Economic Shocks and Internal Migration

Joan Monras

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Labor relocation and negative economic shocks

Does spatial factor relocation respond to local negative economic shocks?

- Maybe:
  - Long-run evidence from historic episodes (for example Hornbeck (2012))
  - Short-run evidence on labor relocation – independent of the nature of the shock (Blanchard and Katz, 1992)
- Maybe it doesn't need to:
  - Housing is not destroyed, maybe negative shocks transfer to lower housing prices
    $\rightarrow$ lowering the incentives of escaping local negative shocks

    (Glaeser and Gyourko, 2005)

How does spatial factor relocation respond to local shocks?

- Little evidence showing the mechanism of adjustment to negative shocks

Importance of labor relocation

How fast does labor relocate across local labor markets?

Some papers suggest that relocation costs are high:

- Kennan and Walker (2011) estimate moving costs of around $300,000 on average (and often the income gains from moving would not compensate for these costs)

But:

- How do these translate into the aggregate movements?
- How important are spillovers across locations created by internal migration in determining aggregate movements?

How does this relocation translate into welfare dynamics across space?

- Can internal migration fully insure against local shocks?
- What share of the initial shock becomes permanent?

This paper

In this paper, I argue that:

- Factor relocation is very responsive to local economic shocks

For this, it is important to note that:

1. Gross flows of workers between metropolitan areas are larger than net flows
2. Out- and in-migration rates need not respond equally

Key intuition:

- It is less "costly" to avoid moving to a hard hit location than moving out from it

First contribution: a new stylized fact

Stylized fact: In-migration rates are more responsive to shocks than out-migration rates

1) During the Great Recession:

1. In-migration rates decline in hard hit locations in the short-run
    - A 1% decrease in wages, reduces in-migration rates by .2pp ($\partial(I/L)/\partial lnw \approx .2$).
2. Out-migration rates do not respond in hard hit locations in the short-run
3. Thus, net in-migration rates decline in hard hit locations in the short-run
    - **Identification:** Based on pre-crisis HH indebtedness to identify local labor demand shocks (Mian et al., 2013)

2) How general is this fact?

1. Population growth rates mostly explained by differences in in-migration rates
2. Prevalent feature in the US across data sets, time spans, geographic aggregations

Main contribution: Dynamic Spatial Equilibrium model

(Very tractable) dynamic spatial general equilibrium model built around:

1. Stylized fact about the response of internal migration to shocks
2. Forward looking dynamic location choice model (Kennan and Walker (2011))
3. Spatial equilibrium model (quantitative version of Rosen (1974) - Roback (1982))

Contribution: First paper to combine 1, 2, and 3

Preview of the main results of the model:

1. Dynamics:

$$N_{t+1,m} = \widetilde{\eta}_t \frac{V_{t,m}^{1/\lambda}}{V_t^{1/\lambda}} N_t + (1 - \eta_{m,t}) N_{t,m} \tag{1}$$

2. Long-run welfare:

$$\Delta \ln V_m \approx \lambda \Delta \ln N_m + \Delta \ln V \tag{2}$$

where $1/\lambda$ is the (easy to estimate) response of in-migration to local shocks.

Third contribution: Great Recession, welfare, and space

Use the quantitative model to explore:

1. The potential role of labor relocation after the Great Recession
    - Abstracting from other mechanisms of adjustment
2. Welfare changes across locations as a function of the incidence of the Great Recession

Main conclusions:

1. Within 10 years the new long-run equilibrium is attained
2. Internal migration can dissipate around 60 percent of the initial shock
    - Despite the fact that population did not leave from the most affected locations in higher proportions

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    1. Basic Setup
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How responsive are migration rates to local shocks?

The Great Recession as a local labor demand shock:

- The Great Recession reduced labor demand disproportionately in:
  - Highly leveraged local labor markets (Mian et al., 2013)
- Compare different local labor markets before and after the Great Recession:
  - First stage: Did labor market outcomes worsen in particular locations?
  - Second stage: How did internal migration rates respond?

Main estimation equation

I estimate the following equation:

$$Y_{mt} = \alpha + \beta \ln X_{mt} + Controls + \delta_t + \delta_m + \varepsilon_{mt} \quad (3)$$

Where Y_{mt} is:

1. In-migration rate $\equiv \frac{I_{mt}}{N_{mt}}$
2. Out-migration rate $\equiv \frac{O_{mt}}{N_{mt}}$
3. Net in-migration rate $\equiv \frac{I_{mt}-O_{mt}}{N_{mt}}$

And where X_{mt} is a measure of the conditions in the local labor market:

- wages, unemployment rate, and employment rate in metropolitan area m at time t.

Endogeneity: Migration affects local economic conditions.

Data source: ACS Summary Statistics

Two identification strategies: First Stage

1. **Household debt Shock**:

$$\ln X_{mt} = \alpha + \beta \text{ Debt to Income ratio in } 2006_m * Shock_t + \delta_m + \delta_t + \eta_{mt}$$

2. **Aggregate Demand - employment Shock**:

$$\ln X_{mt} = \alpha + \beta \text{Debt to Inc. in '}06_m * \text{Share Non-trade employ. in '}00_m * Shock_t + \delta_m + \delta_t + \eta_{mt}$$

Intuition:

1. Mian et al. (2013) show that employment in non-tradables decreases more in more indebted counties (while in tradables declines uniformly)
2. Use the importance of non-tradable sector in indebted metopolitan areas to predict what cities suffer more from the crisis

First stage for entire population

Table: First Stage: Labor demand shock

VARIABLES	(1) Wages OLS	(2) Wages OLS	(3) Unemployment OLS	(4) Unemployment OLS	(5) Employment OLS	(6) Employment OLS
Debt to income x Post	-0.0174***		0.0120***		-0.0101***	
	(0.00374)		(0.00247)		(0.00290)	
Debt to income x Share non-trade x Post		-0.0726***		0.0453***		-0.0400***
		(0.0122)		(0.00917)		(0.00980)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes

Notes: Robust standard errors reported. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Event type graph

Net in-migration rates

Table: The migration response to the crisis: (net) In-migration rates

VARIABLES	(1) Net migration IV1	(2) Net migration IV2	(3) Net migration IV1	(4) Net migration IV2	(5) Net migration IV1	(6) Net migration IV2
(log) Weekly Wages	0.188**	0.205***				
	(0.0843)	(0.0640)				
Unemployment rate			-0.273***	-0.328***		
			(0.0990)	(0.0822)		
Employment rate					0.325***	0.371***
					(0.116)	(0.0936)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	30.50	37.71	65.08	63.43	31.18	40.66

Notes: Robust standard errors reported. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table: The migration response to the crisis: separating in- and out-migration

