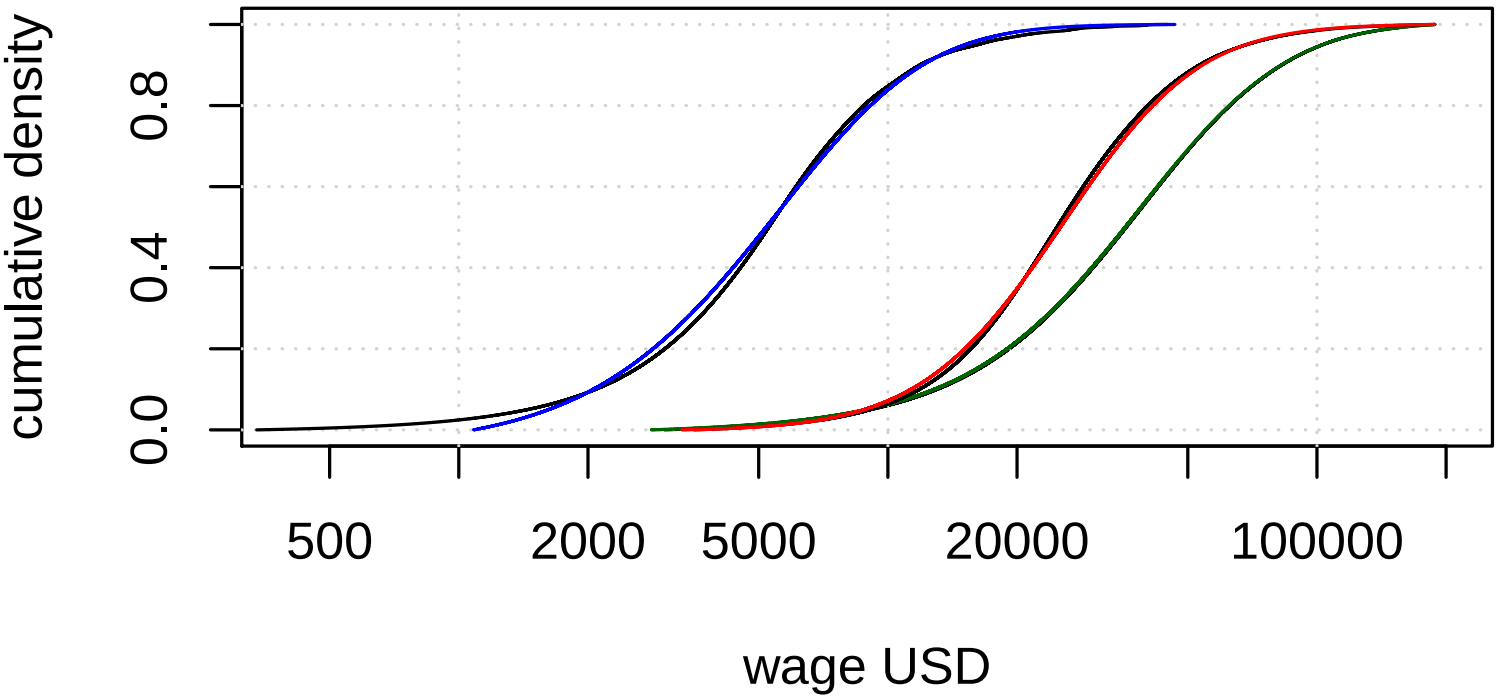


Distribution of x_U in Mexican (black), American (blue) and Mexican migrant (red) populations.

Wages

Equilibrium wages internalize migrants' sorting, and matching with firms:

$$w_i(x_i) = \begin{cases} \int_{x_i^c}^{x_i} \frac{\partial}{\partial x} \pi_i(r, 1 - S_i(r)/R_i^F) \mathrm{d}r + w_i(x_i^c) & \text{for } x_i \geq x_i^c \\ \pi_i(x_i, h_i^c) - \pi_i(x_i^c, h_i^c) + w_i(x_i^c) & \text{for } x_i < x_i^c, \end{cases}$$



Model wage distributions: Mexican stayers (blue), immigrants (red) and Americans (green) compared to the data (black).

Calibration details

- Calibration for 2015 using census data on distributions of wages in the US (IPUMS) and Mexico (MIS).
- A version of the basin-hopping algorithm with Monte-Carlo search procedure through a 14-dimensional space.
- The Euler method on a grid of 100,000 points to compute distributions and other functions.
- Procedure boils down to solving two first-order differential equations, and evaluating the current vector of parameters with actual data.

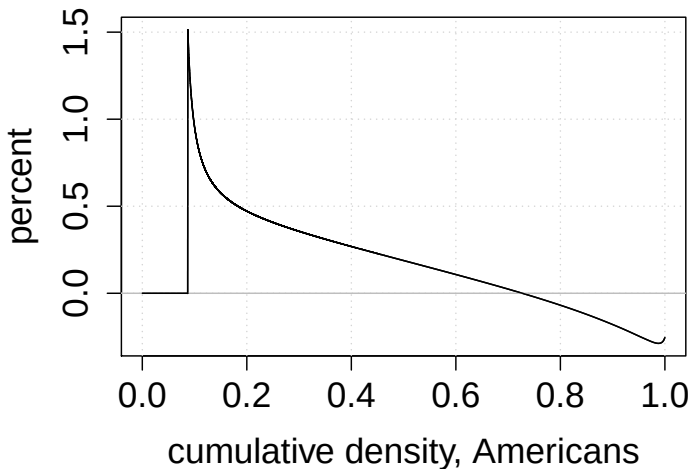
$$\Xi = \{k_U, \gamma_U, R_U^F, s_U, k_M, \gamma_M, R_M^F, s_M, \theta, \delta_0, \delta_1, t_1, t_2, x_U^*\}$$

Counterfactual scenarios

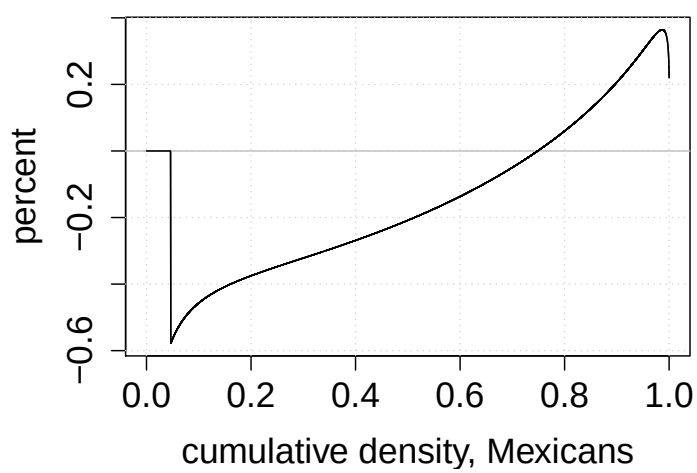
Simulations of the model

1. No-migration scenario: infinite migration cost from Mexico to the US,
2. Search through the space of migration policies,
3. Robustness checks [if we have time].

