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The effects of immigration on convergence dynamics in the US

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Motivation of the paper

Large-scale immigration to the US resumed in the 1970s and continued steadily until the recent recession:

→ the foreign born population rose from 9.6 million in 1970 (4.7 percent of total population) to 40.0 million (or 12.9 percent) in 2010

In general, immigrant flows exert

- a downward pressure on wages of workers of similar characteristics
- an upward pressure on wages of workers with different characteristics

These flows are quite heterogeneously distributed across skills and space

⇒ immigrant flows are likely to yield very important redistributive effects between groups of workers and between different areas of the country

→ the latter aspect, however, has been largely neglected

Basic theoretical framework

Almost all empirical studies quantify the wage impact of immigrants using a simple theoretical framework in which output is realized according to

$$Y = AL^{\alpha}K^{1-\alpha}$$

assuming

- $L = E\phi(s)$ where E is the generic number of employed workers while $\phi(s)$ is an index of skill intensity

$$\phi(s) = \left[\sum_{j=1}^{S} \beta_j s_j^{\rho}\right]^{\frac{1}{\rho}}$$

  in which s_j is the share in E of skill level j
- at each skill level j

$$L_j \equiv Es_j = \left(N_j^{\frac{\sigma-1}{\sigma}} + \phi M_j^{\frac{\sigma-1}{\sigma}}\right)^{\frac{\sigma}{\sigma-1}}$$

  where σ is the elasticity of substitution between immigrants (M) and natives (N)

Empirical implications from the basic framework

Profit maximization under perfect competition and absence of externalities yield, in the steady-state, the following main implications for the empirical analysis:

- no long run effects of labor supply and, hence, immigrant flows on the average wage
  - $\rightarrow$ the average wage grows at a constant rate equal to $1/\alpha$ times the growth rate of TFP
- relative wage effects largely depend on the assumption on σ
- need to distinguish between partial and total effects on wages
  - partial effects (i.e., direct impact on wage of workers with the same skill, assuming labor supply of other skills stays constant):
    - if σ is infinite: negative impact on wages of less-educated natives (Borjas, 2003; Borjas and Katz, 2007)
    - if σ is positive but finite: small but positive effect on wages of less-educated natives; positive effect on the average wage of natives; strong, negative effect on immigrants that entered the country previously (Card 2009; Ottaviano and Peri, 2012)
  - total effects (i.e., allow for the indirect impacts in all other groups) depend on:
    - relative sizes of skill groups
    - partial wage effects
    - skills profile of migrants

Empirical implications from more general frameworks

In addition, by relaxing assumptions in the basic framework, it is possible to allow for dynamic effects of immigrant flows on TFP via:

- the endowment of human capital and innovative capacity (Gagliardi, 2015; Hunt and Gauthier-Loiselle, 2010; Niebhur, 2010)
- the productivity of natives induced by increased cultural diversity (Peri, 2005 and 2006)
- dynamic effects stemming from reorganization of production (Peri, 2012)

In other words, immigration can yield static and dynamics changes in productivity due to changes in:

- skill composition of the workforce
- organization of production across skills
- capital intensity
- innovative capacity

Redistributive effects of immigration

Immigrant flows are quite heterogenously distributed across

- **skills**: in 2010, immigrants are
  - much more likely than natives to have low levels of schooling (32% for immigrants; 11% for natives)
  - as likely as natives to be highly educated (27% for immigrants; 28% for natives)
  - underrepresented in the middle of the skill distribution (41% for immigrants, 61% for natives)
- **space**: new migrants tend to choose destinations where they have strong networks, the so-called "gateway-states". In 2010:
  - about 65% of the total foreign-born population lived in just six states (California, New York, Texas, Florida, New Jersey and Illinois)
  - over one-fourth of the total foreign-born population lived in California

Whatever the adopted theoretical framework, immigrant flows are likely to yield very important redistributive effects across individuals and across areas of the country

Content of the analysis

Aim: identify the impact of large-scale immigration on convergence dynamics among the US states by:

1. determining the effects of migrations on Gross State Product (GSP) per worker, employment and population
2. analyzing convergence dynamics using predicted and counterfactual data on GSP per capita and GSP per worker

