Immigration, Innovation, and Growth

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Motivation

- Canonical models suggest immigration (and population growth) should cause innovation, economic dynamism, and growth through new ideas, more effort, higher demand.
- Immigration is also the focus of major political controversies.
- Does immigration cause local economic dynamism, innovation, and growth?

A key challenge for identification:
Omitted factors jointly determine immigration,
AND innovation, dynamism, and growth.

Our approach:

- Isolate plausibly exogenous **immigration shocks** to US counties using 130 years of census data.

Literature

Identification: The Problem

Equation of interest:

$$Y_d^t - Y_d^{t-1} = \delta_t + \delta_s + \beta I_d^t + \epsilon_d^t$$

- But: Migrants are likely drawn to places that are innovative.

$\rightarrow$ OLS biased: $cov(I_d^t, \epsilon_d^t) \neq 0$. Need instrument.

- Conventional Card (2001)-type instrument: interaction of 'push factor' with 'social pull' factor in migration

$$I_{o,d}^t = \alpha + ... + \gamma \underbrace{I_o^t}_{\text{push}} \times \underbrace{A_{o,d}^{t-1}}_{\text{social}} + \nu_{o,d}^t$$

- But: Ancestry patterns likely correlated with unobserved factors linked to innovation (e.g.: Indian engineers in Silicon Valley).

$\Rightarrow$ Instrument Ancestry with historical interactions of push and economic pull factors. (Burchardi-Chaney-Hassan'19)

Identification: Economic Factors in Historical Migration

$$I_{o,d}^t = \alpha + ... + \gamma \underbrace{I_o^t}_{\text{push}} \times \underbrace{A_{o,d}^{t-1}}_{\text{social}} + \nu_{o,d}^t$$

- Add economic pull factor: Migrants choose destinations that are attractive to the average migrant arriving at the time.
- The stock of ancestry cumulates as a function of historical immigration flows. Iterate to solve.

⇒ Instrument Ancestry with historical interactions of push and economic pull factors.

- To be extra safe, use broad leave-out categories, e.g.
  - Push: all migrants leaving o but settling in another region
  - Pull: fraction of European migrants settling in d

Identification: Economic Factors in Historical Migration

$$I_{o,d}^t = \alpha + \underbrace{I_o^t}_{\text{push}} \times (\theta \underbrace{I_d^t / I^t}_{\text{economic}} + \gamma \underbrace{A_{o,d}^{t-1}}_{\text{social}}) + \nu_{o,d}^t$$

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Identification: Economic Factors in Historical Migration

$$A_{o,d}^{t} = ... + \sum_{\tau=1880}^{t} \beta^{\tau} \underbrace{I_o^{\tau}}_{\text{push}} \underbrace{I_d^{\tau} / I^{\tau}}_{\text{economic}} + u_{o,d}^{t}$$

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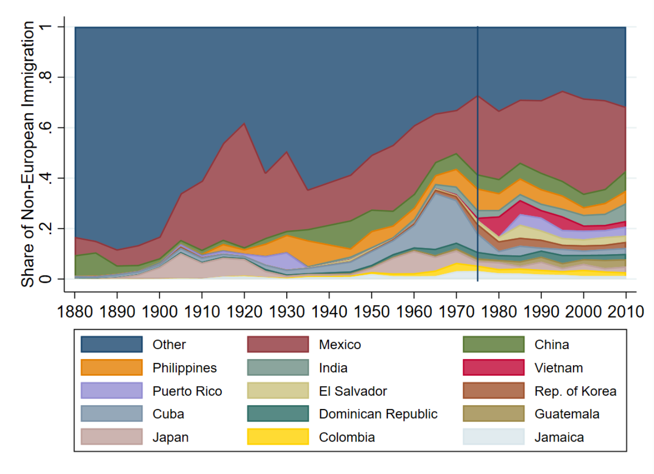
Push Factor

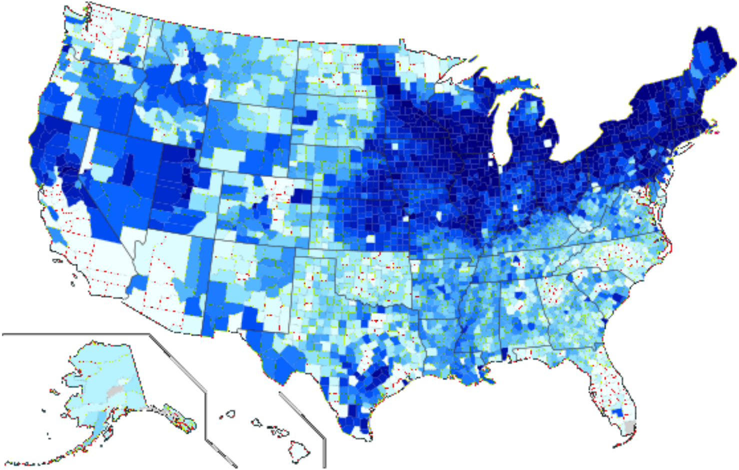
Top non-European origin countries



Notes: The figure shows the share of non-European immigration by origin country, breaking out migrants from the largest senders of migrants to the U.S. overall.