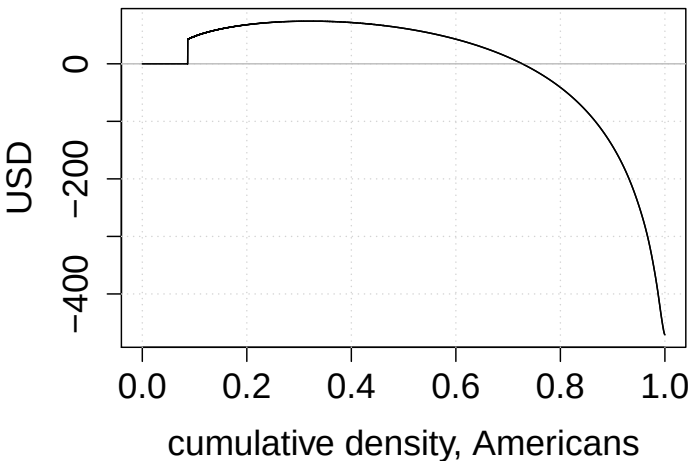
No-migration scenario - benchmark welfare effects



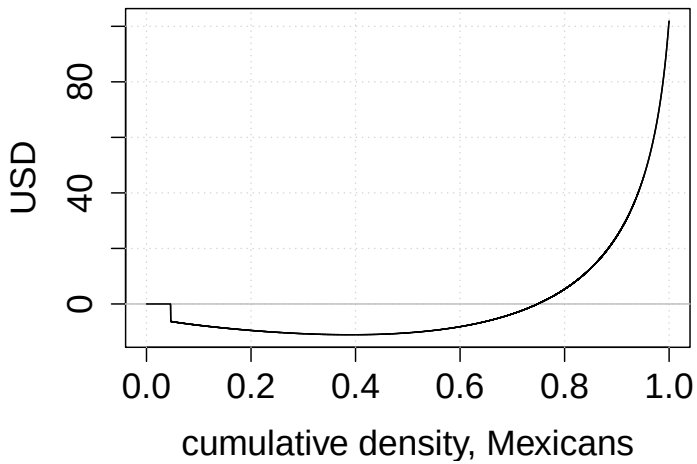
(a) Relative changes, US natives



(b) Relative changes, Mex natives

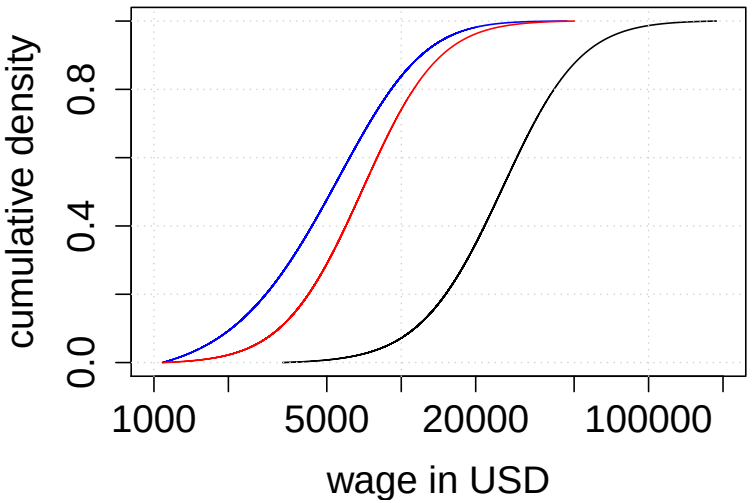


(c) Absolute changes, US natives

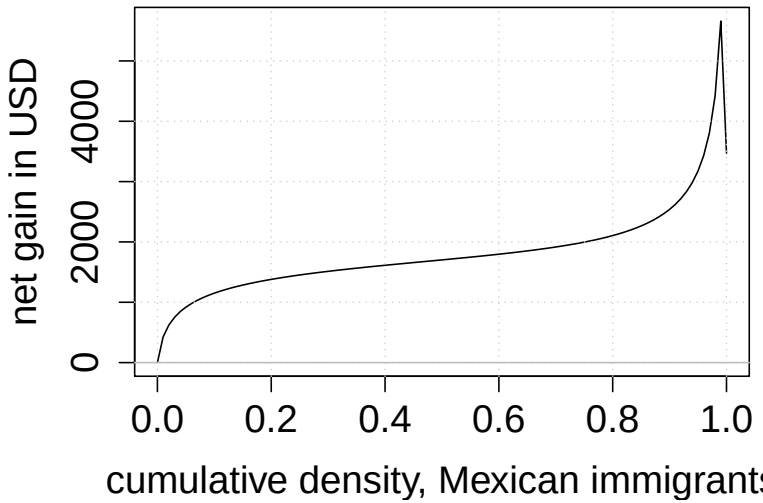


(d) Absolute changes, Mex natives

No-migration scenario - net welfare effects for migrants



(a) CDFs of Mexican wages

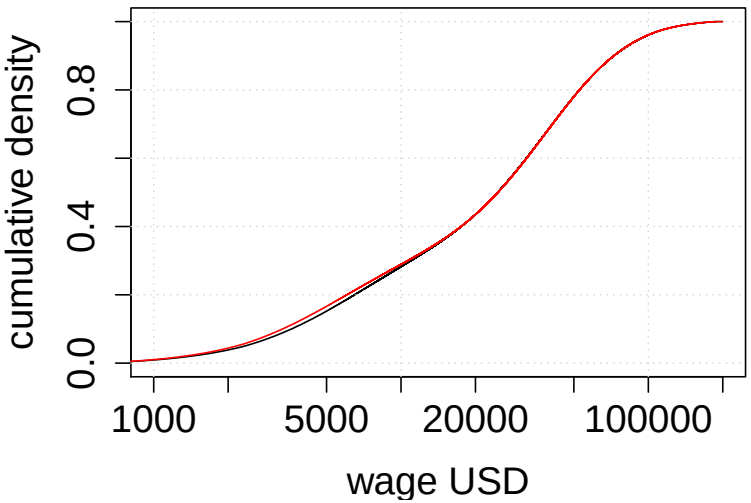


(b) Distribution of net gains in USD

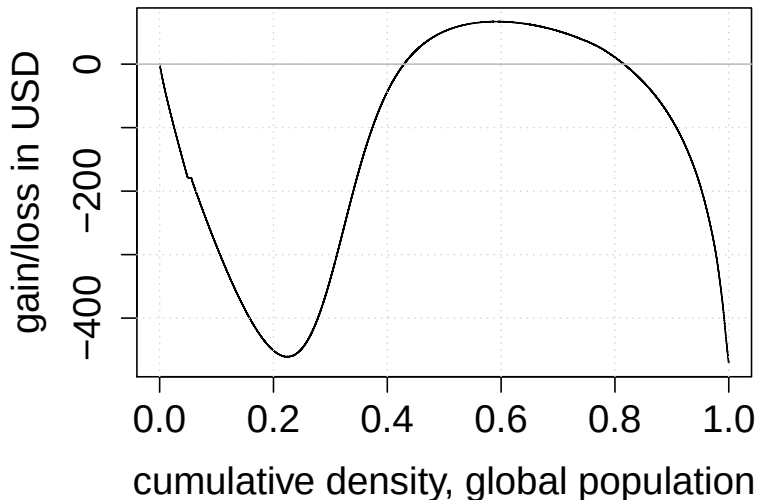
LEFT: Model wage distributions: Mexican stayers (blue), immigrants in the US (black) and net of migration cost immigrants in the US (red).

