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The Spatial Distribution of Migrant Inventors

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Disclaimer

- The views expressed in this study are those of the authors, and do not necessarily reflect the views of the World Intellectual Property Organization or its Member States.

Motivation

- Immigration and innovation are becoming close phenomena (Freeman, 2010).
- Skilled immigrants are over-represented:
  - in the US: 25% S&E, ~50% PhDs, 24% inventors, or 26% US-based Nobel Laureates, are foreign-born (only 12% of the whole labor force) (Stephan and Levin, 2001; Peri, 2007; Kerr, 2009).
- Disproportionate contribution to their host country innovation and economic development.
- Non-random settlement patterns across cities and regions – that significantly differs from the agglomeration patterns of their native counterparts.
- Link between cultural similarity and tendency to concentrate in space. Network effects are probably more important for foreign nationalities with more difficulties to be assimilated by the local culture.

Contribution

1. It compiles and presents a new unit record dataset about inventors and their migratory background residing in OECD regions (+selected countries), spanning a large number of years (1990-2010).
2. It identifies the main patterns of immigrant inventors' settlement across regions, which is likely to have strong implications for regional economic development.

Hypothesis

- Immigrant inventors tend to concentrate in certain regions more disproportionately than their native counterparts.
- Larger areas are most usually chosen, because of their opportunities for integration, their superior supply of amenities and their higher amount of job opportunities.
- Skill-selection and Region-selection: the most skilled are more likely to migrate, and they sort themselves towards the most productive areas.
- Firms in highly-productive regions recruit their labor force from the global labor market, and less often from the local one.
- These patterns tend to reinforce over time thanks to the existence of network effects; which are likely more relevant for foreign nationalities with more difficulties to be assimilated by the local culture.

Literature Review

- **Immigration contributing to innovation**
  - Skilled immigrants increase the absolute number of innovative people and fostering the production of knowledge through different knowledge spillovers (Ozgen et al., 2011, etc.).
  - Ethnic diversity shown correlated with economic prosperity (Alesina et al., 2013)
  - Immigrants are over-represented among the most productive S&E (Stephan and Levin, 2001)
  - Increase in foreign students raises patent applications, more than an increase in skilled immigration (Chellaraj et al., 2008)
  - Foreign-born graduates are more likely to file patents than native graduates – although foreign-born enroll disproportionately in S&E disciplines (Hunt and Gauthier-Loiselle, 2012)
  - Student or trainee visas holders outperform native college graduates in terms of wages, patenting, commercializing and licensing patents (Hunt, 2011)
  - Cultural diversity effects on boosting creativity and new knowledge creation (Alesina et al., 2013; Bosetti et al., 2013)
- **Increasing academic and policy interest in immigration and innovation by Regions**
  - Mobility is one pillar of the European Research Area (ERA), (EC, 2007, 2006).
  - Uneven settlement within countries: UK 8.8%, London 28% and France 9.8%, Paris 23% (Freeman, 2006), also in the US (Kerr, 2007, 2010)
  - This spreads to Travel-to-Work areas (Nathan, 2011)
  - Few studies on migration and innovation by regions: US states skilled migration by decades (Hunt & Gauthier-Loiselle, 2010), US cities annual changes in H-1B visas (Kerr & Lincoln, 2010), US cities diversity (Ottaviano and Peri, 2006; Peri et al., 2013), European NUTS2 regions in two periods (Ozgen et al., 2011).

Why our data is useful?

- Previous studies
  - US-centrism largely characterizes the immigration-innovation literature as a whole (Breschi et al., 2013), and also does so in its regional dimension.
  - Census-based data limitation, which are released only every 10 years.
  - No skill differentiation of immigrants.
- Our data
  - inventors with migratory background (i.e. foreign nationality)
  - (aggregated) across regions from OECD and other selected economies
  - spans for more than 20 years (1990-2010).
  - can be expanded with all the Patent data information
    - Citations
    - Technological fields (IPC, ECLA, etc.)
    - Patent families
    - Legal status (grant, refusal etc.)

Data

- **Nationality data**: PCT international applications (WIPO IPSTATS database).
  - PCT requirement where only nationals or residents of a PCT contracting state can file PCT applications.
  - 80% of inventors' records between 1990 and 2010 with both nationality and residence information.