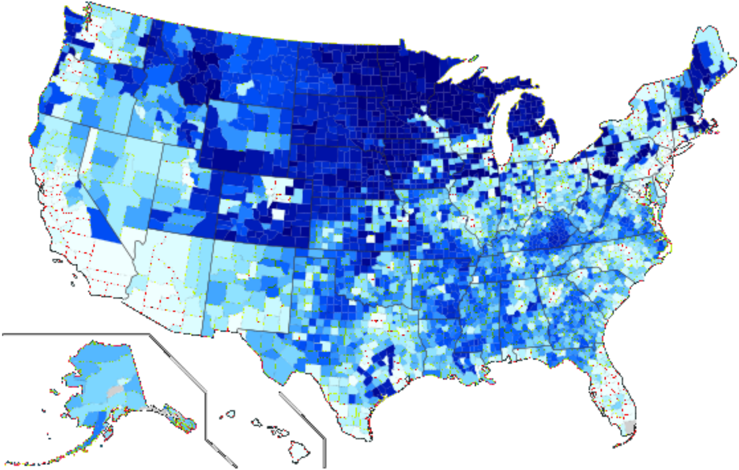
Economic Pull Factor

Destinations of Immigrants Pre 1880



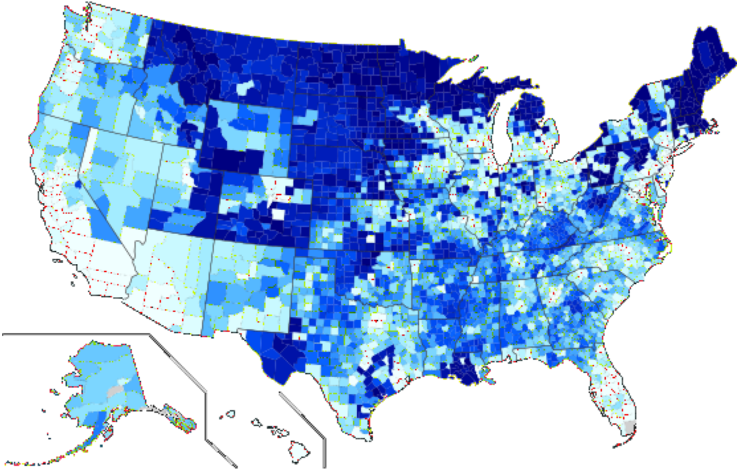
Economic Pull Factor

Destinations of Immigrants 1880-1890



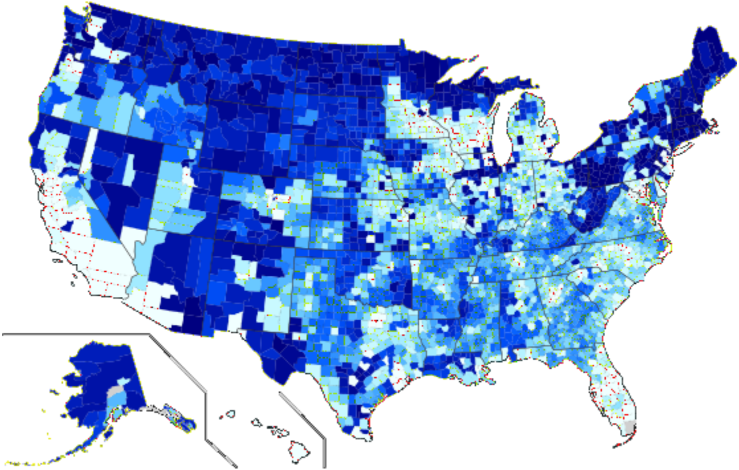
Economic Pull Factor

Destinations of Immigrants 1890-1900



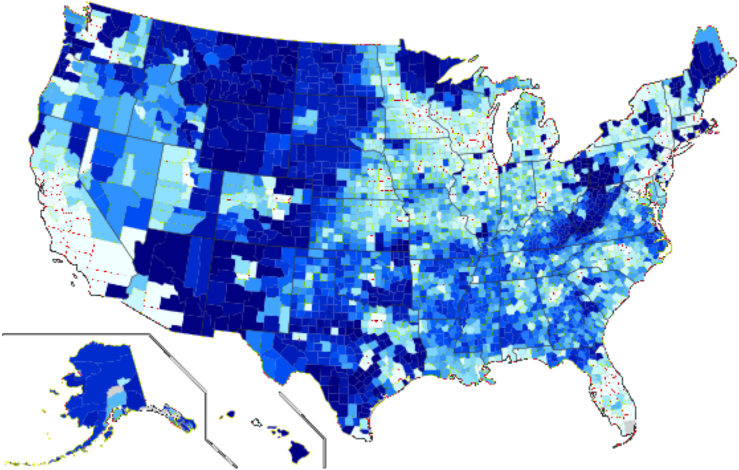
Economic Pull Factor

Destinations of Immigrants 1900-1910



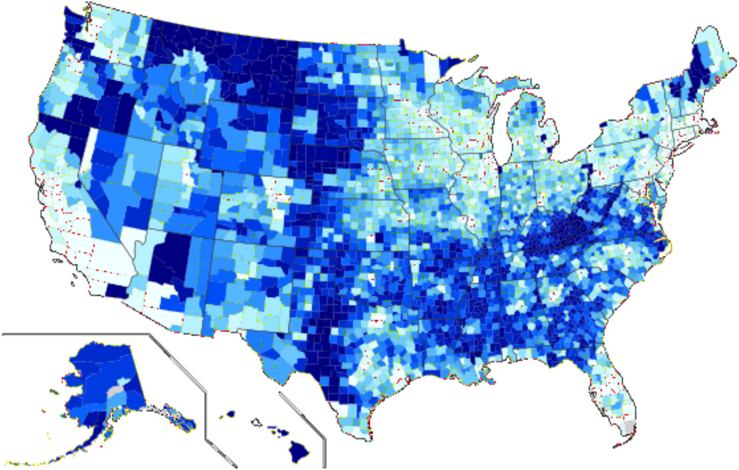
Economic Pull Factor

Destinations of Immigrants 1910-1920



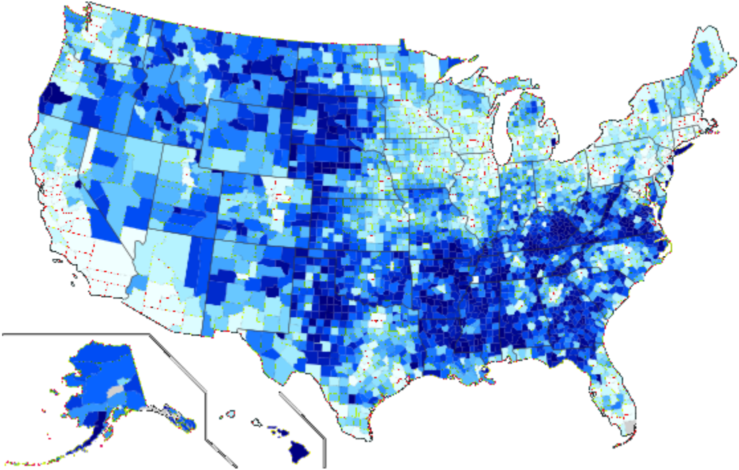
Economic Pull Factor

Destinations of Immigrants 1920-1930



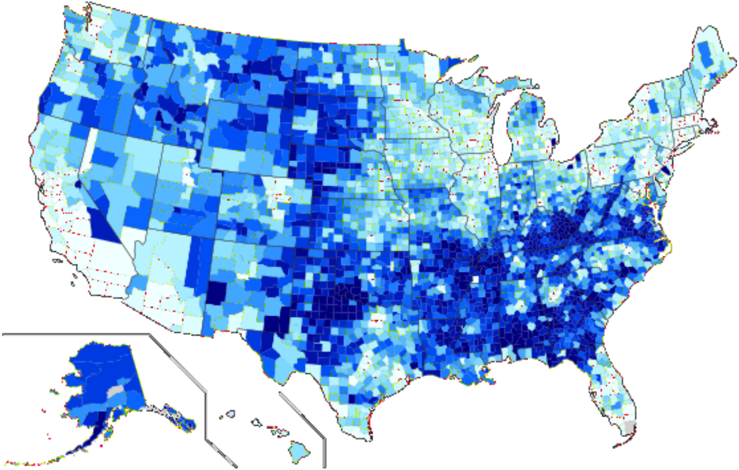
Economic Pull Factor

Destinations of Immigrants 1930-1950



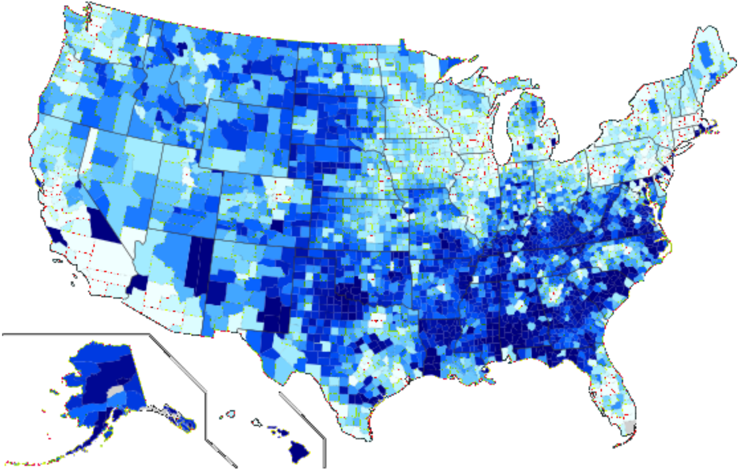