RIGHT: difference between the blue and the red curve.

No-migration scenario - global inequality



(a) Global CDF of wages



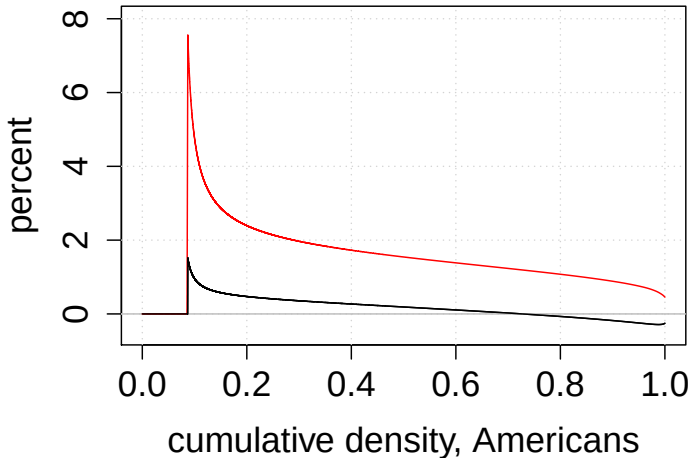
(b) Distribution of net gains in USD

LEFT: Global wage distribution: reference (black), no-migration (red).

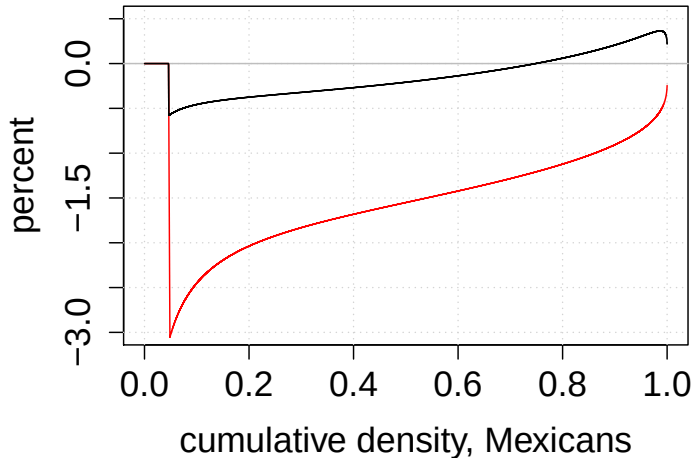
RIGHT: difference between the red and the black curve.

Gini coefficient with migration: 0.4772.
Gini coefficient without migration: 0.4805.

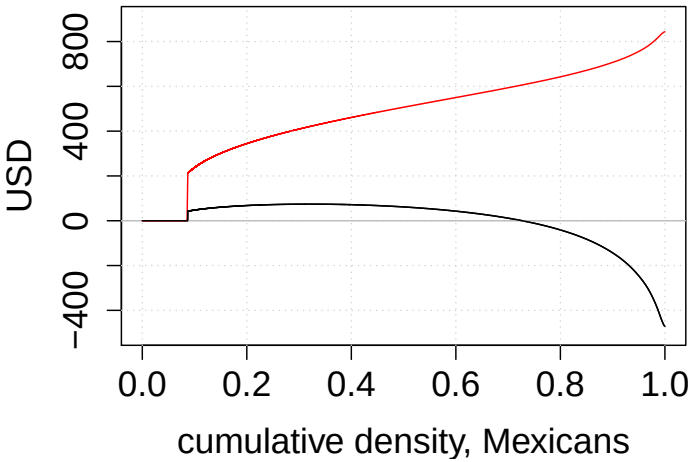
No-migration scenario - wage effects only