Panel A: In-migration rates

VARIABLES	(1) In migration IV1	(2) In migration IV2	(3) In migration IV1	(4) In migration IV2	(5) In migration IV1	(6) In migration IV2
(log) Weekly Wages	0.217***	0.221***				
	(0.0593)	(0.0465)				
Unemployment rate			-0.315***	-0.354***		
			(0.0612)	(0.0563)		
Employment rate					0.374***	0.401***
					(0.0750)	(0.0668)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	30.50	37.71	65.08	63.43	31.18	40.66

Panel B: Out-migration rates

VARIABLES	(1) Out migration IV1	(2) Out migration IV2	(3) Out migration IV1	(4) Out migration IV2	(5) Out migration IV1	(6) Out migration IV2
(log) Weekly Wages	0.0461	0.0293				
	(0.0443)	(0.0298)				
Unemployment rate			-0.0669	-0.0469		
			(0.0674)	(0.0498)		
Employment rate					0.0794	0.0531
					(0.0811)	(0.0568)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	30.50	37.71	65.08	63.43	31.18	40.66

Notes: Robust standard errors reported. *** p<0.01, ** p<0.05, * p<0.1.

Event type graph

Summary of main result

Result

A 1% decrease in wage leads to a a decrease of the in-migration rates by .2pp

Sensitivity of the results:

1. Excluding the immigrant workers from the computation of migration rates Table
2. Separating high and low skilled workers Table
3. Both natives and immigrant low skilled workers Table, Explaining (Cadena and Kovak, 2016)
4. Stronger results for younger workers Table
5. Some (very interesting) heterogeneity by home-ownership status Tables

We have established a fact:

- Internal migration helped mitigate local shocks during the Great Recession, mainly through changes in in-migration rates Explanation of Mian et al. (2013)

Two questions to move forward:

1. How prevalent this asymmetry is?
2. How important is internal migration?

How prevalent the asymmetry is?

What I propose in this paper:

- Decompose the population growth rates of a cohort into in- and out- migrations rates
- Using various geographies and time periods show that:

Most of the variation in population growth rates is associated with variation in in-migration rates

Decomposing population growth rates

The population growth rate is in-migration minus out-migration:

$$\frac{N_{m,t} - N_{m,t-1}}{N_{m,t-1}} = \frac{I_{m,t}}{N_{m,t-1}} - \frac{O_{m,t}}{N_{m,t-1}} \tag{4}$$

where $N_{m,t}$ refers to the cohort of workers that at time t are in metropolitan area m.

Regressions:

$$\frac{I_{m,t}}{N_{m,t-1}} = \alpha_1 + \beta_1 \frac{N_{m,t} - N_{m,t-1}}{N_{m,t-1}} + (+\delta_m + \delta_t) + \varepsilon_{m,t} \tag{5}$$

$$\frac{O_{m,t}}{N_{m,t-1}} = \alpha_2 - \beta_2 \frac{N_{m,t} - N_{m,t-1}}{N_{m,t-1}} + (+\delta_m + \delta_t) + \epsilon_{m,t} \tag{6}$$

Then, always $\beta_1 + \beta_2 = 1$, so:

- β_1 is then the share of the variation explained by the variation in in-migration rates
- β_2 is the share explained by the variation in out-migration

Data source: Census and CPS | Summary Statistics

Table: In- migration, out-migration and population growth

Panel A: Census data, metropolitan-level variation

	(1) In-migration rate	(2) Out-migration rate	(3) In-migration rate	(4) Out-migration rate	(5) In-migration rate	(6) Out-migration rate
Population growth rate	1.099***	0.0985*	0.861***	-0.139**	0.829***	-0.171***
	(0.0542)	(0.0542)	(0.0617)	(0.0617)	(0.0432)	(0.0432)
Observations	444	444	444	444	444	444
R-squared	0.739	0.022	0.975	0.905	0.986	0.946

Panel B: Census data, state-level variation

	(1) In-migration rate	(2) Out-migration rate	(3) In-migration rate	(4) Out-migration rate	(5) In-migration rate	(6) Out-migration rate
Population growth rate	1.044***	0.0440	0.857***	-0.143*	0.726***	-0.274***
	(0.0722)	(0.0722)	(0.0746)	(0.0746)	(0.0634)	(0.0634)
Observations	204	204	204	204	204	204
R-squared	0.671	0.004	0.964	0.891	0.980	0.939

Panel C: CPS data, regional variation

	(1) In-migration rate	(2) Out-migration rate	(3) In-migration rate	(4) Out-migration rate	(5) In-migration rate	(6) Out-migration rate
Population growth rate	1.464***	0.464***	0.820***	-0.180	0.685***	-0.315***
	(0.154)	(0.154)	(0.211)	(0.211)	(0.0863)	(0.0863)
Observations	270	270	270	270	270	270
R-squared	0.340	0.049	0.476	0.246	0.925	0.892
Geography FEs	no	no	yes	yes	yes	yes
Time FEs	no	no	no	no	yes	yes

Notes: Robust standard errors reported. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. The subtraction of every two columns needs to add up to 1.

Summary of results until now

Not only:

- In-migration is more responsive than out-migration during the Great Recession

But also:

- In-migration differences seem to explain much more of the variance in population growth
- City/regional decline: not attracting people instead of population leaving

But, how fast and how important as an insurance mechanism is this?

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Jump to Graphs of the calibrated model, Jump to Conclusion

Building blocks of the model

Key assumptions of the model:

1. Local labor demand in each location is downward sloping (at least in the short-run)
2. Internal migration responds to local labor market conditions

Standard pieces of the Rosen (1974) - Roback (1982) model:

- The model has M regions
- There is a single final consumption good that is freely traded across regions
- Two factors of production: Land and Labor
- Location decision induces dynamics:
  - Workers live for infinitely many periods
  - Workers decide where to live in the following period given current and future local conditions

I will study what happens when:

- Unexpected permanent shocks occur

Timing

The timing of the model is the following:

1. At the beginning of each period an unexpected permanent shock can happen in a location
2. Given the current distribution of workers across locations:
   - Firms maximize profits
   - Wages are determined
3. Given the wages in the economy, workers decide where to live in the following period

Key features for the model

1. Congestion forces stronger than agglomeration forces
    - Attained through competition in the labor market with a fixed factor
    - Needed for existence and uniqueness of equilibrium
2. Dynamic location choice model that is:
    - Simple enough to study general equilibrium
    - Realistic enough to study dynamics and welfare

Labor Market

Perfectly competitive labor market:

$$\ln w_m = \ln(1-\theta_m) + \ln B_m + \frac{1}{\sigma}\ln Q_m - \frac{1}{\sigma}\ln N_m \tag{7}$$

The key feature that I need is:

- Short-run downward sloping demand curve
- We can easily incorporate search frictions in this framework

Search frictions extension

- We can also incorporate more realistic models of internal trade

Location Choice

The indirect utility of the workers living in m and considering to move to m':

$$v^i_{t,m,m'} = \ln V_{t,m'} + \epsilon^i_{t,m,m'} = \ln A_{m'} + \ln w_{t,m'} + \beta \mathrm{E}_t\{\ln V_{t+1,m'}\} + \epsilon^i_{t,m,m'}$$

Thus, workers maximize:

$$\max_{m' \in M} \{\ln V_{t,m'} + \epsilon^i_{t,m,m'}\}$$

So, given the realization of $\epsilon_{m,m'}$, each individual chooses location.