Economic Pull Factor

Destinations of Immigrants 1950-1960



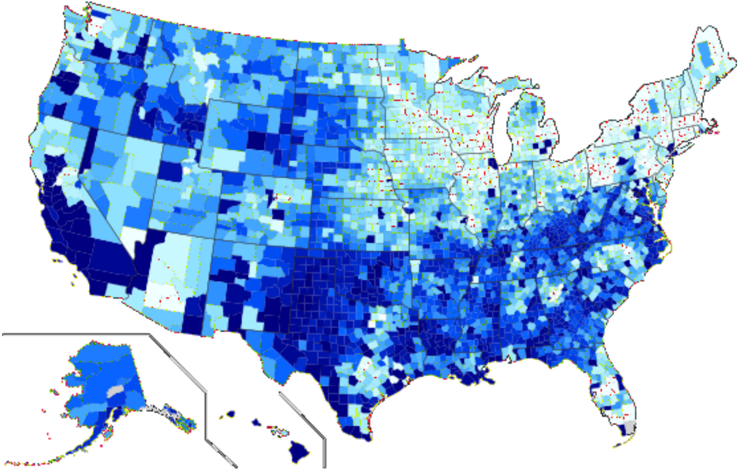
Economic Pull Factor

Destinations of Immigrants 1960-1970



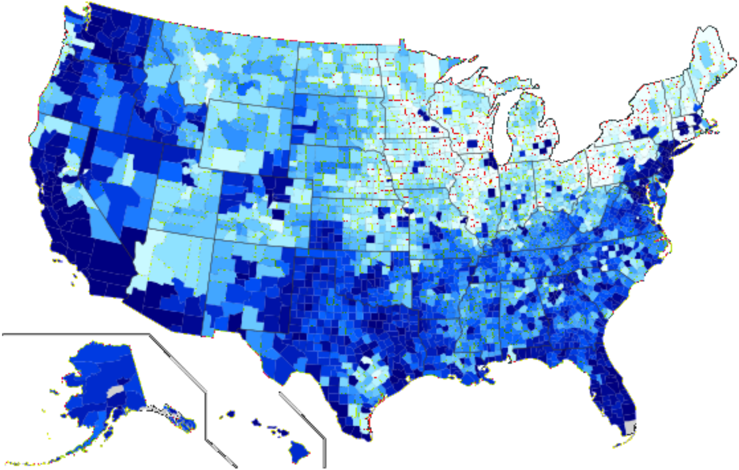
Economic Pull Factor

Destinations of Immigrants 1970-1980



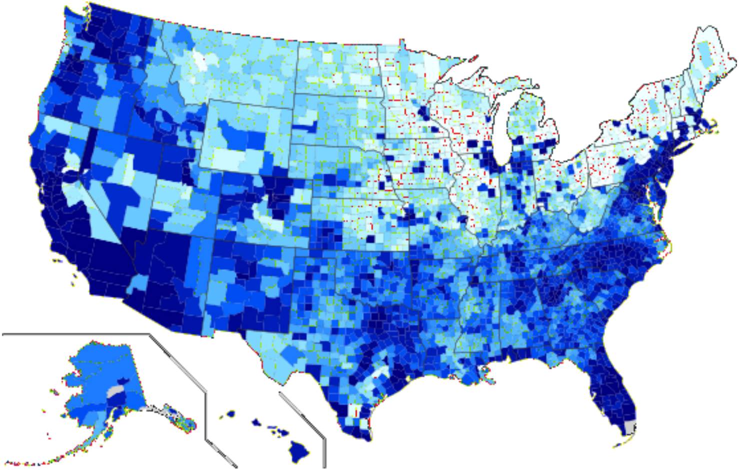
Economic Pull Factor

Destinations of Immigrants 1980-1990



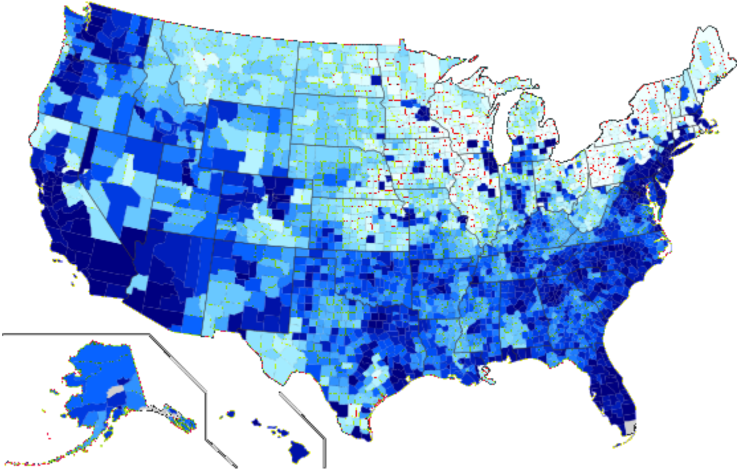
Economic Pull Factor

Destinations of Immigrants 1990-2000



Economic Pull Factor

Destinations of Immigrants 2000-2010



Construct an Instrument for I_d^t in 3 steps

Step 1 Construct instrumented ancestry as

$$\hat{A}_{o,d}^{t-1} = \sum_{\tau=1880}^{t-1} \hat{\beta}^{\tau} \left(I_{o,-r(d)}^{\tau} \frac{I_{Euro,d}^{\tau}}{I_{Euro}^{\tau}} \right)^{\perp}$$