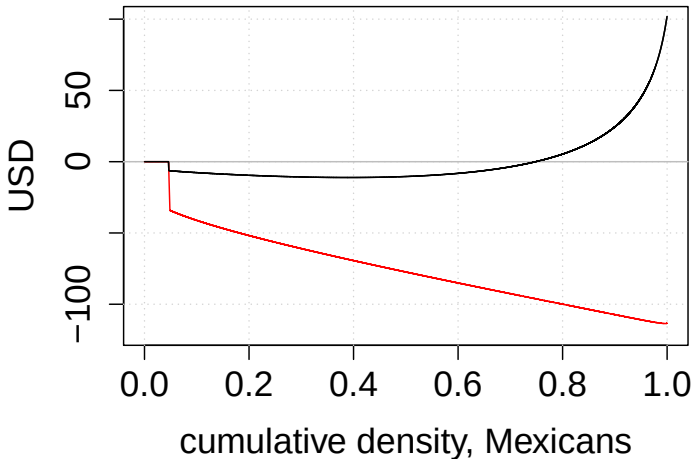
(a) Relative changes, US natives



(b) Relative changes, Mex natives

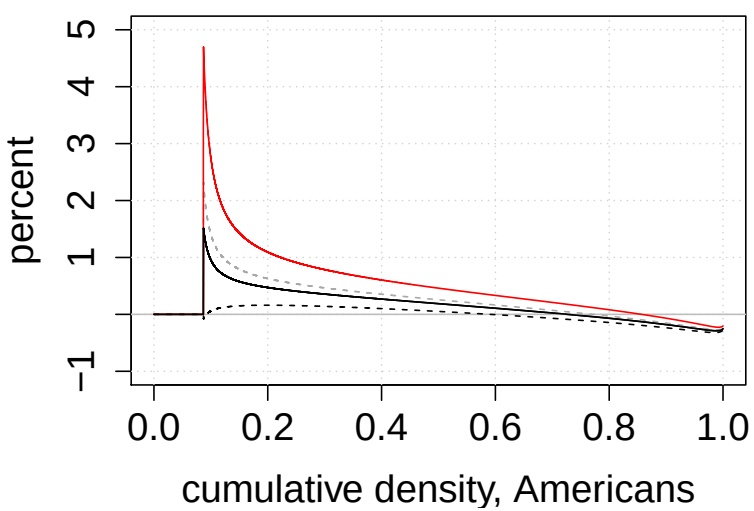


(c) Absolute changes, US natives

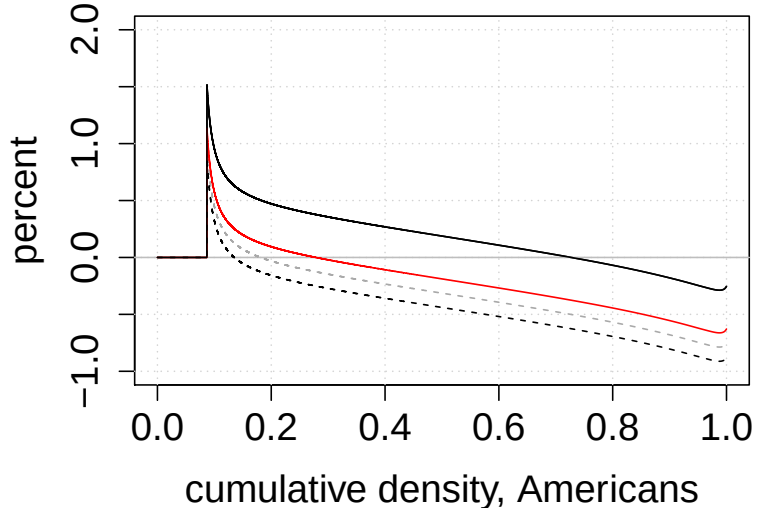


(d) Absolute changes, Mex natives

No-migration scenario - fiscal and MS effects



(a) Fiscal, relative changes, US natives

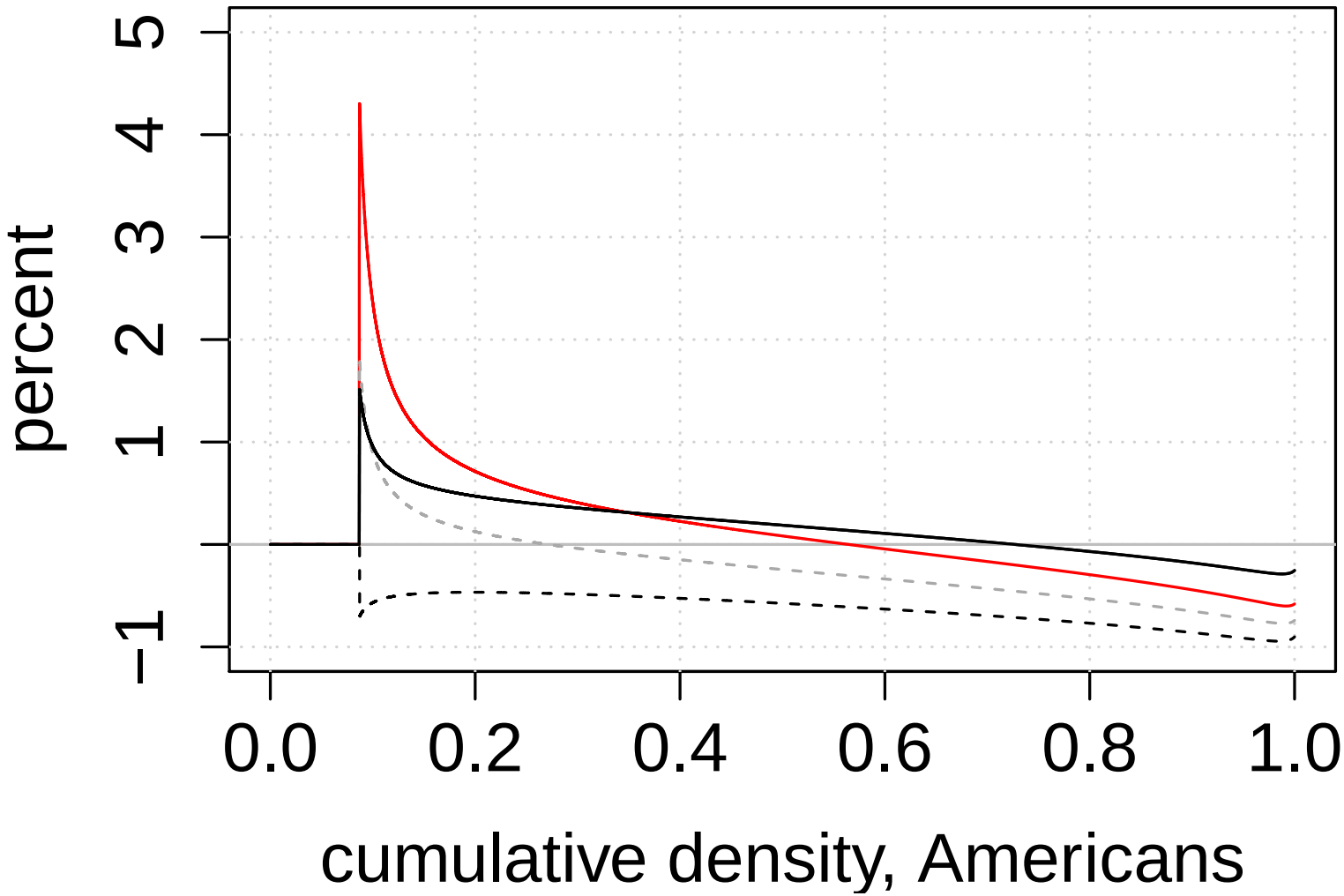


(b) Price, relative changes, US natives

LEFT: Fiscal effects in reference (black), conservative (red; 100% participation), middle (gray dashed; 90%) and optimistic (black dashed; 80%) scenarios.

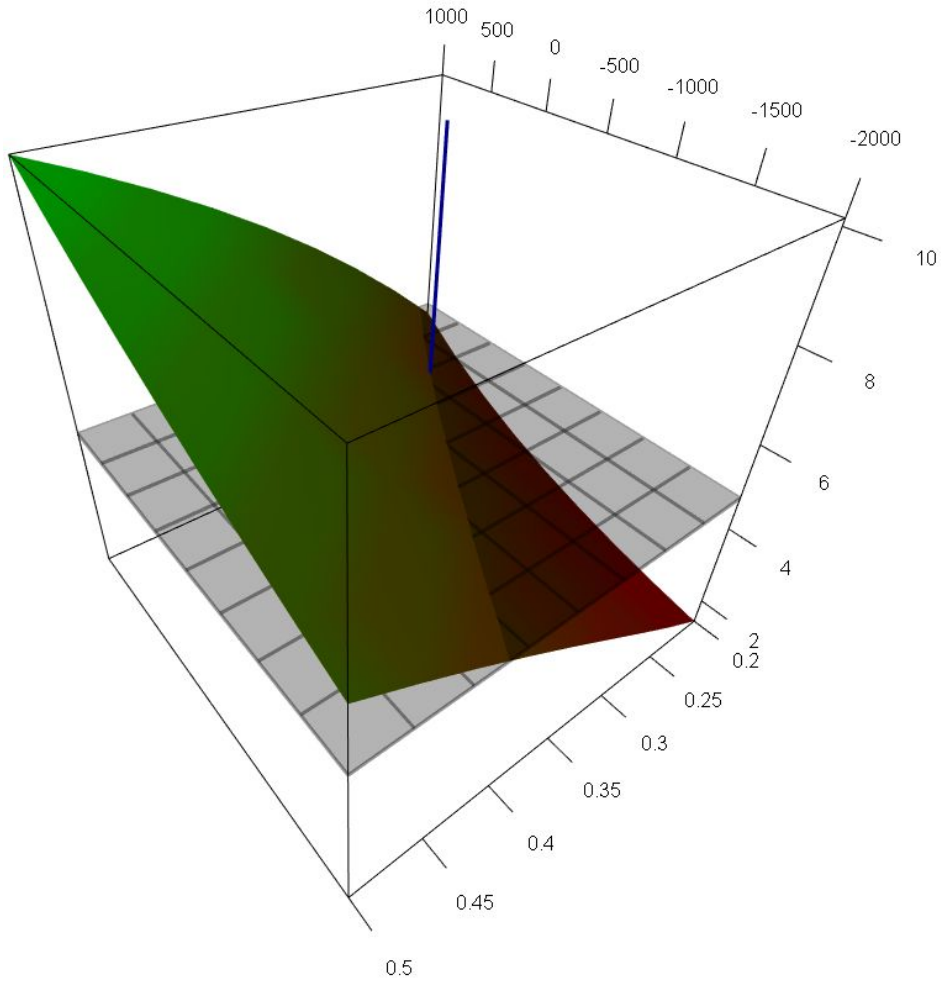
RIGHT: Market size effects in reference (black), conservative (red; $\epsilon = 7$), middle (gray dashed; $\epsilon = 5.5$) and optimistic (black dashed; $\epsilon = 4$) scenarios.