- **Region data:** OECD's REGPAT (OECD, REGPAT database, January 2013).
  - detailed regional information of all OECD and EU28 countries (+selected economies)
  - only those regionalized records from REGPAT belonging to inventors in the PCT applications.

Methodology: Unit Record

- Record = unique *inventor name - application number* pair
- No unique identifier linking the PCT inventors in REGPAT records with those in WIPO's PCT unit record data.
- PCT records can only be linked by applications numbers
- 5,391,520 inventor names have to be linked
  - 4,712,916 (87%) matched directly
  - 624'240 (13%) were matched by different algorithms.
  - 54'364 (<1%) unmatched:
    - 18'981 duplicated records surplus
    - 15,511 invalid PCT numbers
    - 19,872 (<1%) unmatched
- Unit Record Output:
  - 4,430,113 records (83%) with valid nationality.
  - 1,705,708 out of 2,049,168 (83%) unique valid PCT applications in REGPAT have at least one inventor with a valid nationality.
  - Fully linkable with
    - WIPO's unit record PCT data (entity id)
    - EPO's Patstat (appln_id)
    - Any NUTS3 (or equivalent) data

Methodology: Regional panel

- Unit records aggregated at the region-unit level:
  - 283 NUTS2 regions of 28 European countries
  - 366 Metropolitan Statistical Areas (MSA) of the US.
- … and annually for the period 1990-2010.
- Two different types of geographical variables:
  - Region unit data variables (attributes or *by region*)
    - stock of resident inventors
    - stock of immigrant inventors
    - immigration rate of inventors
    - fractionalization or *cultural diversity* index (Ottaviano and Peri, 2006).
    - Variant of fractionalization index (w/o natives)
  - Region-Nationality variables (corridor or relational):
    - stock of inventors
    - rate of inventors by Region
    - rate of inventors by Nationality

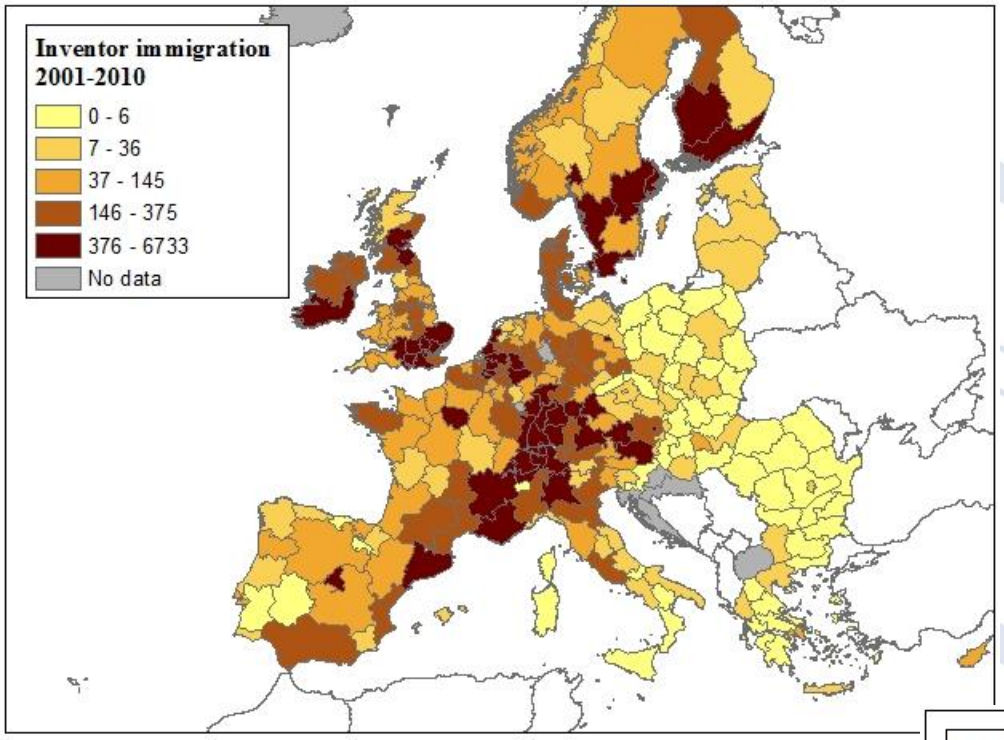
RESULTS

Overview of inventor immigration

- High migration rates for our sample of skilled individuals, as compared to the rest of the population: in 2000, 8.6% vs. 1.8% of 25+ population and 5.4% tertiary education (Beine et al., 2007).
- Inventor **immigration** is largely concentrated in OECD countries: 95.3%
  - the US captures 50.1% of all immigrant inventors
- Inventor **emigration** is highly concentrated in OECD countries as well: 60.9% of all are nationals of an OECD country.
- Only China and India present larger emigrant stocks than their OECD counterparts.