We pay some attention to spatial effects:

- the location of immigrants is not random: destination depends, among other things, on distance from the entry point
- states are not islands: the evolution of GSP of a state depends, among other things, on the behavior of neighboring economies via trade, information and factor flows

Outline of the empirical analysis

1. determine the effect of international migrations on GSP
   a. IV estimate of the elasticities of GSP per worker, employment and population with respect to immigration
      - growth of immigrants is instrumented

   b. use estimated elasticities to calculate:
      - predicted values of GSP per capita and GSP per worker
      - counterfactual values of GSP per capita and GSP per worker based on hypothetical scenarios on immigration flows

2. analyze convergence using Distribution Dynamics (DD) analysis
   - employ a spatial nonparametric estimator to adjust the mean function (Hyndman *et al.*, 1996)
   - study convergence among US states using predicted data
   - establish the role of international migrations on convergence using counterfactual data

Effects of migrations on GSP

considering state s in year t

1. decompose the growth rate of output per capita

$$\text{define } y_{st} \equiv \frac{Y_{st}}{P_{st}} \quad \Rightarrow \quad \frac{\Delta y_{st}}{y_{st}} = \frac{\Delta Y_{st}}{Y_{st}} - \frac{\Delta P_{st}}{P_{st}}$$

$$\text{define } \tilde{y}_{st} \equiv \frac{Y_{st}}{L_{st}} \quad \Rightarrow \quad \frac{\Delta Y_{st}}{Y_{st}} = \frac{\Delta \tilde{y}_{st}}{\tilde{y}_{st}} + \frac{\Delta L_{st}}{L_{st}}$$

$$\Rightarrow \quad \frac{\Delta y_{st}}{y_{st}} = \frac{\Delta \tilde{y}_{st}}{\tilde{y}_{st}} + \frac{\Delta L_{st}}{L_{st}} - \frac{\Delta P_{st}}{P_{st}}$$

2. determine the impact of immigration via an IV estimate of

$$\frac{\Delta b_{st}}{b_{st}} = d_t + d_s + \eta_b \frac{\Delta L^F_{st}}{L_{st}} + \epsilon_{st}$$

where:

b_{st} is alternatively $\tilde{y}$, L or P; d_t and d_s are decade and state dummies

$\frac{\Delta L^F_{st}}{L_{st}}$, the growth rate of employment due to immigrants, is instrumented

instruments: immigrant workers imputed growth and info on spatial structure

estimated elasticities $\hat{\eta}_P$, $\hat{\eta}_L$ and $\hat{\eta}_{\tilde{y}}$ are then used to calculate:

- per capita GSP predicted by the model
- counterfactual per capita GSP based on hypothetical scenarios on immigration flows

which represent the inputs for the DD analysis

Distribution Dynamics

Convergence is analyzed using the Distribution Dynamics approach:

- let $F(Y_t)$ and $F(Y_{t+s})$ represent the cross-sectional distributions of per capita income at time t and $t+s$
- assume they admit a density $(f(Y_t)$ and $f(Y_{t+s})$ respectively)
- assuming the dynamics between time t and $t+s$ can be modeled as a first order process, then

$$f\left(Y_{t+s}\right)=\int_{-\infty}^{\infty} f\left(Y_{t+s}|Y_t\right)\ f\left(Y_t\right)\,dY_t$$

- convergence is assessed through:
  - an estimate of the **conditional density** (or stochastic kernel) $f\left(Y_{t+s}|Y_t\right)$
  - an estimate of the **ergodic** (or stationary) **distribution** (as $s\rightarrow\infty$), assuming that the process is Markov and time homogeneous

Conditional density: estimation issues

The *mean-bias* issue:

- the mean function, $M(Y_t)$, is the mean of the conditional density
- the properties of the conditional density estimator derive from those of the mean function estimator
- the mean function estimator implicit in the traditional kernel estimator of the conditional density (the local constant estimator) has poor bias properties (*mean-bias*)

$\Rightarrow$ Hyndman *et al.* (1996): replace the local constant estimator with a smoother with better bias properties

The *spatial dependence* issue:

- in convergence studies, $M(Y_t)$ is in fact an autoregression often affected by *spatial dependence* problems
- consequences of neglecting spatial dependence in the estimate of $M(Y_t)$ are also carried over onto the conditional density estimate

$\Rightarrow$ need for an estimator of the mean function that allows for spatial dependence

Conditional density estimation: the SNP estimator

The Spatial NonParametric (SNP) estimator (Gerolimetto and Magrini, 2016):

- a two-step procedure for nonparametric regression with spatially dependent data
- does not require *a priori* parametric assumptions on spatial dependence
- draws the information on the dependence structure from a nonparametric estimate of the spatial covariance matrix
- being developed from the local linear estimator, can be employed to estimate the mean function required in Hyndman's *mean-bias* adjustment

$\Rightarrow$ provides a way of dealing with both the *mean-bias* and the *spatial dependence* issues

Data

- 48 conterminous US states
- overall time span: 1960-2006
- sources:
  - most data come from Peri (2012)
  - population data are from US Bureau of the Census

IV regression analysis

- dependent variables: average growth rate by decade of GSP per worker, employment and population
- explanatory variable: net inflow of immigrant workers over a decade as a percentage of initial employment
- instruments:
  - inverse of distance from the Mexico-US border interacted with decade dummies
  - inverse of distance from Los Angeles interacted with decade dummies
  - imputed net inflow of immigrant workers over a decade as a percentage of initial employment
    - → imputed net inflow: weighted average of nationwide immigrant workers inflow by 10 different origin areas, with weights reflecting their location-specific share in 1960

Data

Distribution Dynamics analysis

- GSP per capita and GSP per worker as predicted by the regression models
  - → convergence dynamics reflect, among other things, the effect of immigration
- counterfactual values of GSP per capita and GSP per worker:
  1. emphasize the effect arising from the 6 traditional "gateway-states" (California, Florida, Illinois, New Jersey, New York and Texas)
     - → in each decade and for all states but the 6 "gateway-states", employment growth due to immigrants is set equal to the corresponding cross-sectional average (net of growth occurring in the gateways)
  2. emphasize the effect arising from secondary migration flows (from the 1990s)
     - → since 1990, in each decade and for all states but the 4 main flows recipients (Nevada, Arizona, Georgia and North Carolina), employment growth due to immigrants is set equal to the corresponding cross-sectional average (net of growth occurring in the gateways)
  3. neutralize the differential effect of immigration
     - → in each decade and for all states, employment growth due to immigrants is set equal to the cross-sectional average
- orthodromic distance between state capitals

Estimated elasticities

2SLS Estimates of the Impact of Immigration

	GSP per worker	Employment	Population
coefficient	0.9244	1.0387	1.1136
s.e.	0.1641	0.2722	0.1399
p-value	0.00	0.00	0.00

Notes: 2SLS estimates are obtained using inverse of distance from the Mexican border and Los Angeles (both interacted with decade dummies) as well as imputed immigrants as instruments. Each dependent variable is measured as the percentage variation over an intercensus period; the explanatory variable is the net inflow of immigrant workers over an intercensus period as a percentage of the initial employment.

p-values of Moran's I on Regression Residuals

	GSP per worker	Employment	Population
1960-1970	0.00	0.32	0.00
1970-1980	0.03	0.00	0.00
1980-1990	0.00	0.00	0.01
1990-2000	0.95	0.05	0.00
2000-2006	0.22	0.08	0.00

Notes: the test employs a 5-nearest neighbor spatial-weighting matrix.