No-migration scenario - fiscal and MS effects



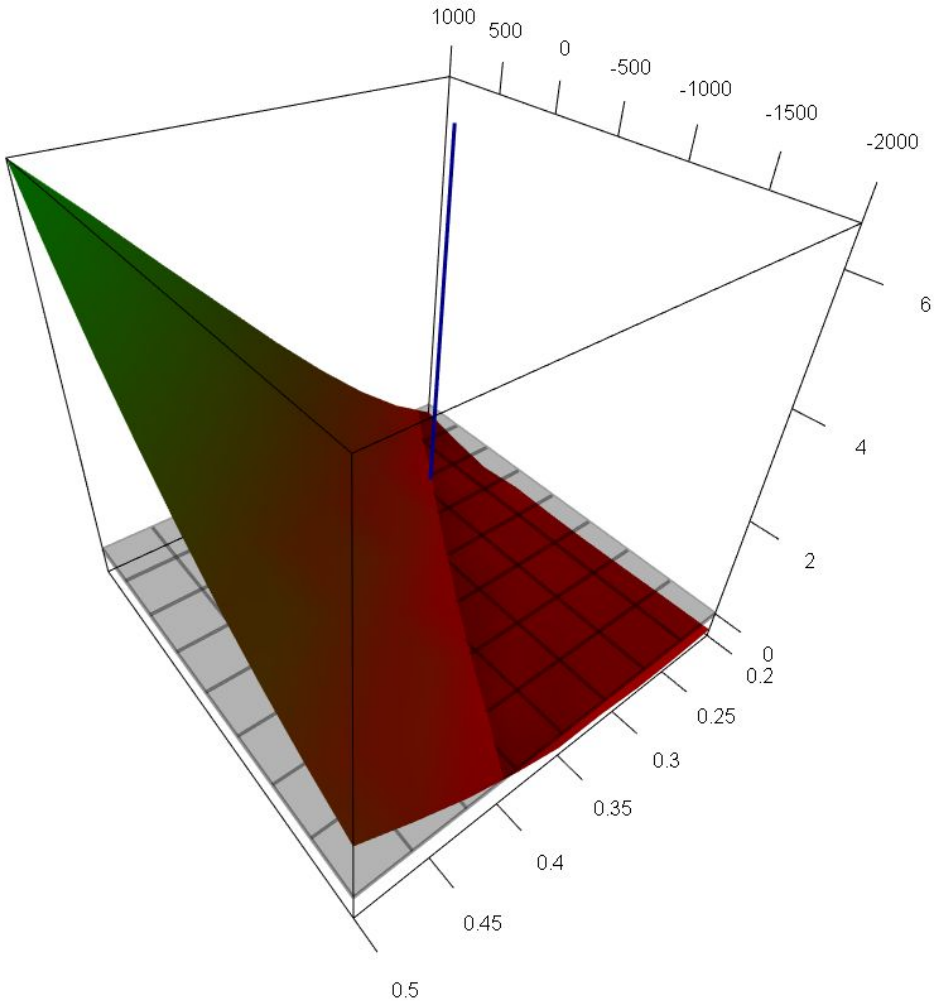
Total effects (wage + entry/exit + fiscal + market size) in reference (black), conservative (red), middle (gray dashed) and optimistic (black dashed) scenarios.

Search for alternative migration policies



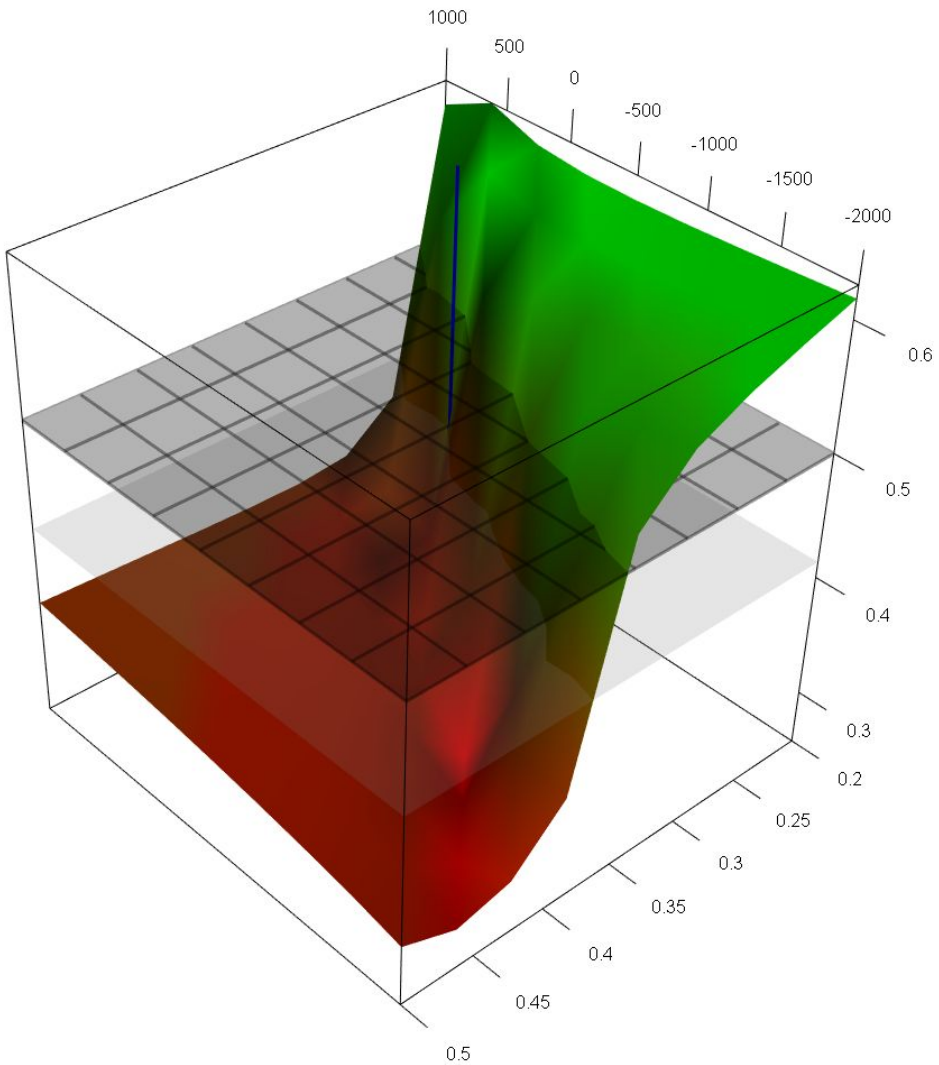
Share of Mexican immigrants in the US (reference: 4.75%).