Top European NUTS2 by immigration stocks and rates, 2001-2010

Country	NUTS2 region	Immigrant counts	Country	NUTS2 region	Immigration rate
CH	Nordwestschweiz	6733	CH	Nordwestschweiz	0.470
NL	Noord-Brabant	6014	CH	Rég. Lémanique	0.460
CH	Rég. Lémanique	4219	BE	Bruxelles	0.409
FR	Île de France	3895	CH	Zürich	0.391
CH	Zürich	3777	LU	Luxembourg	0.339
DE	Oberbayern	3049	CH	Zentralschweiz	0.334
DE	Karlsruhe	2734	CH	Ostschweiz	0.299
DE	Köln	2473	GB	Inner London	0.261
SE	Stockholm	2331	BE	Brabant Wallon	0.248
GB	East Anglia	2286	CH	Ticino	0.239
DE	Darmstadt	2275	IE	Southern And Eastern	0.206
GB	Inner London	2264	BE	Prov. Antwerpen	0.194
DE	Rheinhessen-Pfalz	2181	CH	Espace Mittelland	0.194
FI	Etelä-Suomi	2037	BE	Vlaams-Brabant	0.190
DE	Düsseldorf	1920	NL	Noord-Brabant	0.179
GB	Berkshire, Buckinghamshire And Oxfordshire	1913	BE	Prov. Hainaut	0.171
DK	Hovedstaden	1707	GB	Outer London	0.171
DE	Stuttgart	1688	AT	Wien	0.170
FR	Rhône-Alpes	1685	BE	Prov.	0.167



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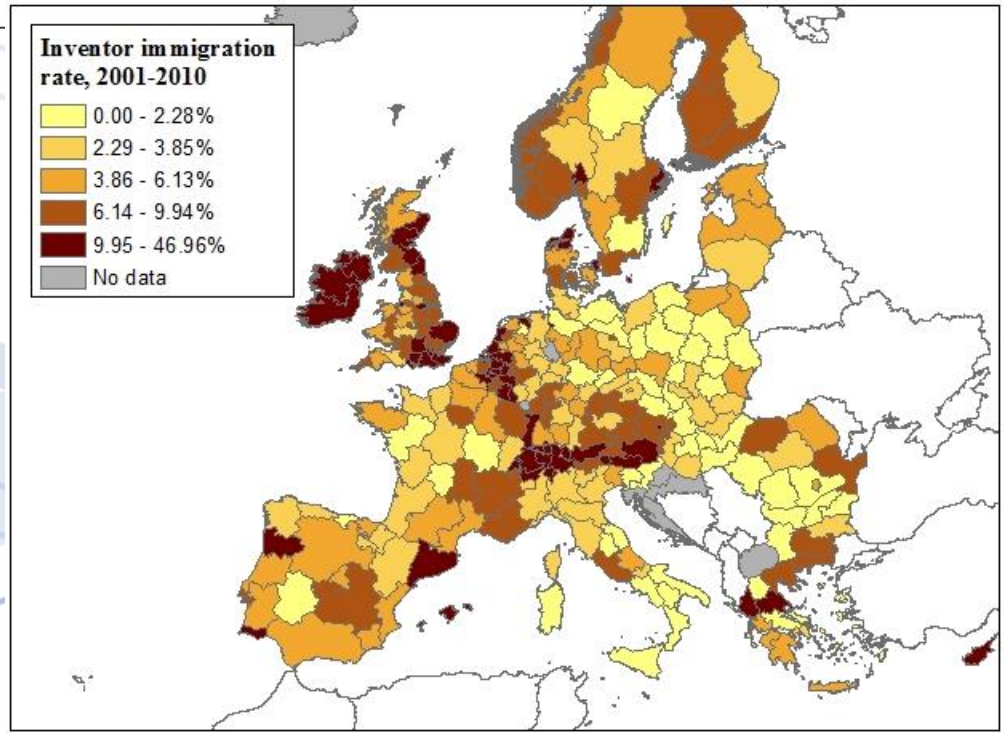
<-Stocks