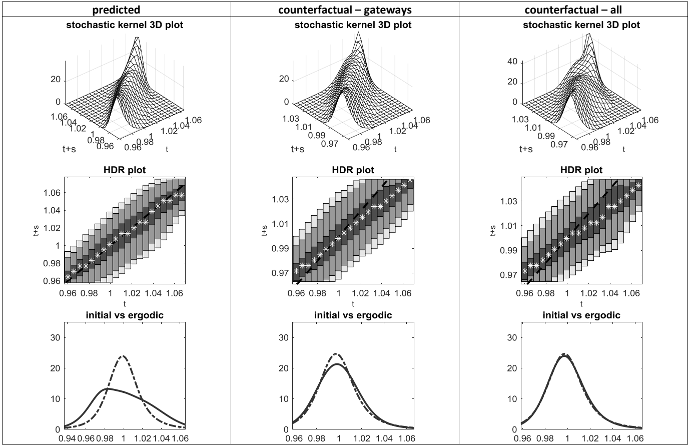
Mean function estimate - spatial dependence

p-values of Moran's I on data and nonparametric regression residuals

	GSP per capita	GSP per worker
Data		
1970 (predicted)	0.00	0.00
1990 (predicted)	0.00	0.00
2006 (predicted)	0.01	0.03
2006 (counterfactual - gateways)	0.01	0.16
2006 (counterfactual - all)	0.00	0.06
Mean function estimate - NP regression residuals		
1970 (predicted) - 2006 (predicted)	0.00	0.00
1970 (predicted) - 2006 (counterfactual - gateways)	0.00	0.00
1970 (predicted) - 2006 (counterfactual - all)	0.00	0.00
1990 (predicted) - 2006 (predicted)	0.00	0.00
1990 (predicted) - 2006 (counterfactual - second migration)	0.30	0.18
1990 (predicted) - 2006 (counterfactual - all)	0.00	0.01
Mean function estimate - SNP regression residuals		
1970 (predicted) - 2006 (predicted)	0.47	0.97
1970 (predicted) - 2006 (counterfactual - gateways)	0.28	0.34
1970 (predicted) - 2006 (counterfactual - all)	0.10	0.26
1990 (predicted) - 2006 (predicted)	0.19	0.52
1990 (predicted) - 2006 (counterfactual - second migration)	0.25	0.83
1990 (predicted) - 2006 (counterfactual - all)	0.01	0.21

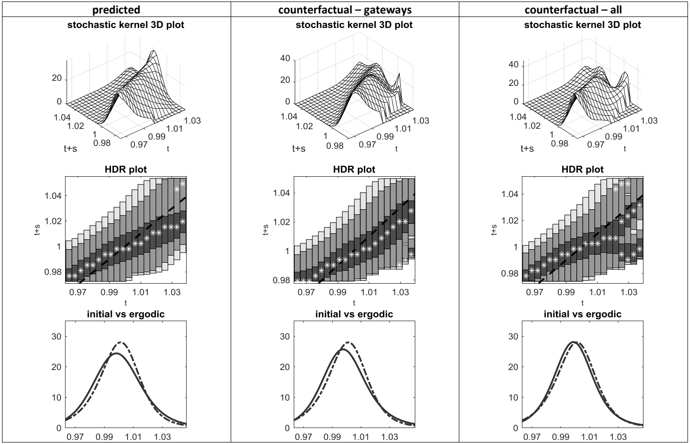
Notes: the test employs a 5-nearest neighbor spatial-weighting matrix.

Distribution Dynamics of GSP per capita – 1970-2006



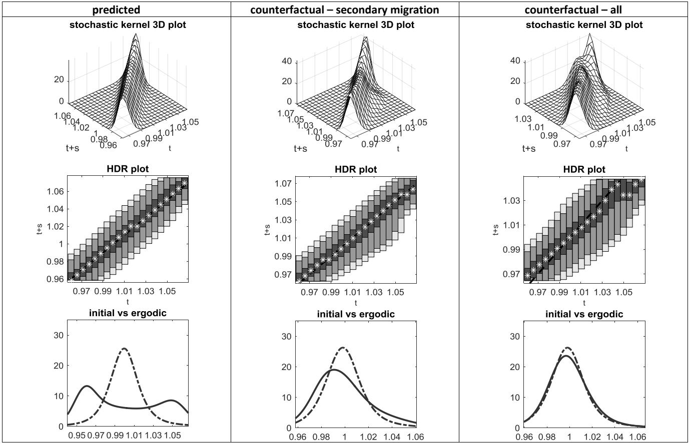
	predicted		counterfactual traditional gateways		counterfactual all	
	CV	IR	CV	IR	CV	IR
ergodic	0.0315	0.0492	0.0204	0.0303	0.0189	0.0266
Δ from 1970	0.0092	0.0223	0.0002	0.0043	-0.0013	0.0006
	statistic	p-value	statistic	p-value	statistic	p-value
Cramér-von Mises	2.3173	0.0000	0.0929	0.6684	0.0054	1.0000