Search for alternative migration policies



Change in average wages of US native workers.

Search for alternative migration policies



Share of strictly better-off native Americans – democratic poll result.

Conclusions

- The distributional effects of migration just like the public debate: are on the knife-edge.
- Low-skilled, negatively selected migration from Mexico benefits the high earners in the US, and depresses the wages of the least skilled.
- Current pattern of Mexico-US migration decreases global inequality.
- Firm entry/exit effect counterbalances wage impact, market size is strong and globally beneficial, while fiscal effects are ambiguous.
- There might not be a migration policy that:
  - increases the number of Mexicans in the US,
  - boosts the average wage of native American,
  - is beneficial for below-median voters.

Thank you for your attention

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Cumulative supplies of skills

The cumulative supply of Mexican workers' skill x in the US:

$$S_U^M(x) = \Pr\left[X_U \geq x : (1-\delta_1) w_U(X_U) \geq \max\left(w_M(X_M), w_M^c\right) + \delta_0\right].$$

An analogous supply function for Mexican stayers:

$$S_M^M(x) = \Pr\left[X_M \geq x : (1-\delta_1) w_U(X_U) < w_M(X_M) + \delta_0,\ w_M(X_M) \geq w_M^c\right].$$

The supply of talent in the US:

$$S_U(x) = R_U^W \Pr\left[X_U \geq x,\ w_U(X_U) \geq w_U^c\right] + S_U^M(x).$$

The only group of workers active on Mexican labor market, are Mexican natives:

$$S_M(x) = S_M^M(x).$$

Demand for skills

Firm's operating profits equal to the remaining surplus after paying wages to employees:

$$r_i(h_i) = \max_{x \in [0,1]} \pi_i(x_i, h_i) - w_i(x_i),$$

while the skill level of an employed worker fulfills:

$$x_i^*(h_i) \in \arg\max_{x \in [0,1]} \pi_i(x, h_i) - w_i(x).$$

Entrepreneurs continue to enter the market only if their expected profits cover the fixed cost of entry:

$$\mathbb{E}[r_i] = \int_0^1 r_i(h_i) dh_i \geq \phi_i.$$

The cumulative demand for skill x in country i:

$$D_i(x) = R_i^F \Pr\left[x_i^*(H_i) \geq x, \mathbb{E}[r_i(H_i)] \geq \phi_i\right].$$

Definition of equilibrium

Definition

An equilibrium is characterized by:

- the supply of skills $S_i : [0,1] \to [0,1]$ in each country, which is determined by workers sorting decisions;
- the demand for skills $D_i[0,1] \to [0,1]$ in each country, which is determined by firms' profit maximization;
- firms' entry decision, which boils down to a zero expected profit condition;
- wages $w_i : [0,1] \to \mathbb{R}$ in each country, which are set to clear the markets: $S_i(x) = D_i(x)$ for $i \in \{0,1\}$ and all $x \in [0,1]$.

Sorting

Define a function of Mexicans' skills that differentiates Mexican stayers from emigrants to the US. We call this mapping the *separation function* $\psi : [x_M^m, x_M^*] \times [x_U^m, x_U^*]$, and define it as an American skill level $\psi(x_M) \in [x_U^m, x_U^*]$, such that a Mexican worker equipped with a bundle of: $(\psi(x_M), x_M), \forall x_M \in [x_M^m, x_M^*]$ receives an identical remuneration in both countries:

$$(1 - \delta_1) w_U(\psi(x_M)) - \delta_0 = w_M(x_M).$$

Hence, any Mexican worker $(\psi(x_M), x_M), \forall x_M \in [x_M^m, x_M^*]$ is indifferent between migrating to the US and remaining in her home country.

Therefore:

$$S_U^M(x_U) = \begin{cases} \int_{x_U^m}^{x_U^*} \frac{\partial}{\partial x_U} C(r, \psi^{-1}(r)) \mathrm{d}r + 1 - x_U^*, & x_U < x_U^m, \\ \int_{x_U}^{x_U^*} \frac{\partial}{\partial x_U} C(r, \psi^{-1}(r)) \mathrm{d}r + 1 - x_U^*, & x_U \in [x_U^m, x_U^*], \\ 1 - x_U, & x_U \in (x_U^*; 1]; \end{cases}$$

$$S_M(x_M) = \begin{cases} \int_{x_M^m}^{x_M^*} \frac{\partial}{\partial x_M} C(\psi(r), r) \mathrm{d}r + 1 - x_M^*, & x_M < x_M^m, \\ \int_{x_M}^{x_M^*} \frac{\partial}{\partial x_M} C(\psi(r), r) \mathrm{d}r + 1 - x_M^*, & x_M \in [x_M^m, x_M^*], \\ 1 - x_M, & x_M \in (x_M^*; 1]. \end{cases}$$

Solution

Taking the first derivative of Americans' wage function, we arrive at the following differential equation:

$$\frac{\partial}{\partial x_U} w_U(x_U) = \frac{\partial}{\partial x_U} W(F(x_U)) \leftrightarrow$$
$$\frac{\partial}{\partial x_U} \Pi_U(x_U, h_U(x_U)) = W'(F(x_U))F'(x_U),$$

We proceed with exhausting the arbitrage condition, and taking its first derivative:

$$\frac{\partial}{\partial x_M} w_M(\psi^{-1}(x_U)) = (1-\delta_1)\frac{\partial}{\partial x_U} w_U(x_U) \leftrightarrow$$
$$\frac{\partial}{\partial \psi^{-1}(x_U)} \pi_M(\psi^{-1}(x_U), h_M(\psi^{-1}(x_U))) \left(\psi^{-1}(x_U)\right)' = (1-\delta_1)\frac{\partial}{\partial x_U} \pi_U(x_U, h_1(x_U)).$$

For the identified selection pattern, the mass of Mexican immigrants in the US can be computed in a discretized form:

$$S_U^M(x_U - \Delta x_U) = S_U^M(x_U) + \Delta x_U \partial C(x_U, \psi^{-1}(x_U))/\partial x_U,$$

Minimized loss function

Our goal in the calibration procedure is to find such a vector of parameters Ξ that gives the best possible fit of $\hat{W}^U$, $\hat{W}^I$ and $\hat{W}^M$ to the observed distributions W^U, W^I and W^M. In doing so, we need to search through a 14-dimensional space, and each vector of parameters requires a full solution of the model on the defined grid. Therefore, to maximize the performance of such a computationally-intensive search, we propose a Monte Carlo procedure with quantile distribution fitting goal function. Each vector Ξ is evaluated using a subjective goal function:

$$\zeta(\Xi) = p_1 err(W^U) + p_2 e(W^I) + p_3 e(W^M) + p_4 e(F(x_U^c)) + p_5 e(u^M) + p_6 e(S_U^M(x_M^m)), \quad (1)$$

where $e(\cdot)$ is an error function that computes the squared difference between an object from the model and its empirical counterpart in the data, and p's are subjective weights. For the scalars: $F(x_U^c)$, u^M, $S_U^M(x_U^m)$ the reference values are 0, the unemployment rate in Mexico and the number of Mexican immigrants in the US respectively. For distributions we compute Euclidean distances between quantiles of data and model distributions, including every grid point.