Step 2 Use this exogenous variation in ancestry to fit a recursive model of migration (similar to Card shift-share).

$$I_{o,d}^{t} = X_{o,d}'\beta + \gamma[\hat{A}_{o,d}^{t-1} \times \tilde{I}_{o,-r(d)}^{t}] + \nu_{o,d}^{t}$$

Step 3 Sum predicted immigration across origins to isolate an exogenous **immigration shock** to county d at time t.

$$\hat{I}_d^t = \sum_{o} \hat{\gamma}[\hat{A}_{o,d}^{t-1} \times \tilde{I}_{o,-r(d)}^{t}].$$

Instrument Construction: Step 2

	$Immigration^t_{o,d}$				
	(1)	(2)	(3)	(4)	(5)
$\hat{A}^{1975}_{o,d} \times \tilde{I}^{1980}_{o,-r(d)}$	0.0036***	0.0036***	0.0035***	0.0035***	0.0035***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$\hat{A}^{1980}_{o,d} \times \tilde{I}^{1985}_{o,-r(d)}$	0.0016***	0.0016***	0.0016***	0.0016***	0.0016***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$\hat{A}^{1985}_{o,d} \times \tilde{I}^{1990}_{o,-r(d)}$	0.0018***	0.0018***	0.0018***	0.0018***	0.0018***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$\hat{A}^{1990}_{o,d} \times \tilde{I}^{1995}_{o,-r(d)}$	0.0005***	0.0005***	0.0005***	0.0005***	0.0005***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$\hat{A}^{1995}_{o,d} \times \tilde{I}^{2000}_{o,-r(d)}$	0.0004***	0.0004***	0.0004***	0.0004***	0.0004***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$\hat{A}^{2000}_{o,d} \times \tilde{I}^{2005}_{o,-r(d)}$	0.0002***	0.0002***	0.0002***	0.0002***	0.0002***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$\hat{A}^{2005}_{o,d} \times \tilde{I}^{2010}_{o,-r(d)}$	0.0002***	0.0002***	0.0002***	0.0002***	0.0002***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
$I^t_{Euro,d}$				0.0109***	
				(0.0031)	
$I^t_{o,-r(d)} \frac{I^t_{Euro,d}}{I^t_{Euro}}$					0.3913**
					(0.1558)
N	3,583,881	3,583,881	3,583,881	3,583,881	3,583,881
R^2	0.656	0.657	0.709	0.709	0.709
Distance, Latitude Diff.	no	yes	yes	yes	yes
Region-Country FE	no	no	yes	yes	yes
County-Continent FE	no	no	yes	yes	yes
Time FE	no	no	yes	yes	yes

Notes: Standard errors are clustered by country.

Step 1: Time Step 1: County Step 3: Maps

Immigration and Innovation

	OLS	IV	IV
	5-year Difference in Patenting Rate post-1970		
Immigration_d^t	0.167**	0.101***	0.108***
	(0.080)	(0.031)	(0.033)
N	18,846	18,846	18,846
F-Stat		1,202	65
Geography FE	State	State	County
Time FE	Y	Y	Y

Notes: Standard errors are clustered by state.

- +12k migrants (1 s.d.) $\rightarrow$ +27% innovation (rel. to mean).

Identifying Assumption

Any confounding factors that correlate with increases in a given county's innovation or dynamism post-1975 do not also correlate systematically with past instances of the interaction of the settlement of European migrants with the total number of migrants arriving from a set of non-European origins who settle in other US census regions and modern immigration from those non-European origins to other US census regions.

A confounding factor causing, say, Indian migration to Silicon Valley (Santa Clara County) in 2010 **must also systematically correlate with**

- historical Indian migration to **other** Census divisions (push factor)
- historical **European** migration to Silicon Valley (repeatedly across decades and in large-enough numbers to sway averages) (pull factor)
- 2010 Indian migration to **other** Census divisions.

It could also **not reflect**

- **Silicon-Valley-specific** average innovation or immigration levels,
- **California-specific** trends in innovation or immigration,
- or **any common** shifts across counties in 2010.

Robustness

- Obtain almost identical results when we use other reasonable leave-out categories or hold constant $A_{o,d}^{1975}$.
- Do not suffer from issues relating to correlation between pre-existing shares and the error term (Adao & al., 2018).
- Results not driven by specific origins, destinations.
- Results hold with county FE, "bad" controls.
- Use population growth as endogenous variable.
- Alternative functional forms.
- Timing placebo, dynamics.

Dynamism & Income Growth

	5-Year Difference in:				10-year Diff. Wages of	
	Job Creation Rate	*Job Destruction Rate*	*Job Growth Rate Skewness*	*Average Annual Wage*	*Natives*	*Native Non-Movers*
	(1)	(2)	(3)	(4)	(5)	(6)
Immigration$_d^t$	0.176***	0.152***	0.019***	0.083***	0.049***	0.056***
	(0.033)	(0.035)	(0.004)	(0.019)	(0.016)	(0.020)
N	6,600	6,600	12,564	21,976	9,411	6,274
First Stage F-Stat	951	951	151	1,202	750	1,178
Controls:						
Geography FE	state	state	state	state	state	state
Time FE	yes	yes	yes	yes	yes	yes

Notes: Standard errors are clustered by state.

- 12k more migrants (1 s.d.) $\rightarrow$ +7% more job creation (relative to mean), +11% job destruction, +3% job growth skewness, 5% higher per capita wage growth.