We can use distribution of the idiosyncratic taste parameter to obtain probabilities of movement:

$$p^i_{t,m,m'} = p_{m,m'}(V_{t,1}, V_{t,2}, ..., V_{t,M}) \tag{8}$$

By the law of large numbers we obtain the flow of people between m and m':

$$P_{t,m,m'} = p_{m,m'}(V_{t,1}, V_{t,2}, ..., V_{t,M}) * N_{t,m} \tag{9}$$

Notes:

- Notation A for amenities and w for wages.
- Easy to incorporate housing prices and other agglomeration or congestion forces.

Equilibrium

Short-run:

Definition

A short-run equilibrium is defined by the following decisions:

- Given $\{\theta_m, B_m, K_m, \sigma, w_m, r_m\}_{m \in M}$ firms maximize profits.
- Labor and land markets clear in each $m \in M$ so that $\{w_m, r_m\}$ is determined.

Long-run:

Definition

Given $\{\theta_m, B_m, K_m, \sigma, A_m\}_{m \in M}$, a long-run equilibrium is defined as a short-run equilibrium with a stable distribution of workers across space, i.e. with $N_{t+1,m} = N_{t,m}$ for all $m \in M$.

Population flows when ϵ is nested logit

When $\varepsilon_{m,m'}$ is nested logit, then the flows are:

$$P_{t,m,m'} = N_{t,m}\eta_{t,m}\frac{V_{t,m'}^{1/\lambda}}{\sum_{j\in M} V_{t,j}^{1/\lambda}} \tag{10}$$

where

$$\eta_{t,m} = \frac{\eta V_t^{1/\gamma}}{(1-\eta)V_{t,m}^{1/\gamma} + \eta V_t^{1/\gamma}}$$

and

$$\ln V_t = \lambda \ln \sum_{j\in M} V_{t,j}^{1/\lambda}$$

where V_t is the aggregate value in the economy and $\lambda < \gamma$.

Limiting cases

When $\frac{1}{\gamma} \rightarrow \frac{1}{\lambda}$:

- The home location stops having a special role
- As the number of locations increase, everyone relocates each period

When $\frac{1}{\gamma} \rightarrow 0$:

- Then $\eta_{t,m} \rightarrow \eta$, so an (almost) constant fraction relocates
- η helps to obtain realistic equilibrium migration rates: Mapping η to Fixed Costs of moving

Solving the model

We can easily compute:

$$E_t(\ln V_{t+1,m'}) = \gamma \ln[(1-\eta)V_{t+1,m'}^{1/\gamma} + \eta V_{t+1}^{1/\gamma}]$$

Using this we can express the value of each location as:

$$\ln V_{t,m'} = \ln A_{m'} + \ln w_{t,m'} + \beta\gamma(\ln[(1-\eta)V_{t+1,m'}^{1/\gamma} + \eta V_{t+1}^{1/\gamma}]) \tag{11}$$

which iterating forward can be written as:

$$\ln V_{t,m'} = \frac{\beta}{1-\beta}\gamma \ln(1-\eta) + \frac{1}{1-\beta}\ln A_{m'} + \sum_{k=0}^{\infty}\beta^k \ln w_{t+k,m'} + \sum_{k=0}^{\infty}\beta^k \ln \nu_{t+k,m'} \tag{12}$$

In and out-migration

Proposition

If $\epsilon^i_{m,m'}$ are i.i.d. and drawn from a nested logit distribution with shape parameters λ and γ then, in the environment defined by the model, we have that:

1. $\frac{\partial \ln I_m}{\partial \ln w_m} \approx \frac{1}{1-\beta_m}\frac{1}{\lambda}$
2. $\frac{\partial \ln O_m}{\partial \ln w_m} \approx -\frac{1}{1-\beta_m}\frac{1}{\gamma}(1-\eta_m)$

Corollary

If $\epsilon^i_{m,m'}$ are i.i.d. and drawn from a nested logit distribution with shape parameters λ and γ then, in the environment defined by the model, we have that:

1. $\frac{\partial (I_m/N_m)}{\partial \ln w_m} \approx \frac{1}{1-\beta_m}\frac{1}{\lambda}\frac{I_m}{N_m}$
2. $\frac{\partial (O_m/N_m)}{\partial \ln w_m} \approx -\frac{1}{1-\beta_m}\frac{1}{\gamma}(1-\eta_m)\frac{O_m}{N_m}$

And:

$$\frac{\partial \ln N'_m}{\partial \ln w_m} \approx \frac{1}{1-\beta_m}\frac{1}{\lambda}\frac{I_m}{N'_m} - \frac{1}{1-\beta_m}\frac{1}{\gamma}(1-\eta_m)\frac{O_m}{N'_m}$$

The propagation of a local shock

A shock in one location:

1. Reduces wages in that location
2. Fewer workers are attracted to that location
3. These workers are a labor supply shock in non-affected locations
4. Dynamics: Unless we are in the extreme case $1/\gamma = 1/\lambda$, some "stickiness"

Very simple dynamics:

$$N_{t+1,m'} = (\sum_j P_{t,j,m'}) = \widetilde{\eta}_t \frac{V_{t,m'}^{1/\lambda}}{V_t^{1/\lambda}} N_t + (1 - \eta_{m,t}) N_{t,m'} \tag{13}$$

Where $\widetilde{\eta}_t = \sum_j \eta_{j,t} \omega_{t,j}$ and $\omega_{t,j} = \frac{N_{t,j}}{N_t}$

Steady state ($N_{t+1,m} = N_{t,m}$)

Allocation of people across space:

$$N_m = \frac{\tilde{\eta}}{\eta_m} \frac{V_m^{1/\lambda}}{V^{1/\lambda}} N \tag{14}$$

Welfare evaluation:

$$\Delta \ln V_m \approx \lambda \Delta \ln N_m + \Delta \ln V \tag{15}$$

Relative welfare across locations:

$$\Delta \ln V_m - \Delta \ln V_{m'} \approx \lambda(\Delta \ln N_m - \Delta \ln N_{m'}) \tag{16}$$

Note that all crucially depend on λ, which I essentially estimated already!