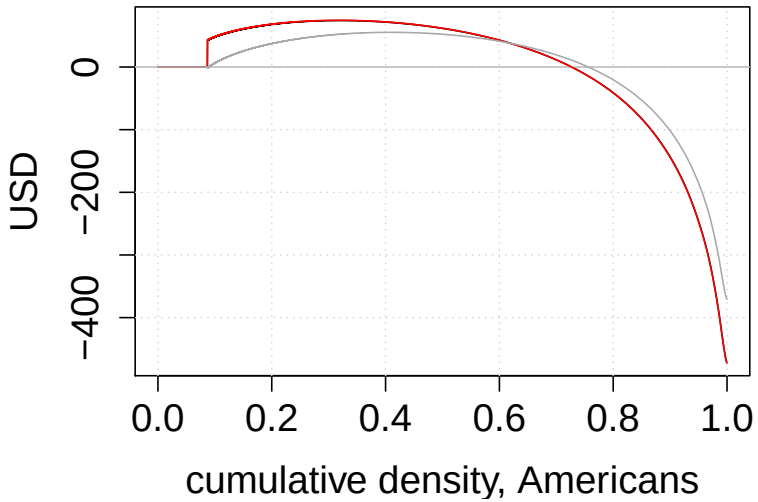
Reference parameter values

Table 1: Estimated parameter values for the reference calibration

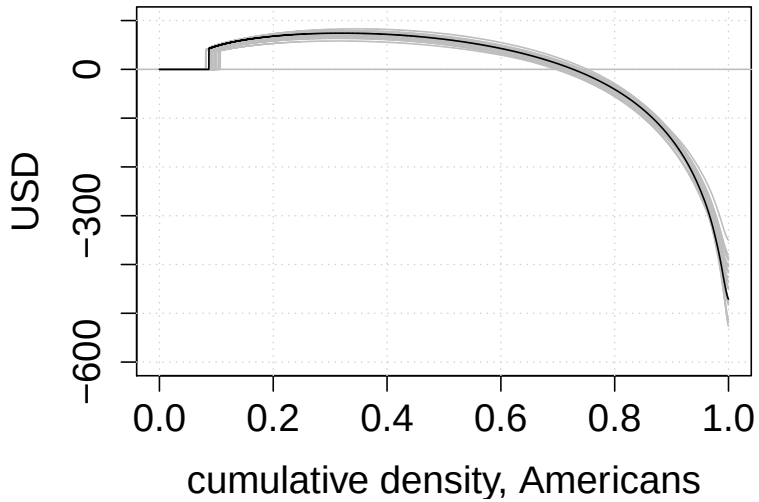
American market	Mexico market	Common parameters
$k_1 = 18,420.79$	$k_2 = 6,062.17$	$\theta = 0.919$
$s_1 = 0.543$	$s_2 = 0.508$	$x_1^* = 0.99994$
$\gamma_1 = 0.219$	$\gamma_2 = 0.084$	$\delta_0 = 203.696$
$R_1^F = 3.688$	$R_2^F = 1.469$	$\delta_1 = 0.265$
		$t_1 = 3.533$
		$t_2 = 0.987$

Other data: $R_U^W = 2.51$; $S_U^M(0) = 0.1376$; $u_U = 8.71\%$; $u_M = 4.6\%$

Robustness checks



(a) Alternative skills of the unemployed

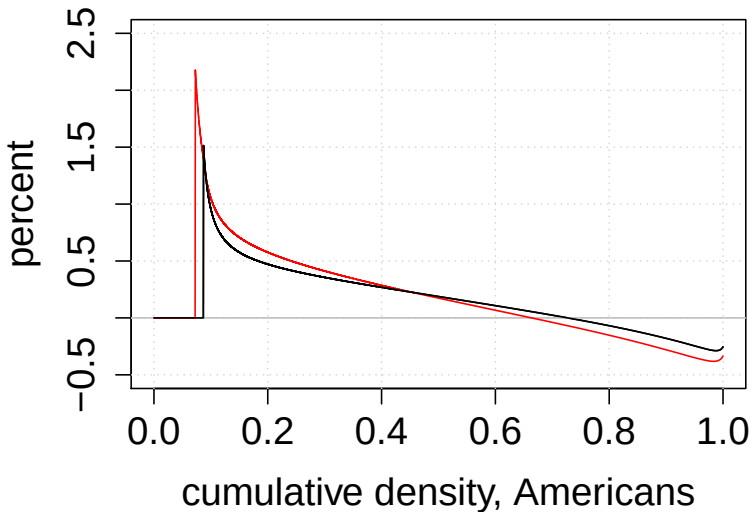


(b) 25 best calibrations

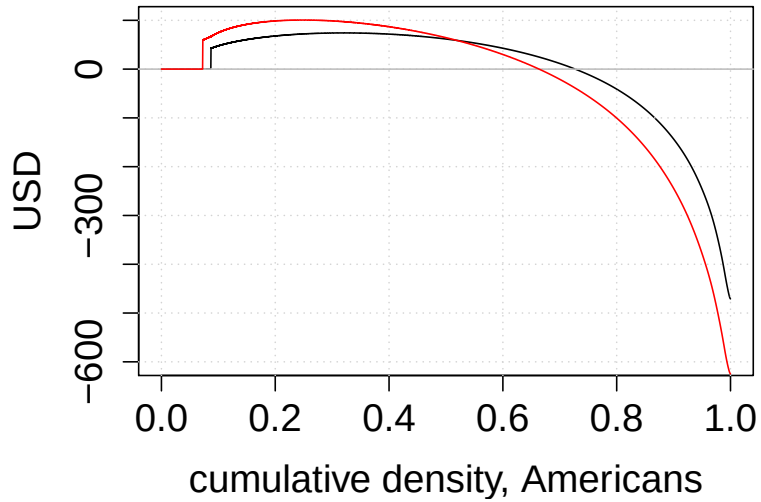
LEFT: The welfare effects assuming alternative distributions of skills in the population of unemployed Americans. The reference scenario (black) assumes a linear CDF, the convex scenario (gray): exponential CDF, while the concave scenario (red): logarithmic CDF.

RIGHT: The welfare effects for 25 best parameterizations found in the calibration algorithm.

Robustness checks



(a) Illegal Mexican immigrants



(b) Illegal Mexican immigrants

LEFT: Relative welfare effects with illegal Mexican immigrants.

RIGHT: Absolute welfare effects with illegal Mexican immigrants.