Education & Immigration's Effect on Innovation

- Generalize IV to instrument separately for effect of education.
- Leverage dramatic differences in education across origins and over time.
- Run a separate **first stage**

$$Education_d^t = \delta_s + \delta_t + \sum_{o=1}^{20} \kappa_o \hat{I}_{o,d}^t + \nu_d^t$$

where $Education_d^t$ is the total number of years of education of adult immigrants to d at t

- to then disentangle in the **second stage**

$$Y_d^t - Y_d^{t-1} = \delta_s + \delta_t + \beta \widehat{Immigration}_d^t + \gamma \widehat{Education}_d^t + \epsilon_d^t$$

Education & Innovation

	5-year Difference in:			
	Patenting		*Avg. Annual Wage*	
	(1)	(2)	(3)	(4)
Immigration$_d^t$	0.200***		0.290***	
	(0.070)		(0.058)	
Average Years Education$_d^t$ $\times$ Immigration$_d^t$	0.221***		0.231***	
	(0.068)		(0.051)	
$\mathbf{1}\{$Low Avg. Education$\}$ $\times$ Immigration$_d^t$		1.863		-0.296
		(4.539)		(0.249)
$\mathbf{1}\{$Medium Avg. Education$\}$ $\times$ Immigration$_d^t$		0.084*		0.189***
		(0.044)		(0.069)
$\mathbf{1}\{$High Avg. Education$\}$ $\times$ Immigration$_d^t$		1.401*		1.514***
		(0.792)		(0.473)
N	18,846	18,846	21,976	21,976

Notes: All specifications include state and time fixed effects. Standard errors are clustered by state.

- Reduced-form effects of highly educated migrants approx 8$\times$ and 6$\times$ larger than (local) average effect.

Regional Spillovers

	5-year Difference in:			
	Patenting		*Avg. Annual Wage*	
	(1)	(2)	(3)	(4)
Immigration_d^t	0.107***	0.080**	0.093***	0.054***
	(0.035)	(0.037)	(0.026)	(0.018)
$\text{Immigration}_{State}^t$	0.001***		0.000	
	(0.000)		(0.001)	
Immigration^t within 100km		0.056***		0.061***
		(0.018)		(0.022)
Immigration^t within 250km		0.014***		-0.006
		(0.005)		(0.011)
Immigration^t within 500km		0.006		-0.001
		(0.005)		(0.008)
N	18,846	18,846	21,976	21,976
First Stage F-Stat d	1,792	6,065	2,289	7,967
First Stage F-Stat Spillover	470	383	434	395
First Stage F-Stat Spillover		150		157
First Stage F-Stat Spillover		66		67

Notes: All specifications include census division and time fixed effects. Standard errors are clustered by state.

Conclusion

- We study the short-term impact of immigration on innovation, dynamism, and growth at the local level.
- Identify plausibly exogenous shocks to immigration shocks at the county level 1975-2010.
- Find that more immigration causes
  - more innovation (patents per person)
  - more dynamism and creative destruction
  - higher wages for native non-movers.
- More highly educated immigrants boost innovation by more.
- Immigration causes positive spillovers to nearby areas.

THANK YOU

Table: First Stage Regressions Varying Sample of Counties based on 1970 Population

Sample:	All	<95%	>5% and <95%	<95%	>5% and <95%
	(1)	(2)	(3)	(4)	(5)
			$Immigration_d^t$		
$\widehat{Immigration}_d^t$	2.100***	0.615***	0.619***		
	(0.061)	(0.105)	(0.105)		
$\widehat{Immigration}_d^{t,mid90}$					2.066***
					(0.390)
$\widehat{Immigration}_d^{t,bot95}$				2.064***	
				(0.378)	
N	21,987	20,881	19,775	20,881	19,775
F-Stat	1,202	34	35	30	28
R^2	0.777	0.190	0.195	0.336	0.336
Controls:					
State FE	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes

Notes: Standard errors are clustered by state.

BACKUP SLIDES

Step 1: Time | Step 1: County | Step 2: o-d | Step 3: Maps | Population Growth | Alt. IV
Constr. IV | Specific Countries | Controls | Educ. Wages | Spillovers Wages | Dynamics
Population Growth | Growth Model

Main Contributions

1. Isolate plausibly exogenous shocks to immigration 1975-2010.
2. Immigration causes a significant increase in local innovation, economic dynamism, and income growth.
3. The impact of immigration on innovation increases significantly with immigrants' schooling level.
4. The impact of immigration diffuses over space, with a fast spatial decay.

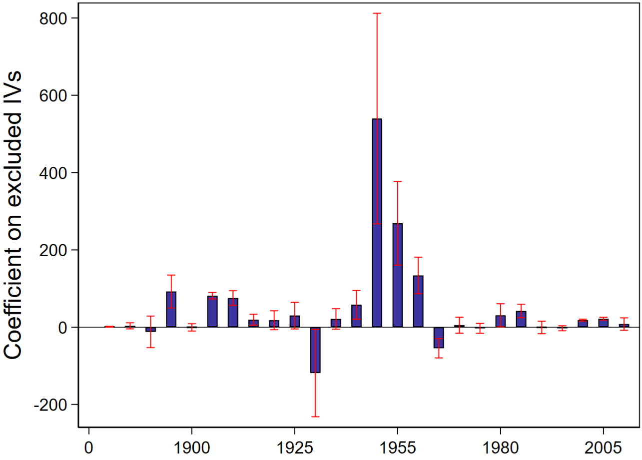
Return

Related Literature

- Endogenous growth & innovation mechanisms
  Aghion & Howitt 1992, Romer 1990, Peretto 1998, Young 1998, Jones 1995, Jones, et al. 2017
  - $\rightarrow$ Test short-term reduced-form predictions at county level
- Empirical work on declining dynamism in the US economy
  Decker, et al. 2014, Hathaway and Litan 2014, Alon, et al. 2018, Hopenhayn, et al. 2018, Karahan, et al. 2016
  - $\rightarrow$ Bring an identification strategy and a link to immigration
- Empirical work on the effects of immigration
  Altonji & Card 1991, Borjas 1999, Sequeira, Nunn, & Qian 2018, Akcigit, et al. 2017, Peters 2017
  - $\rightarrow$ Identify effects on local innovation, dynamism, and income growth.