Model Discussion

In the model:

1. Positive bilateral flows across any locations
2. Labor relocation as a response to a local negative shock can be a consequence of:
   - Changes in in-migration rates
   - Changes in out-migration rates
   - A combination of the two
3. If short-run labor demand is downward sloping:
   - Internal relocation spreads local shocks across the territory
   - Alternatively, other congestion forces like housing could be the source of spillovers
4. The discrete choice part models population flows and not final population distribution
5. Long-run welfare is easy to compute

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Model Estimation/Calibration: Key parameters

1. Local labor demand elasticity:
   - Monras (2015a) using immigration shocks estimates an *inverse* local labor demand elasticity equal to -.7 for low skilled.
   - Monras (2015b) using minimum wage increases estimates a local labor demand elasticity equal to -1.3 for low skilled.
   - Borjas and Monras (2016) obtain a labor demand elasticity of around -1.
   - In this paper, robustness to many different local labor demand elasticities estimates, but main results use unit elasticity.
2. Sensitivity of internal migration to local shocks:
   - Out-migration rates do not seem to respond: $\frac{1}{\gamma} = 0$ (So, limiting case of the model discussed before)
   - In-migration rates respond: $\partial(\frac{I_m}{N_m})/\partial \ln w_m \approx 0.2$, and

$$\frac{1}{\hat{\lambda}} = \frac{0.2}{0.05}(1 - \hat{\beta}(1 - \hat{\eta})) = \frac{1}{2.56}$$

When $\frac{1}{\gamma} = 0$, then $(1 - \beta_m) = (1 - \hat{\beta}(1 - \hat{\eta}))$, assuming $\beta = 0.95$

Rest of the calibration

1. $1-\theta_m$ is the share of output devoted to labor: $\hat{\theta}_m = 1 - \frac{w_m N_m}{Q_m}$
2. Local Labor Demand Shifter: $\hat{TFP}_m = B_m K_m^{\theta_m} = Q_m / N_m^{1-\hat{\theta}_m}$
3. Calibrate η to match equilibrium migration rates
4. Calibrate β to .95 (Kennan and Walker, 2011)
5. Amenities and initial conditions are calibrated assuming long-run spatial equilibrium in 2005.
6. Calibration of the shock:
    - Change in local demand for labor consistent with the predicted change in wages between 2005 - 2008 given Aggregate Demand measure introduced before.

Results from the calibration

The model boils down to a dynamic system of 2 state variables per location and 2 equations:

$$N_{t+1,m} = \eta \frac{V_{t,m}^{1/\lambda}}{V_t^{1/\lambda}} N_t + (1-\eta) N_{t,m} \tag{17}$$

$$V_{t+1,m} = (A_m w_{t,m})^{\frac{-1}{\beta(1-\eta)}} V_{t,m}^{\frac{1}{\beta(1-\eta)}} V_{t+1}^{\frac{-\eta}{(1-\eta)}} \tag{18}$$

That only depends on the calibrated/estimated parameters.

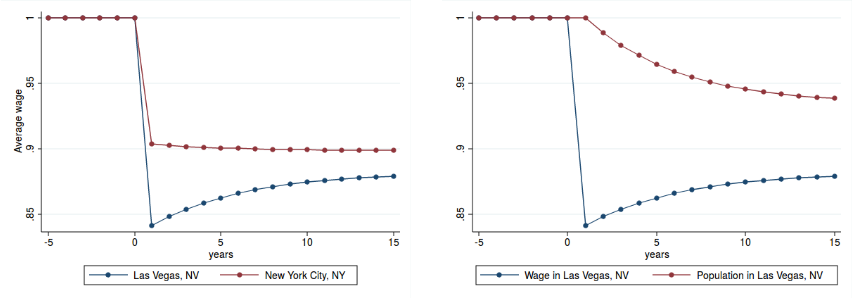
Note: V_{t+1} can be recovered from its definition.

With the calibrated model we can study:

1. Speed of convergence to new spatial equilibrium
2. The evolution of welfare across space

Wages and population

Figure: The evolution of the wages and population in the model

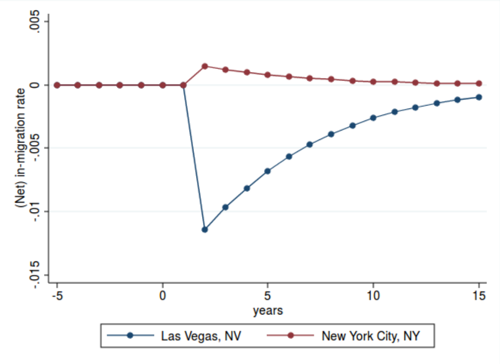


Notes: This graph shows the evolution of wages and population in a number of cities according to the model calibrated to match the implied productivity loss during the Great Recession.

Alternative labor demand elasticities

In-migration rates

Figure: The evolution of the in migration rate in the model



Notes: This graph shows the evolution of the in-migration rate in a number of cities according to the model calibrated to match the implied productivity loss during the Great Recession.

Internal migration and local insurance

A simple test:

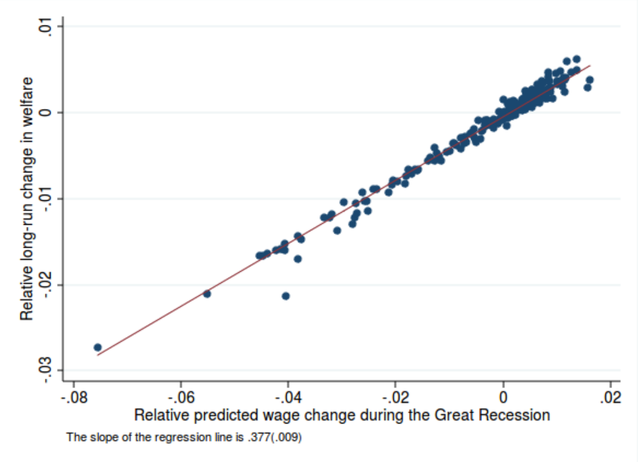
$$\Delta^{2020-2005} \ln \mathrm{V}_m = \alpha + \beta \Delta^{\widehat{2010-2005}} \ln w_m + \varepsilon_m$$

where $\Delta^{\widehat{2010-2005}} \ln w_m$ is the initial size of the shock predicted by the local aggregate demand decrease.

Note that

- If $\beta = 0$ then internal migration fully insures against local shocks
- If $\beta = 1$ the initial shock transfer 1 to 1 to long run welfare
- Thus, $1 - \beta$ measures how much of the initial shock dissipates thanks to internal migration

Change in long-run welfare following the Great Recession



Conclusion: At least 60 percent of initial shock potentially absorbed through internal migration

Conclusion

How does internal migration respond to local shocks?