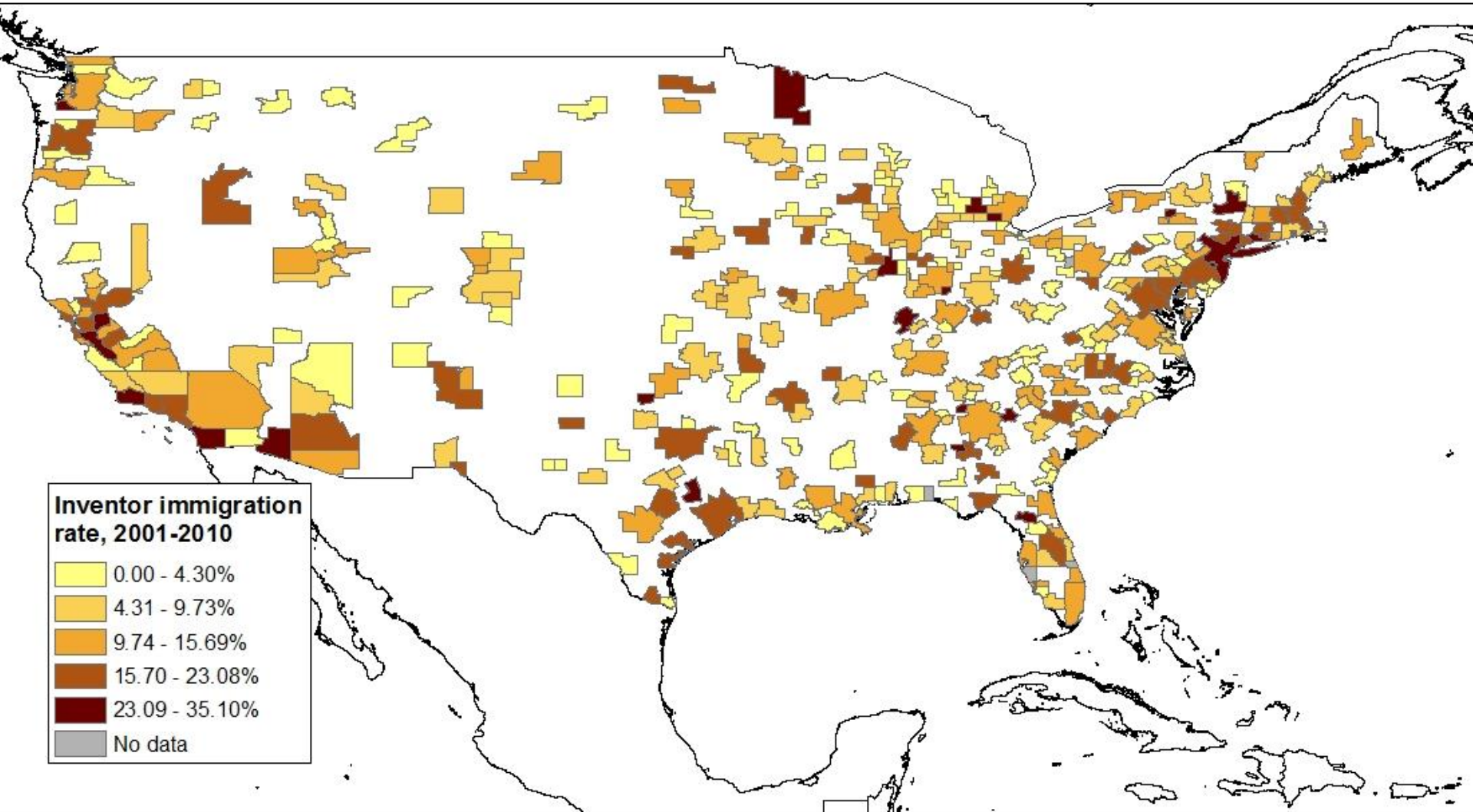
Rates->



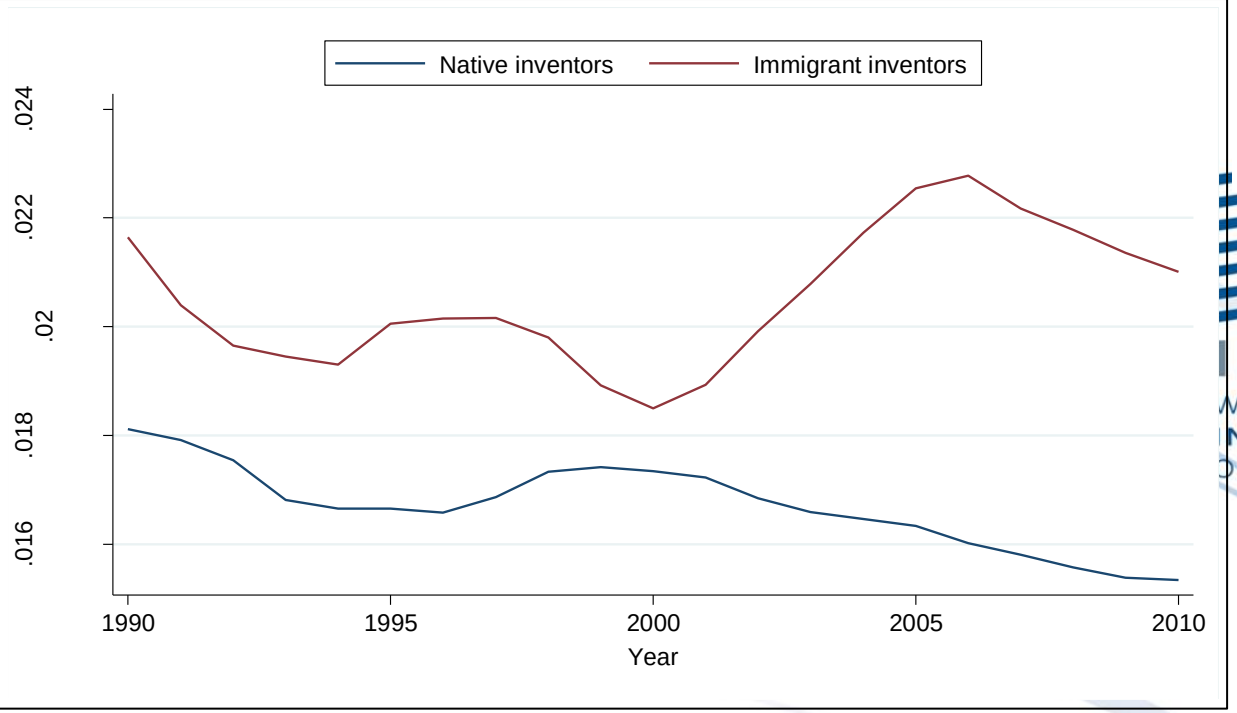
Top US MSAs by immigration stocks and rates, 2001-2010

MSA	Immigrant counts	MSA	Immigration rate
San Diego	20752	San Diego	0.351
San Jose-Santa Clara	20386	Evansville	0.321
New York	17396	San Jose-Santa Clara	0.307
San Francisco	15246	Stockton	0.303
Boston	14753	Trenton	0.296
Los Angeles	6500	Champaign-Urbana	0.294
Philadelphia	6167	New Haven	0.285
Chicago	6001	Albany	0.282
Houston	5742	Lansing-East Lansing	0.263
Dallas	3593	Ithaca	0.262
Washington	3523	Ann Arbor	0.255
Minneapolis	2921	Gainesville	0.255
New Haven	2608	Athens	0.249
Seattle	2514	CollegeStation-Bryan	0.248
Trenton	2248	Columbus	0.246
Portland	2231	Santa Barbara	0.238
Atlanta	2013	New York	0.237
Detroit	1776	Dallas	0.226
Albany	1755	San Francisco	0.224
Austin	1722	Boston	0.223
Raleigh-Cary	1598	Greensboro-High Point	0.221