Return

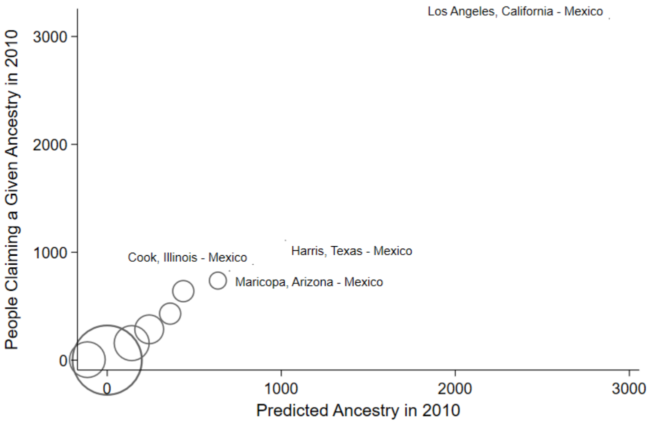
Step 1: Effect of historical push-pull on Ancestry today



Notes: Red lines give 95% confidence intervals. Standard errors are clustered at the origin country level. (F-stat 32,645.9, R^2 0.5041)

Return Add'l Slides

Step 1: Fit of Predicted Ancestry



Notes: This figure plots actual ancestry in 2010 against predicted ancestry, with the size of each circle indicating the log number of observations in a given bin of predicted ancestry. The labeled counties are those with the highest number of individuals declaring a given ancestry in 2010.

Return Add'l Slides

Step 2: Predicting Origin-by-Destination Immigration

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	(1)	(2)	(3)	(4)	(5)
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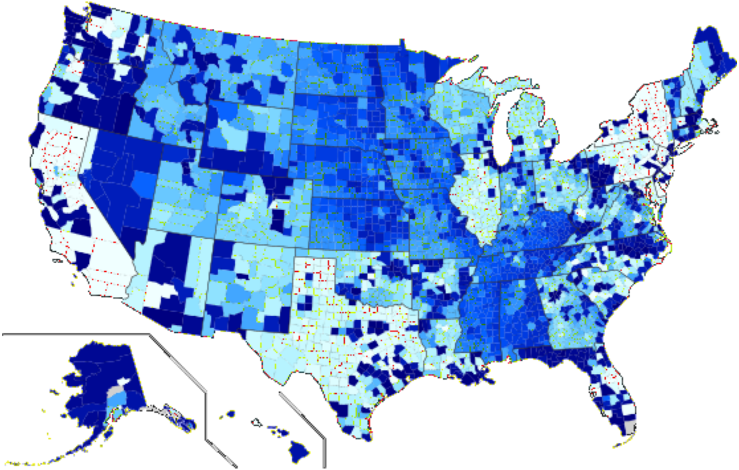
$I^t_{Euro,d}$				0.0109***	
				(0.0031)	
$I^t_{o,-r(d)} \frac{I^t_{Euro,d}}{I^t_{Euro}}$					0.3913**
					(0.1558)
N	3,583,881	3,583,881	3,583,881	3,583,881	3,583,881
R^2	0.656	0.657	0.709	0.709	0.709
Controls:					
Distance	no	yes	yes	yes	yes
Latitude Dis.	no	yes	yes	yes	yes
Region-Country FE	no	no	yes	yes	yes
County-Continent FE	no	no	yes	yes	yes
Time FE	no	no	no	yes	yes
Concurrent European Immigration	no	no	no	no	yes

Notes: Standard errors are clustered by country and *,**, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Return Add'l Slides

Step 3: Immigration Shock $\hat{I}_d^{1980}$

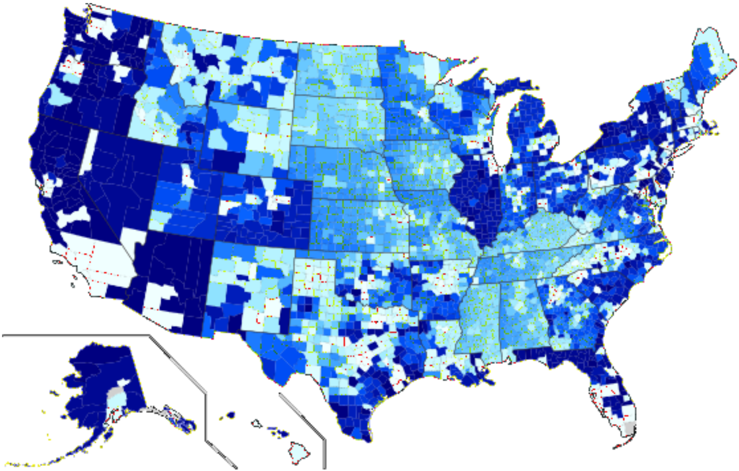
Conditional on County and State-Time Fixed Effects