- In-migration rates decline in hard hit locations during the Great Recession
- Out-migration rates do not respond on impact
- Population growth rates mainly explained by variation in in-migration rates

How much labor relocation helps?

Introduce a parsimonious dynamic spatial equilibrium model to show that

- Within 10 years most of the local shocks during the Great Recession dissipate
- At least 60 percent of the initial incidence of the shock is dissipated through internal migration

Appendix

Data

Standard microlevel labor market data:

- American Community Survey/Census/Current Population survey to compute:
  - Yearly average wages and unemployment rates at the metropolitan area
  - In- and out-migration rates
- Census data to compute:
  - The importance of the construction sector in 2000
  - The importance of the "non-tradable sector" in 2000

BEA data to compute per capita GDP at the metropolitan area

Mian et al. (2013) data to compute:

- The debt to income ratio at the metropolitan area

Main facts to keep in mind:

1. Labor market outcomes deteriorated during the Great Recession, variance across localities
2. Internal migration is around 5 percent of the population
3. It decreases during crisis (Saks and Wozniak, 2011)

Back to In- out- migration rates | Back to Population growth rates

Table: Summary statistics, period 2005-2010

Variable	Mean	Std. Dev.	Min.	Max.
Debt to Income, 2006	1.977	0.595	0.865	3.784
Share of emp. in non-tradable sectors, 2000	0.221	0.032	0.163	0.432
Non-trade emp x Debt to Income	0.442	0.172	0.201	1.236
Years 2005-2006				
Total population	2,150,467	2,604,588	51,253	10,028,307
Sample size	4087.606	3921.324	124	15235
Average weekly wages	377.48	51.447	238.739	605.967
Unemployment rate	0.049	0.013	0.004	0.118
Employment rate	0.845	0.028	0.697	0.931
In-migration rate	0.054	0.019	0.006	0.126
Out-migration rate	0.053	0.019	0.005	0.259
Net in-migration rate	0.001	0.017	-0.2	0.093
Years 2007-2010				
Total population	2,233,383	2,679,241	47,997	10,176,648
Sample size	4051.202	3975.764	91	15362
Average weekly wages	357.875	51.535	209.414	580.365
Unemployment rate	0.071	0.029	0.008	0.172
Employment rate	0.834	0.039	0.635	0.947
In-migration rate	0.048	0.016	0	0.15
Out-migration rate	0.047	0.015	0.004	0.159
Net in-migration rate	0	0.009	-0.063	0.09

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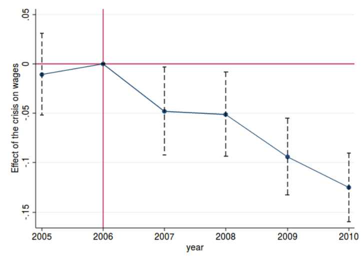
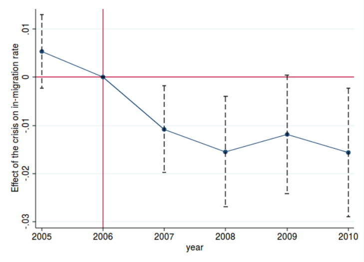
Table: Summary statistics: migration rates

Variable	Mean	Std. Dev.	Min.	Max.
Metropolitan area migration				
	Pooled Censuses 1980-2000			
In-migration rate	0.177	0.083	0.065	0.618
Out-migration rate	0.175	0.043	0.049	0.433
	2000 Census			
In-migration rate	0.168	0.073	0.079	0.618
Out-migration rate	0.168	0.039	0.049	0.395
	1990 Census			
In-migration rate	0.187	0.09	0.069	0.466
Out-migration rate	0.183	0.045	0.113	0.433
	1980 Census			
In-migration rate	0.177	0.099	0.065	0.578
Out-migration rate	0.182	0.049	0.116	0.426
State migration				
	Pooled Censuses 1980-2000			
In-migration rate	0.114	0.053	0.046	0.645
Out-migration rate	0.11	0.03	0.074	0.419
	2000 Census			
In-migration rate	0.105	0.046	0.056	0.335
Out-migration rate	0.104	0.026	0.074	0.345
	1990 Census			
In-migration rate	0.114	0.052	0.055	0.385
Out-migration rate	0.113	0.033	0.077	0.321
	1980 Census			
In-migration rate	0.118	0.06	0.046	0.437
Out-migration rate	0.116	0.031	0.081	0.339
Regional migration				
	Pooled CPS 1982-2013			
In-migration rate	0.025	0.013	0.007	0.077
Out-migration rate	0.025	0.011	0.009	0.071

Figure: Evolution of wages and in-migration rates during the Great Recession





Notes: This figure reports the estimate of the interaction of year dummies with the Deb to Income x Share of employment in non-tradable sectors, controlling for metarea and year fixed effects. 95 percent confidence intervals are reported.

Back to First Stage | Back to Second Stage

In-migration rates of native workers

Table: The migration response to the crisis: natives

Panel A: In-migration rates

VARIABLES	(1) In migration IV1	(2) In migration IV2	(3) In migration IV1	(4) In migration IV2	(5) In migration IV1	(6) In migration IV2
(log) Weekly Wages	0.166***	0.183***				
	(0.0525)	(0.0426)				
Unemployment rate			-0.233***	-0.293***		
			(0.0590)	(0.0560)		
Employment rate					0.251***	0.305***
					(0.0631)	(0.0591)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	30.50	37.71	62.74	54.81	39.10	45.34

Notes: Robust standard errors reported. *** p<0.01, ** p<0.05, * p<0.1.