Immigration rates of inventors, US MSAs, 2001-2010



HHI concentration index natives vs. Immigrants



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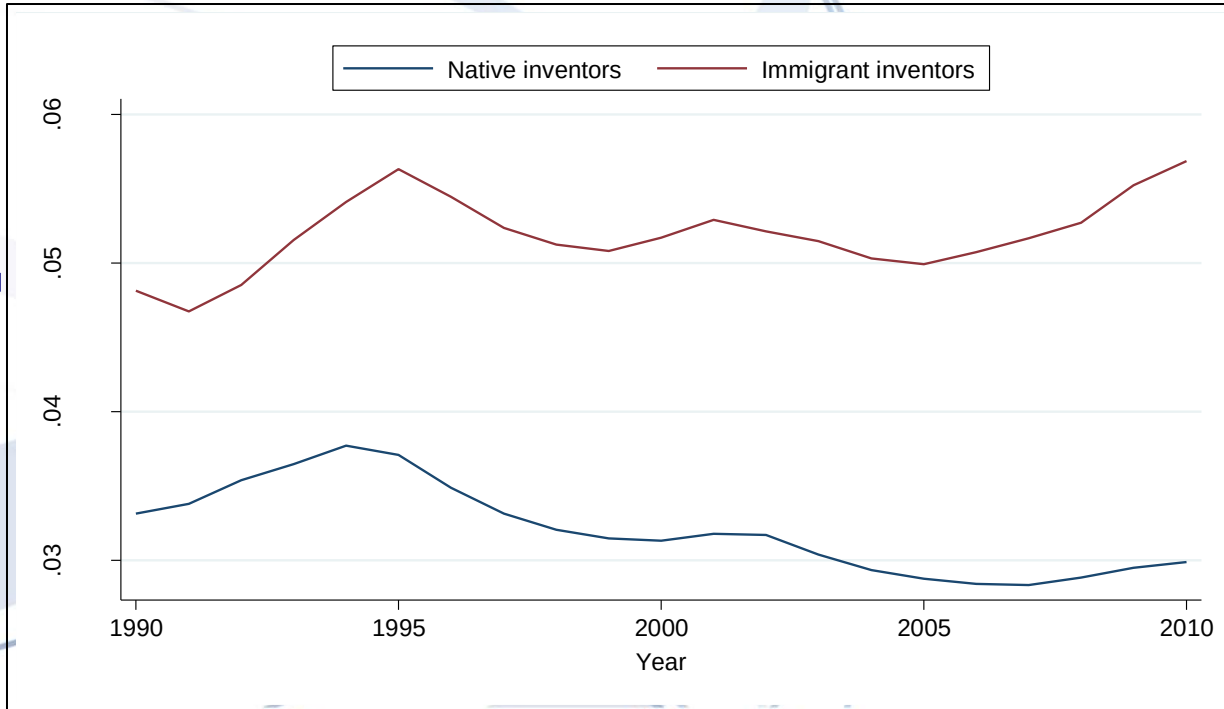
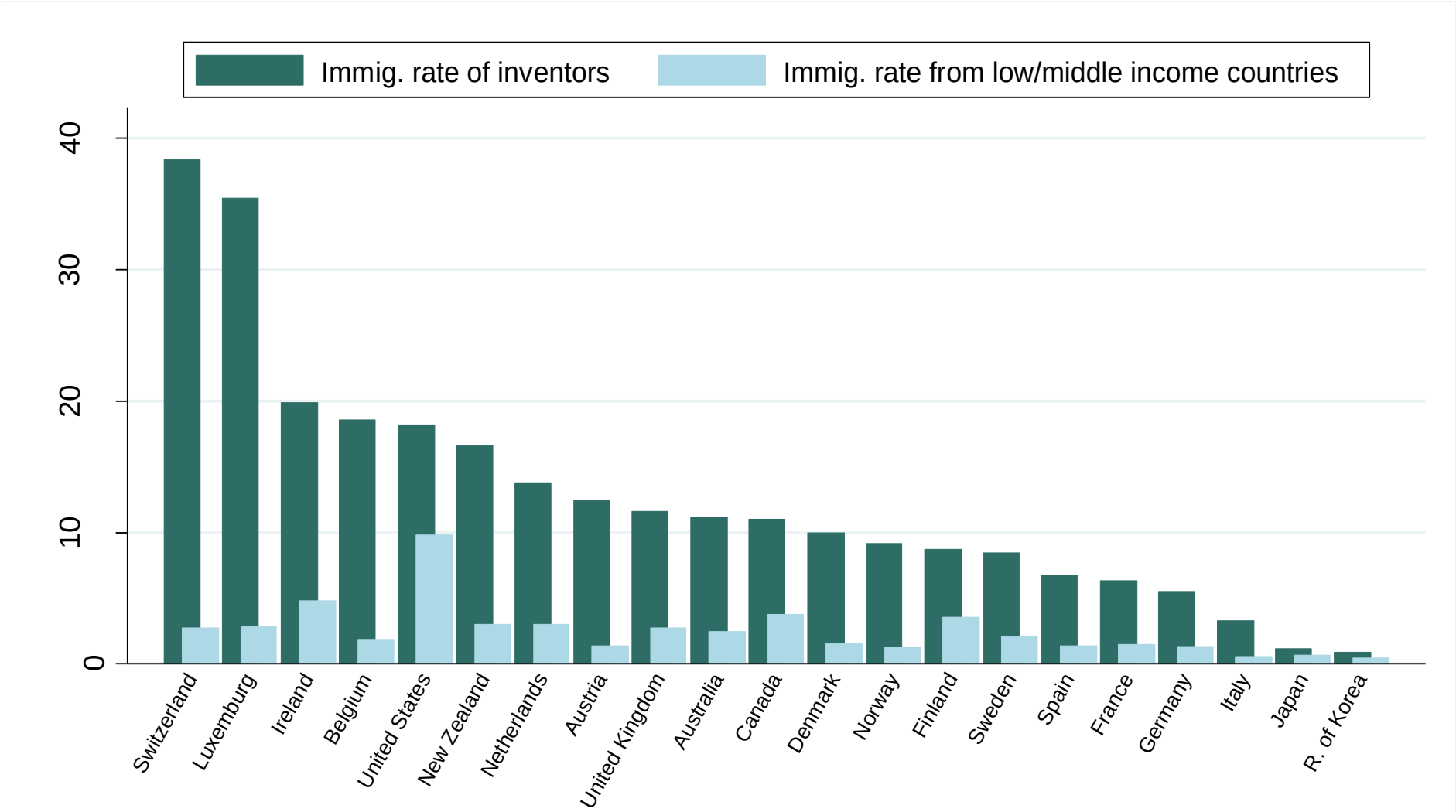