Robustness checks

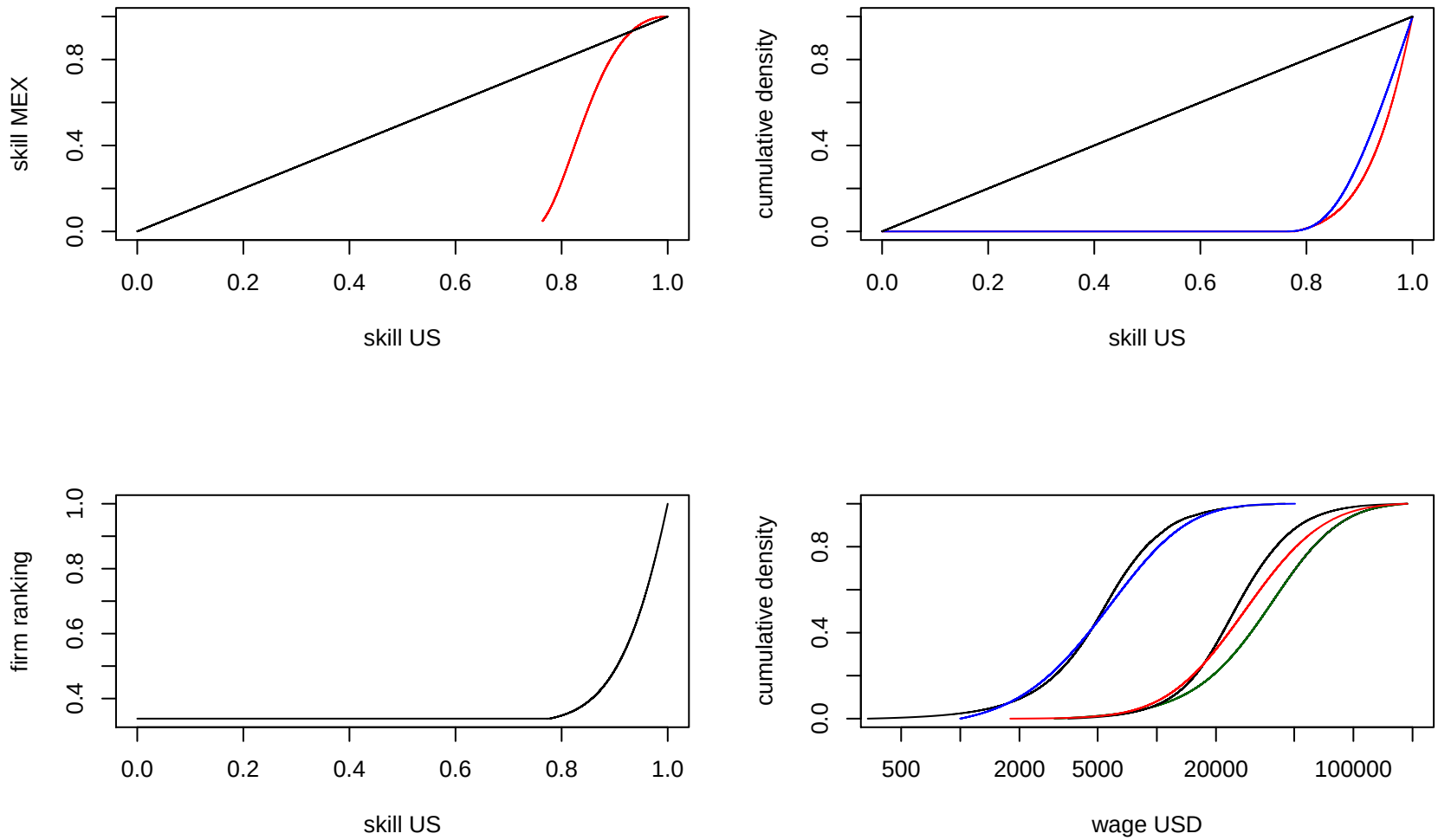


Figure 10: Estimation of Borjas (1987) model with Clayton

Robustness checks

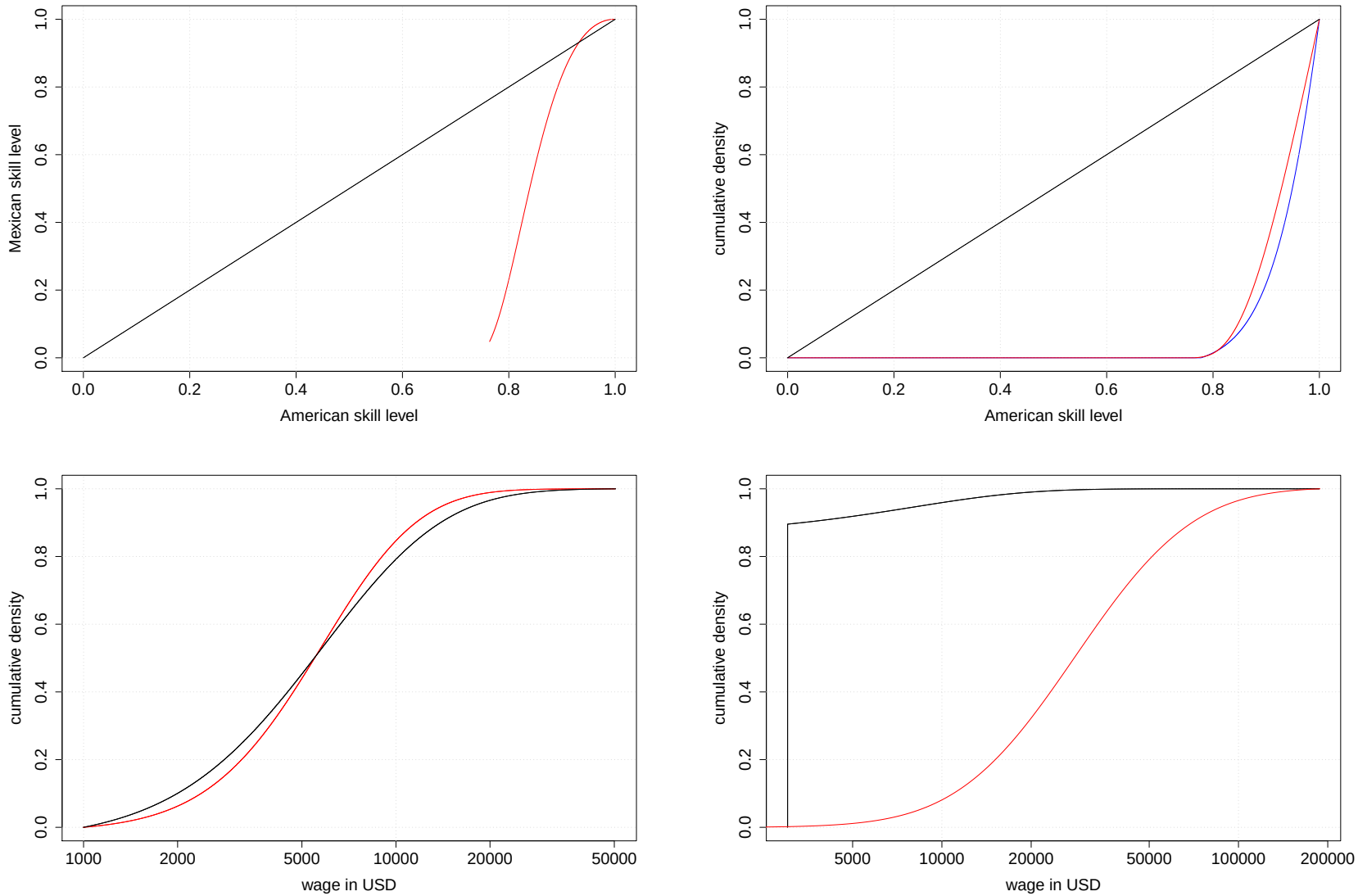


Figure 11: Estimation of Borjas (1987) model with Clayton