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In-migration rates of young workers

Table: The migration response to the crisis: workers less than 35 years old

Panel A: In-migration rates

VARIABLES	(1) In migration IV1	(2) In migration IV2	(3) In migration IV1	(4) In migration IV2	(5) In migration IV1	(6) In migration IV2
(log) Weekly Wages	0.315***	0.306***				
	(0.0869)	(0.0674)				
Unemployment rate			-0.458***	-0.491***		
			(0.0906)	(0.0802)		
Employment rate					0.543***	0.556***
					(0.113)	(0.0947)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	30.50	37.71	65.08	63.43	31.18	40.66

Panel B: Out-migration rates

VARIABLES	(1) Out migration IV1	(2) Out migration IV2	(3) Out migration IV1	(4) Out migration IV2	(5) Out migration IV1	(6) Out migration IV2
(log) Weekly Wages	0.0417	0.0111				
	(0.0655)	(0.0466)				
Unemployment rate			-0.0606	-0.0178		
			(0.0983)	(0.0753)		
Employment rate					0.0719	0.0202
					(0.118)	(0.0855)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	30.50	37.71	65.08	63.43	31.18	40.66

Notes: Robust standard errors reported. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Back

In-migration rates of older workers

Table: The migration response to the crisis: workers less than 35 years old

Panel A: In-migration rates

VARIABLES	(1) In migration IV1	(2) In migration IV2	(3) In migration IV1	(4) In migration IV2	(5) In migration IV1	(6) In migration IV2
(log) Weekly Wages	0.136***	0.146***				
	(0.0467)	(0.0371)				
Unemployment rate			-0.197***	-0.235***		
			(0.0560)	(0.0515)		
Employment rate					0.234***	0.266***
					(0.0671)	(0.0602)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	30.50	37.71	65.08	63.43	31.18	40.66

Panel B: Out-migration rates

VARIABLES	(1) Out migration IV1	(2) Out migration IV2	(3) Out migration IV1	(4) Out migration IV2	(5) Out migration IV1	(6) Out migration IV2
(log) Weekly Wages	0.0481	0.0379				
	(0.0398)	(0.0275)				
Unemployment rate			-0.0699	-0.0608		
			(0.0595)	(0.0460)		
Employment rate					0.0830	0.0688
					(0.0716)	(0.0523)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	30.50	37.71	65.08	63.43	31.18	40.66

Notes: Robust standard errors reported. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

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Migration rates of renters

Table: The migration response to the crisis: renters

Panel A: In-migration rates

VARIABLES	(1) In migration IV1	(2) In migration IV2	(3) In migration IV1	(4) In migration IV2	(5) In migration IV1	(6) In migration IV2
(log) Weekly Wages	0.260***	0.301***				
	(0.0865)	(0.0723)				
Unemployment rate			-0.378***	-0.482***		
			(0.114)	(0.104)		
Employment rate					0.449***	0.546***
					(0.134)	(0.119)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	30.50	37.71	65.08	63.43	31.18	40.66

Panel B: Out-migration rates

VARIABLES	(1) Out migration IV1	(2) Out migration IV2	(3) Out migration IV1	(4) Out migration IV2	(5) Out migration IV1	(6) Out migration IV2
(log) Weekly Wages	-0.160*	-0.0804				
	(0.0967)	(0.0648)				
Unemployment rate			0.232*	0.129		
			(0.128)	(0.0967)		
Employment rate					-0.276*	-0.146
					(0.155)	(0.110)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	30.50	37.71	65.08	63.43	31.18	40.66

Notes: Robust standard errors reported. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

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Migration rates of homeowners

Table: The migration response to the crisis: homeowners free of mortgage

Panel A: In-migration rates

VARIABLES	(1) In migration IV1	(2) In migration IV2	(3) In migration IV1	(4) In migration IV2	(5) In migration IV1	(6) In migration IV2
(log) Weekly Wages	0.162**	0.171***				
	(0.0743)	(0.0570)				
Unemployment rate			-0.236***	-0.274***		
			(0.0895)	(0.0791)		
Employment rate					0.280**	0.310***
					(0.111)	(0.0932)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	30.50	37.71	65.08	63.43	31.18	40.66

Panel B: Out-migration rates

VARIABLES	(1) Out migration IV1	(2) Out migration IV2	(3) Out migration IV1	(4) Out migration IV2	(5) Out migration IV1	(6) Out migration IV2
(log) Weekly Wages	0.280***	0.208***				
	(0.0848)	(0.0657)				
Unemployment rate			-0.406***	-0.333***		
			(0.108)	(0.0894)		
Employment rate					0.482***	0.377***
					(0.143)	(0.107)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	30.50	37.71	65.08	63.43	31.18	40.66

Notes: Robust standard errors reported. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

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Migration rates of homeowners

Table: The migration response to the crisis: homeowners with mortgage

Panel A: In-migration rates

VARIABLES	(1) In migration IV1	(2) In migration IV2	(3) In migration IV1	(4) In migration IV2	(5) In migration IV1	(6) In migration IV2
(log) Weekly Wages	0.198***	0.176***				
	(0.0642)	(0.0466)				
Unemployment rate			-0.287***	-0.281***		
			(0.0670)	(0.0586)		
Employment rate					0.341***	0.319***
					(0.0829)	(0.0679)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	30.50	37.71	65.08	63.43	31.18	40.66

Panel B: Out-migration rates

VARIABLES	(1) Out migration IV1	(2) Out migration IV2	(3) Out migration IV1	(4) Out migration IV2	(5) Out migration IV1	(6) Out migration IV2
(log) Weekly Wages	0.149***	0.0725**				
	(0.0482)	(0.0350)				
Unemployment rate			-0.217***	-0.116**		
			(0.0722)	(0.0570)		
Employment rate					0.258***	0.132**
					(0.0931)	(0.0658)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	30.50	37.71	65.08	63.43	31.18	40.66

Notes: Robust standard errors reported. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

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Out-migration rates of homeowners

Table: The migration response to the crisis: homeowners in recourse States

Panel A: Out-migration rates, homeowners with mortgage payments

VARIABLES	(1) Out migration IV1	(2) Out migration IV2	(3) Out migration IV1	(4) Out migration IV2	(5) Out migration IV1	(6) Out migration IV2
(log) Weekly Wages	0.198**	0.0480				
	(0.0975)	(0.0445)				
Unemployment rate			-0.240**	-0.0725		
			(0.0952)	(0.0648)		
Employment rate					0.281**	0.0823
					(0.129)	(0.0737)
Observations	828	828	828	828	828	828
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	11.41	19.02	44.63	27.92	18.83	22.40

Panel B: Out-migration rates, homeowners free of mortgage payments

VARIABLES	(1) Out migration IV1	(2) Out migration IV2	(3) Out migration IV1	(4) Out migration IV2	(5) Out migration IV1	(6) Out migration IV2
(log) Weekly Wages	0.156	0.0947				
	(0.107)	(0.0659)				
Unemployment rate			-0.189*	-0.143*		
			(0.109)	(0.0869)		
Employment rate					0.221	0.162*
					(0.138)	(0.0984)
Observations	828	828	828	828	828	828
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	11.41	19.02	44.63	27.92	18.83	22.40

Notes: Robust standard errors reported. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

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Out-migration rates of homeowners

Table: The migration response to the crisis: homeowners in non-recourse States

Panel A: Out-migration rates, homeowners with mortgage payments

VARIABLES	(1) Out migration IV1	(2) Out migration IV2	(3) Out migration IV1	(4) Out migration IV2	(5) Out migration IV1	(6) Out migration IV2
(log) Weekly Wages	0.138***	0.123***				
	(0.0461)	(0.0447)				
Unemployment rate			-0.243***	-0.223**		
			(0.0907)	(0.0920)		
Employment rate					0.270***	0.237**
					(0.104)	(0.0998)
Observations	432	432	432	432	432	432
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	27.19	28.31	46.94	42.81	23.94	23.71