Distribution dynamics of GSP per worker – 1970-2006



	predicted		counterfactual traditional gateways		counterfactual all	
	CV	IR	CV	IR	CV	IR
ergodic	0.0180	0.0265	0.0177	0.0249	0.0161	0.0219
Δ from 1970	0.0018	0.0043	0.0014	0.0027	-0.0002	-0.0003
	statistic	p-value	statistic	p-value	statistic	p-value
Cramér-von Mises	0.2339	0.2187	0.2738	0.1656	0.1348	0.4682

Distribution dynamics of GSP per capita – 1990-2006



	predicted		counterfactual secondary migration		counterfactual all	
	CV	IR	CV	IR	CV	IR
ergodic	0.0249	0.0445	0.0201	0.0307	0.0192	0.0272
Δ from 1990	0.0077	0.0214	0.0030	0.0076	0.0000	0.0032
	statistic	p-value	statistic	p-value	statistic	p-value
Cramér-von Mises	11.8003	0.0000	1.1054	0.0020	0.0528	0.9168

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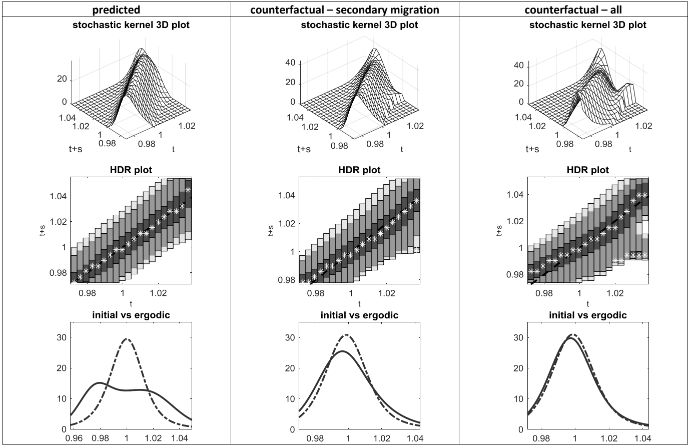
Distribution dynamics of GSP per worker – 1990-2006



	predicted		counterfactual secondary migration		counterfactual all	
	CV	IR	CV	IR	CV	IR
ergodic	0.0169	0.0291	0.0147	0.0233	0.0135	0.0201
Δ from 1990	0.0038	0.0109	0.0019	0.0053	0.0006	0.0021
	statistic	p-value	statistic	p-value	statistic	p-value
Cramér-von Mises	4.0541	0.0000	0.3395	0.1072	0.0644	0.8461

Conclusions

Regression analysis

- estimates
  - immigration stimulates employment, productivity and population growth
  - the three elasticities are close to 1
  - with respect to Peri's estimates:
    - → $\hat{\eta}_{\tilde{y}}$ is slightly higher (0.92 vs 0.88)
    - → $\hat{\eta}_{N}$ is slightly lower (1.04 vs 1.09)
    - → our estimates are statistically more significant
- spatial dependence
  - little evidence of spatial dependence in the residuals of the regressions on employment and productivity growth
  - evidence of spatial dependence in the residuals of the regressions on population growth

Conclusions

Distribution dynamics

- divergence between 1970 and 2006
  - stronger between 1990 and 2006
  - stronger for income per capita than for income per worker
- counterfactual analysis suggests the inflow of migrants played an important role:
  - neutralizing the differential role of immigrant flows almost completely eliminates divergence
    - → suggests that the skill composition of immigrant flows plays no role in the explanation of divergence
  - divergence cannot be attributed to the role of traditional gateway states
  - divergence is (only partially) attributable to secondary migration
    - → suggests that inter-state migrations do not play an equilibrating role, given that secondary migration tends to behave as migration of natives
- spatial dependence:
  - need to employ SNP in the mean-adjustment procedure