Later Years Return Add'l Slides

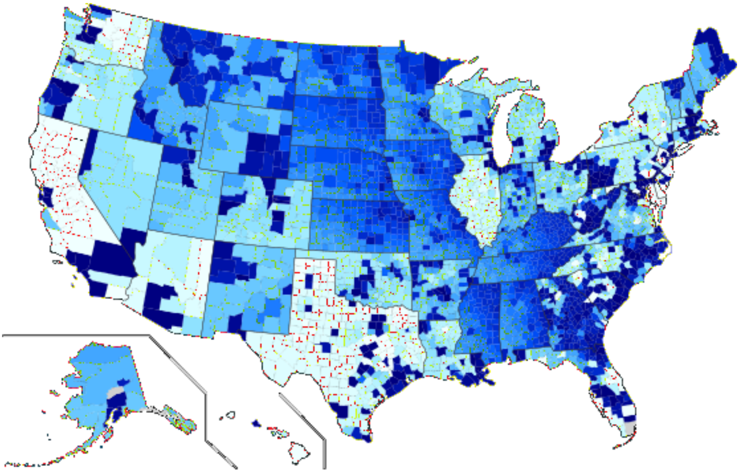
Immigration Shock $\hat{I}_d^{1985}$

Conditional on County and State-Time Fixed Effects



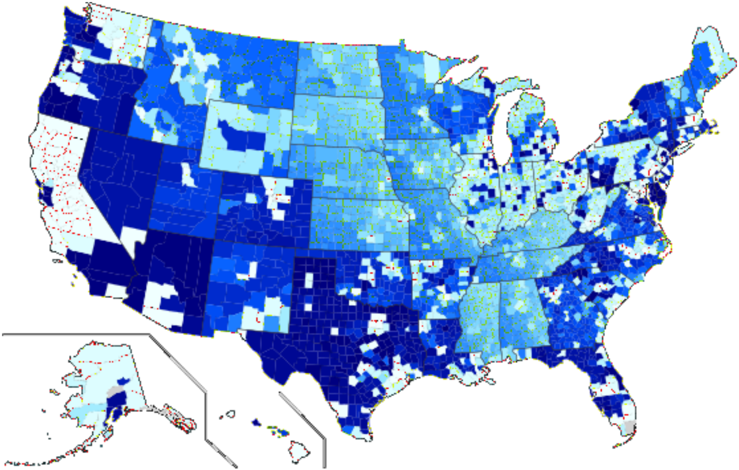
Immigration Shock $\hat{I}_d^{1990}$

Conditional on County and State-Time Fixed Effects



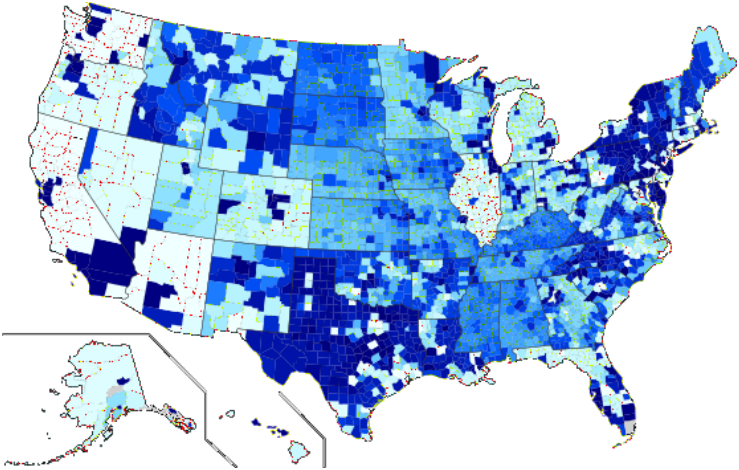
Immigration Shock $\hat{I}_d^{1995}$

Conditional on County and State-Time Fixed Effects



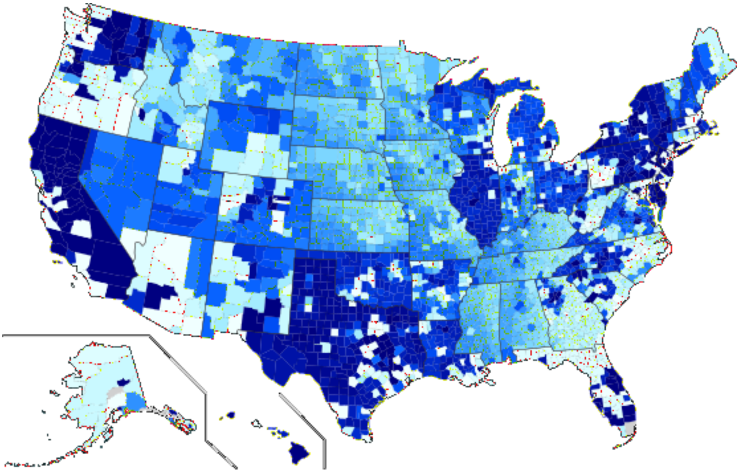
Immigration Shock $\hat{I}_d^{2000}$

Conditional on County and State-Time Fixed Effects



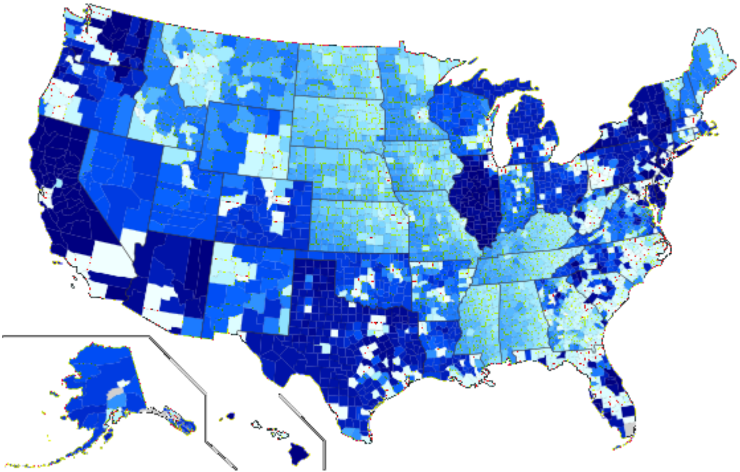
Immigration Shock $\hat{I}_d^{2005}$

Conditional on County and State-Time Fixed Effects



Immigration Shock $\hat{I}_d^{2010}$

Conditional on County and State-Time Fixed Effects



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First-stage: County-Level Population Change

	(1)	(2)	(3)	(4)	(5)
			5-Year Population Growth		
$\widehat{Immigration}_d^t$	1.890***	1.890***	1.818***	1.767***	1.921***
	(0.168)	(0.190)	(0.180)	(0.157)	(0.323)
N	21,986	21,986	21,986	6,600	21,986
F-Stat	127	99	102	126	35
R^2	0.233	0.272	0.314	0.370	0.795
Controls:					
Geography FE	None	Division	State	State	County
Time FE	no	yes	yes	yes	yes
MSA Counties	no	no	no	yes	no

Notes: Standard errors are clustered by state.

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Robustness: Alternative Instruments

Specification:	*Ancestry in 1975 Only*	*Leave-Out Correlated Counties*	*Leave-Out Own Continent*
	(1)	(2)	(3)
	5-year Difference in Patenting		
Immigration_d^t	0.093***	0.098***	0.094***
	(0.027)	(0.033)	(0.027)
N	18,846	18,846	18,846
First Stage F-Stat	1,171	127	830
Controls:			
Geography FE	state	state	state
Time FE	yes	yes	yes

Notes: Standard errors are clustered by state.

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Robustness: Instrument Construction

	5-year Difference in Patenting per 100,000 People Post-1980		
Specification:	*Predicted Ancestry Shares*	*Realized Ancestry Shares*	*Realized Ancestry No Leave-Out*
	(1)	(2)	(3)
Immigration_d^t	0.195**	0.106***	0.132**
	(0.090)	(0.035)	(0.055)
N	18,846	18,846	18,846
First Stage F-Stat	656	265	361
Adão et al (2019) First Stage False Rejection Rate:	4.5	28.2	28.2
Instrument Functional Form:			
Instrumented Ancestry	yes	no	no
Shift Leave-Out	yes	yes	no
Controls:			
Geography FE	state	state	state
Time FE	yes	yes	yes

Notes: Standard errors are clustered by state.