Panel B: Out-migration rates, homeowners free of mortgage payments

VARIABLES	(1) Out migration IV1	(2) Out migration IV2	(3) Out migration IV1	(4) Out migration IV2	(5) Out migration IV1	(6) Out migration IV2
(log) Weekly Wages	0.279***	0.290***				
	(0.0825)	(0.0827)				
Unemployment rate			-0.492***	-0.527***		
			(0.144)	(0.149)		
Employment rate					0.547***	0.560***
					(0.167)	(0.170)
Observations	432	432	432	432	432	432
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	27.19	28.31	46.94	42.81	23.94	23.71

Notes: Robust standard errors reported. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

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In-migration rates of low-skilled workers

Table: The migration response to the crisis: low-skilled

Panel A: In-migration rates

VARIABLES	(1) In migration IV1	(2) In migration IV2	(3) In migration IV1	(4) In migration IV2	(5) In migration IV1	(6) In migration IV2
(log) Weekly Wages	0.185***	0.189***				
	(0.0482)	(0.0439)				
Unemployment rate			-0.256***	-0.257***		
			(0.0464)	(0.0419)		
Employment rate					0.301***	0.277***
					(0.0574)	(0.0462)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	32.04	27.59	62.98	51.08	32.35	40.35

Notes: Robust standard errors reported. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

In-migration rates of high-skilled workers

Table: The migration response to the crisis: high-skilled

Panel A: In-migration rates

VARIABLES	(1) In migration IV1	(2) In migration IV2	(3) In migration IV1	(4) In migration IV2	(5) In migration IV1	(6) In migration IV2
(log) Weekly Wages	0.260**	0.286***				
	(0.108)	(0.0786)				
Unemployment rate			-0.433***	-0.595***		
			(0.137)	(0.142)		
Employment rate					0.559***	0.845***
					(0.196)	(0.259)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	11.92	21.38	40.12	48.64	16.47	16.20

Notes: Robust standard errors reported. *** p<0.01, ** p<0.05, * p<0.1.

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Reviewing the results in Cadena and Kovak (2016)

In a very nice paper Cadena and Kovak (2016) show that:

1. Mexican low-skilled pop. decreases between 2006 and 2010 in negatively affected cities
2. Native low-skilled pop. stays more or less constant (or increases slightly)

Their result suggests that **Mexicans grease the wheels of the US low skilled labor market**

(Borjas, 2001)

However,
can we conclude from their evidence that low skilled natives did not respond to local shocks?

In-migration rates of native low-skilled workers

Table: The migration response to the crisis: native low-skilled

Panel A: In-migration rates

VARIABLES	(1) In migration IV1	(2) In migration IV2	(3) In migration IV1	(4) In migration IV2	(5) In migration IV1	(6) In migration IV2
(log) Weekly Wages	0.140***	0.146***				
	(0.0430)	(0.0391)				
Unemployment rate			-0.170***	-0.186***		
			(0.0413)	(0.0405)		
Employment rate					0.176***	0.178***
					(0.0418)	(0.0380)
Observations	1,260	1,260	1,260	1,260	1,260	1,260
year FE	yes	yes	yes	yes	yes	yes
metarea FE	yes	yes	yes	yes	yes	yes
widstat	32.04	27.59	62.58	39.05	54.29	52.48

Notes: Robust standard errors reported. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

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Explaining Cadena and Kovak (2016)

Cadena and Kovak (2016) run versions of the following between 2006 and 2010.

$$\Delta \ln \text{Natives}_c = \alpha_1 + \beta_1 \text{Economic Shock}_c + \epsilon_c$$

$$\Delta \ln \text{Mexicans}_c = \alpha_2 + \beta_2 \text{Economic Shock}_c + \varepsilon_c$$

where the the "Economic Shock" can be the change in employment levels, possibly instrumented by debt to income ratio at the metropolitan area c.

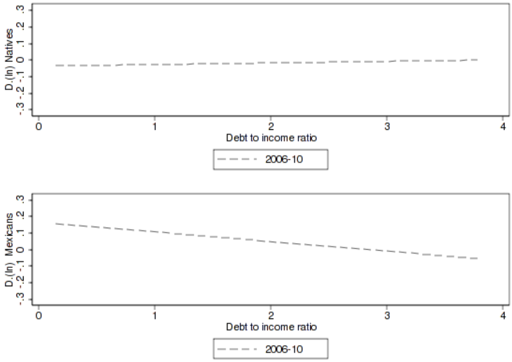
Their findings:

- $\beta_1 \approx 0$ and $\beta_2 < 0$
- They conclude that Mexicans respond to the local economic shocks, while native don't

What happens when we run the exact same regressions but between 2000 and 2006?

Explaining Cadena and Kovak (2016), their evidence

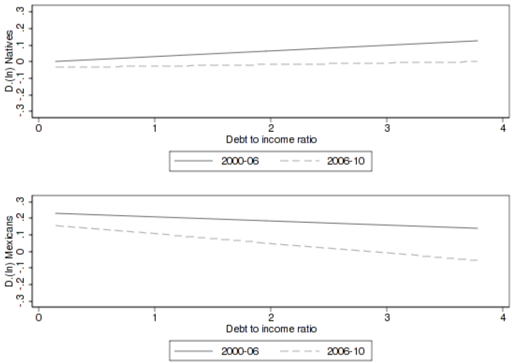
1. **No decline** of native low skilled population in high shocked cities
2. **Decline** of Mexican in high shocked cities



Notes: This graph shows the fitted values of the regression $\Delta \ln \text{Natives}_c = \alpha_1 + \beta_1 \text{Debt to Income ratio}_c + \epsilon_c$ and $\Delta \ln \text{Mex}_c = \alpha_2 + \beta_2 \text{Debt to Income ratio}_c + \epsilon_c$ between 2006-2010.

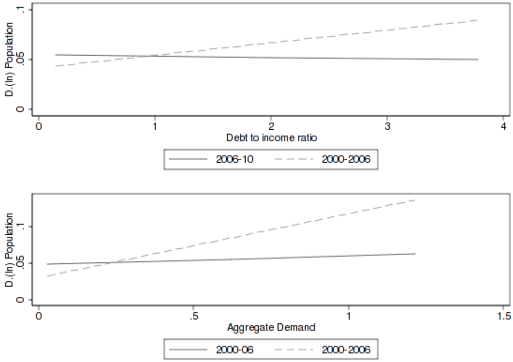
Low skilled natives and Mexicans: Same change in trends

1. The change in population across cities between 2000 and 2006 is similar between natives and Mexican low skilled workers



Notes: This graph shows the fitted values of the regression $\Delta \ln \text{Natives}_c = \alpha_1 + \beta_1 \text{Debt to Income ratio}_c + \epsilon_c$ and $\Delta \ln \text{Mex}_c = \alpha_2 + \beta_2 \text{Debt to Income ratio}_c + \epsilon_c$ between 2006-2010 and between 2000 and 2006.

Change in population trends



Notes: This graph shows the fitted values of the regression $\Delta \ln \text{Pop}_c = \alpha_1 + \beta_1 \text{Debt to Income ratio}_c + \epsilon_c$ and $\Delta \ln \text{Pop}_c = \alpha_2 + \beta_2 \text{Aggregate Demand}_c + \epsilon_c$ between 2006-2010 and between 2000 and 2006.

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Internal migration and city size

Table: Internal migration and city size

VARIABLES	(1) (ln) In migrants OLS	(2) (ln) In migrants OLS	(3) (ln) Out migrants OLS	(4) (ln) Out migrants OLS	(5) (ln) In migrants OLS	(6) (ln) In migrants OLS	(7) (ln) Out migrants OLS	(8) (ln) Out migrants OLS
(ln) Population	0.854***	0.919***	0.922***	0.908***	0.849***	0.891***	0.920***	0.878***
	(0.0406)	(0.0355)	(0.0182)	(0.0172)	(0.0391)	(0.0351)	(0.0174)	(0.0177)
Observations	474	474	474	474	474	474	474	474
R-squared	0.821	0.732	0.931	0.805	0.859	0.818	0.964	0.929
Time FEs	no	no	no	no	yes	yes	yes	yes
Weights	yes	no	yes	no	yes	no	yes	no

Notes: Robust standard errors clustered at the metropolitan area reported. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. All the coefficients are significantly smaller than 1.

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Beveridge curve, Job creation and Wage curve

1. Equilibrium condition is that unemployment growth is 0:

$$s(1-u_c) = u_c^{\eta} v_c^{1-\eta}$$

So:

$$u_c = \frac{s}{s + \theta_c^{1+\eta}} \tag{19}$$

where $\theta_c = v_c/u_c$ is the labor market tightness.

2. The zero profit condition determines the job creation equation:

$$r_c - w_c - \frac{(i_c + s) r_c f}{\theta_c^{\eta}} = 0 \tag{20}$$

3. Nash bargaining between firms and workers (with weight β):

$$w_c = (1-\beta) b_c + \beta r_c (1 + f\theta_c) \tag{21}$$

These 3 equations determine $\{u_c, \theta_c, w_c\}$ in each local labor market.

Importantly: The revenue flow per worker is given by $r_m = p_m(1-\theta_m) B_m Q_m^{\frac{1}{\sigma}} L_c^{-\frac{1}{\sigma}}$

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Moving Costs

The flows implied by a model with moving costs can be written as:

$$P_{m,m'} = N_m * \frac{V_{m,m'}^{1/\lambda}}{\sum_{j \in M} V_{m,j}^{1/\lambda}}$$

where

$$\ln V_{m,m'} = \ln A_{m'} + \ln \omega_{m'} - \ln F_m = \ln V_{m'} - \ln F_m$$

Using this expression we obtain:

$$P_{m,m'} = N_m * \frac{(V_{m'}/F_m)^{1/\lambda}}{V_m^{1/\lambda} + \sum_{j \neq m'} (V_j/F_m)^{1/\lambda}}$$

We need to compare this expression to what we derived in the model:

$$P_{m,m'} = N_m * \frac{\eta V^{1/\gamma}}{(1-\eta) V_m^{1/\gamma} + \eta V^{1/\gamma}} \frac{V_{m'}^{1/\lambda}}{V^{1/\lambda}}$$

Moving Costs 2

For these expressions to represent the same flows we need them to be equal, so:

$$\frac{(V_{m'}/F_m)^{1/\lambda}}{V_m^{1/\lambda} + \sum_{j \neq m'} (V_j/F_m)^{1/\lambda}} = \frac{\eta V^{1/\gamma}}{(1-\eta)V_m^{1/\gamma} + \eta V^{1/\gamma}} \frac{V_{m'}^{1/\lambda}}{V^{1/\lambda}}$$

So we would need:

$$F_m^{1/\lambda} = \frac{\frac{(1-\eta)V_m^{1/\gamma} + \eta V^{1/\gamma}}{\eta V^{1/\gamma - 1/\lambda}} + V_{m'}^{1/\lambda} - V^{1/\lambda}}{V_m^{1/\lambda}}$$

Note that if $1/\gamma = 0$ then:

$$F_m^{1/\lambda} = \frac{\frac{(1-\eta)}{\eta} V^{1/\lambda} + V_{m'}^{1/\lambda}}{V_m^{1/\lambda}} = \frac{(1-\eta)}{\eta} (V/V_m)^{1/\lambda} + (V_{m'}/V_m)^{1/\lambda}$$

Comments on fixed costs of moving

From the previous expressions we observe that:

- There is non 1 to 1 mapping
- This expression also highlights the high value of previous estimates of moving costs. We established that η is around 5 percent, and λ is around 2.56, and we can assume that $V_{m'}/V_m$ is roughly 1, for similarly sized cities.
  Then:

$$F_m^{1/2.56} = \frac{0.95}{0.05}(V/V_m)^{1/2.56} + (V_{m'}/V_m)^{1/2.56}$$

or

$$F_m \approx (\frac{0.95}{0.05})^{2.56}(V/V_m) + 1 \approx 1878 * (V/V_m) + 1 \approx 1878 * M + 1$$

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Time	Wage convergence	Population convergence
	$\sigma = 0.5$	
5 years	0.828	0.828
10 years	0.991	0.991
15 years	1.000	1.000
	$\sigma = 0.7$	
5 years	0.700	0.700
10 years	0.961	0.961
15 years	0.995	0.995
	$\sigma = 0.9$	
5 years	0.607	0.608
10 years	0.919	0.919
15 years	0.984	0.984
	$\sigma = 1.1$	
5 years	0.540	0.541
10 years	0.876	0.877
15 years	0.967	0.967
	$\sigma = 1.3$	
5 years	0.489	0.491
10 years	0.836	0.837
15 years	0.949	0.949
	$\sigma = 1.5$	
5 years	0.450	0.452
10 years	0.801	0.802
15 years	0.930	0.930
	$\sigma = 1.7$	
5 years	0.420	0.421
10 years	0.770	0.771
15 years	0.911	0.912

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