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Robustness: Specific Countries

	Difference in Patenting per 100,000 People Post-1980				
	Mexico	*China*	*India*	*Philippines*	*Vietnam*
	(1)	(2)	(3)	(4)	(5)
Panel A: Excluding Given Country					
Immigration$_d^t$	0.080***	0.102***	0.101***	0.100***	0.101***
	(0.025)	(0.032)	(0.031)	(0.031)	(0.031)
N	18,846	18,846	18,846	18,846	18,846
First Stage F-Stat	666	1,576	1,267	1,261	1,179
Panel B: Including Only Given Country					
Immigration$_d^t$	0.103***	0.068**	0.129***	0.133**	0.123**
	(0.032)	(0.032)	(0.032)	(0.051)	(0.060)
N	18,846	18,846	18,846	18,846	18,846
First Stage F-Stat	2,094	535	318	22	2
Controls:					
Geography FE	ST	ST	ST	ST	ST
Time FE	yes	yes	yes	yes	yes

Notes: Standard errors are clustered by state.

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Robustness: Bad Controls

	Difference in Patenting per 100,000 People Post-1980					
	(1)	(2)	(3)	(4)	(5)	(6)
Immigration$_d^t$	0.101***	0.102***	0.100***	0.092***	0.082***	0.108***
	(0.031)	(0.032)	(0.031)	(0.029)	(0.027)	(0.033)
Population Density (1970)		-0.001				
		(0.004)				
Patents per 1,000 People (1975)			0.089**			
			(0.042)			
Share High School Education (1970)				27.821**		
				(11.059)		
Share 4+ Years College (1970)					103.990***	
					(29.961)	
N	18,846	18,846	18,846	18,846	18,846	18,846
First Stage F-Stat	911	1,658	911	945	1,017	85
Geography FE	ST	ST	ST	ST	ST	CTY
Time FE	yes	yes	yes	yes	yes	yes

Notes: Standard errors are clustered by state.

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Education & Wages

	(1)	(2)	(3)	(4)	(5)
	5-year Difference in Average Annual Wage ($1,000) Post-1975				
Immigration_d^t	0.239**	0.290***	0.770*	0.400***	
	(0.091)	(0.058)	(0.419)	(0.078)	
$\text{Average Years Education}_d^t \times \text{Immigration}_d^t$		0.231***	0.221**		
		(0.051)	(0.096)		
$\text{Average Years College}_d^t \times \text{Immigration}_d^t$				0.569***	
				(0.084)	
$\mathbf{1}\{\text{Low Avg. Years Education}\} \times \text{Immigration}_d^t$					-0.296
					(0.249)
$\mathbf{1}\{\text{Medium Avg. Years Education}\} \times \text{Immigration}_d^t$					0.189***
					(0.069)
$\mathbf{1}\{\text{High Avg. Years Education}\} \times \text{Immigration}_d^t$					1.514***
					(0.473)
N	21,976	21,976	21,976	21,976	21,976
Controls:					
Geogrpahy FE	State	State	County	State	State
Time FE	yes	yes	yes	yes	yes

Notes: The Montiel-Pflueger Effective F-statistic in Column 1 is 42 (critical value 32 for τ of 5%). Standard errors are clustered by state.

Add'l Slides

Wage Spillovers

	(1)	(2)	(3)	(4)
5-Year Difference in Average Annual Wage ($1,000) Post-1975				
$\text{Immigration}_{d}^{t}$	0.010***	0.009***	0.005***	0.005***
	(0.002)	(0.003)	(0.001)	(0.002)
$\text{Immigration}_{State}^{t}$		0.000		
		(0.000)		
Neighbors' $\text{Immigration}_{d}^{t}$ (Inverse Distance Weight)			0.560***	
			(0.191)	
$\text{Immigration}_{100km}^{t}$				0.006***
				(0.002)
$\text{Immigration}_{250km}^{t}$				-0.001
				(0.001)
$\text{Immigration}_{500km}^{t}$				-0.000
				(0.001)
N	21,976	21,976	21,976	21,976
First Stage F-Stat d	1,166	2,289	3,482	7,967
First Stage F-Stat Spillover		434	165	395
First Stage F-Stat Spillover				157
First Stage F-Stat Spillover				67
Controls:				
Geogrpahy FE	DIV	DIV	DIV	DIV
Time FE	yes	yes	yes	yes

Notes: Standard errors are clustered by state.

Dynamic Effect of Immigration

	Difference in Patenting per 100,000 People			
	ΔPat_{t-2}^{t-1}	ΔPat_{t-1}^{t}	ΔPat_{t-1}^{t+1}	ΔPat_{t-1}^{t+2}
	(1)	(2)	(3)	(4)
$Immigration_d^t$	-0.099	0.108***	0.369***	0.332**
	(0.069)	(0.033)	(0.098)	(0.137)
N	15,705	18,846	15,705	12,564
First Stage F-Stat	80	85	11	7
Controls:				
Geogrpahy FE	county	county	county	county
Time FE	yes	yes	yes	yes

Notes: Standard errors are clustered by state.

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Second Stage: Population Growth and Innovation

	5-year Difference in Patenting per 100,000 People Post-1980			
	(1)	(2)	(3)	(4)
Δ Population$_d^t$	0.223***	0.113***	0.113***	0.087***
	(0.066)	(0.030)	(0.031)	(0.027)
N	18,846	18,846	18,840	18,846
First-Stage F Stat.		112	105	53
Controls:				
Specification	OLS	IV	IV	IV
Geography FE	State	State	State	County
Time FE	yes	yes	yes	yes
State-Time FE	no	no	yes	no

Notes: Standard errors are clustered by state.

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Growth Model Parameters

	Difference in Patenting per 100,000 People Post-1980		*Patenting per 100,000 People Post-1975*		*IHS of Patents Post-1975*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Immigration_d^t	0.101***	0.509***	0.501**	2.505***	0.028***			
	(0.031)	(0.090)	(0.190)	(0.268)	(0.011)			
$\text{sq}(\text{Immigration}_d^t)$		-0.001***		-0.004***				
		(0.000)		(0.000)				
$\Delta\ \text{Population}_d^t$						0.033***		
						(0.012)		
$\text{IHS}(\text{Immigration}_d^t)$							1.723***	
							(0.111)	
$\text{IHS}(\Delta\ \text{Population}_d^t)$								2.471***
								(0.510)
N	18,846	18,846	21,987	21,987	21,987	21,986	21,987	21,986
First Stage F-Stat	911	95	1,202	102	1,202	102	94	16
First Stage F-Stat		11,231		11,879				
Controls:								
Geography FE	state	state	state	state	state	state	state	state
Time FE	yes	yes	yes	yes	yes	yes	yes	yes

Notes: Standard errors are clustered by state.

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