Immigration rates, high vs. middle- and low-income countries, 2001-2010

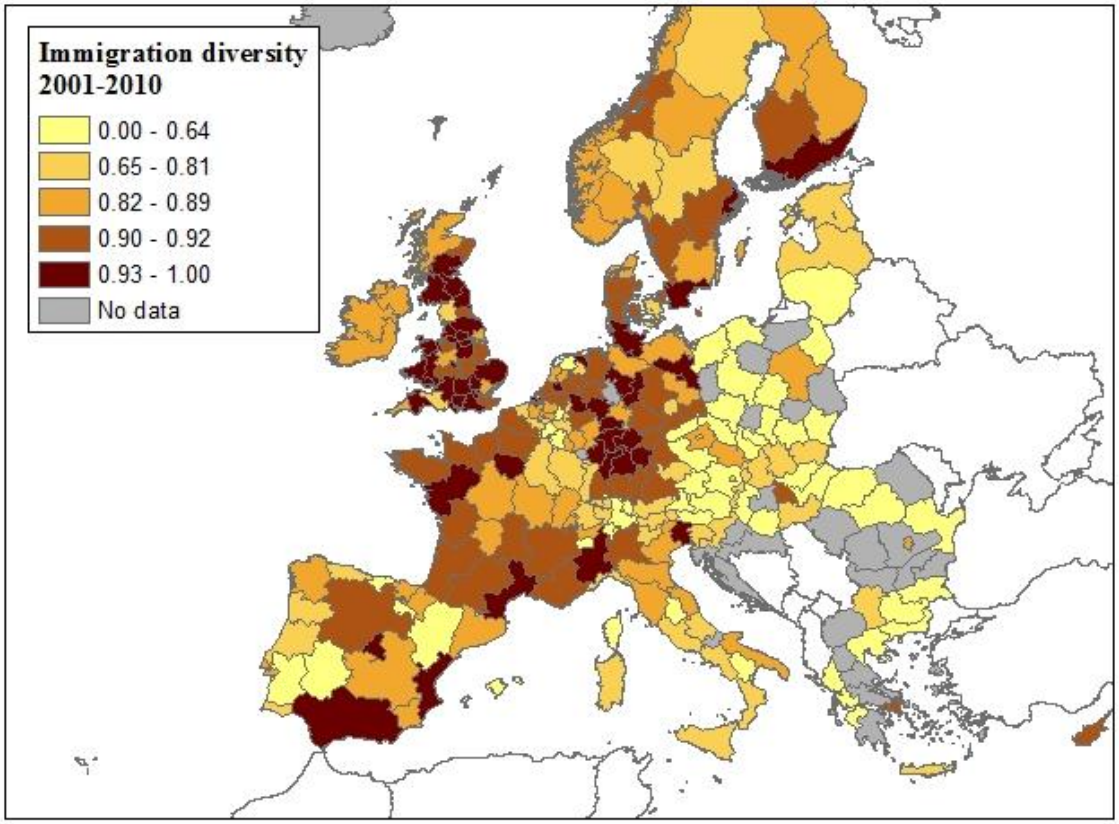


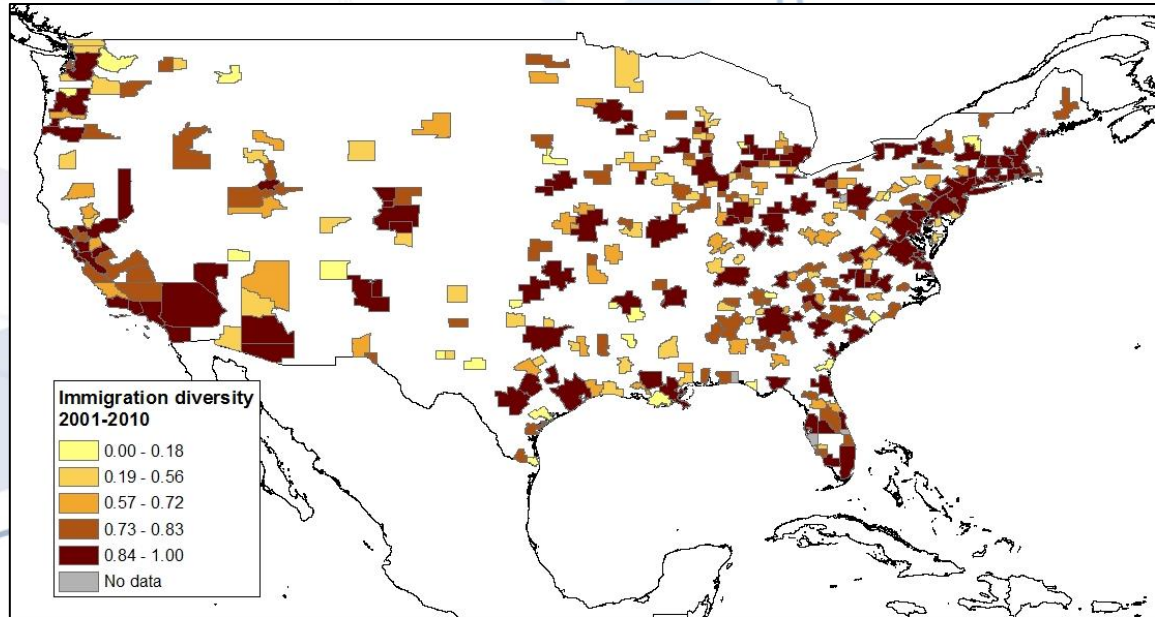
“Europe+English” vs. “rest World”. Top regions, 2001-2010

Country	NUTS2 region	Imm. Rate Europe+Engl.	Country	NUTS2 region	Imm. Rate rest World
CH	Nordwestschweiz	0.434	CY	Kypros / Kibris	0.135
CH	Région Lémanique	0.417	GB	Inner London	0.067
BE	Région de Bruxelles	0.388	DK	Nordjylland	0.063
CH	Zürich	0.348	GB	Outer London	0.061
LU	Luxembourg	0.311	DE	Bremen	0.060
CH	Zentralschweiz	0.309	GB	Northumberland and Tyne and Wear	0.059
CH	Ostschweiz	0.283	FI	Pohjois-Suomi	0.058
CY	Kypros	0.278	FI	Länsi-Suomi	0.053
CH	Ticino	0.224	GB	West Midlands	0.051
BE	Brabant Wallon	0.209	IE	Border, Midland and Western	0.050
GB	Inner London	0.193	NL	Noord-Brabant	0.048
CH	Espace Mittelland	0.181	IE	Southern and Eastern	0.048
BE	Prov. Antwerpen	0.176	GB	Hampshire and Isle of Wight	0.047
BE	Prov. Luxembourg	0.167	GB	South Yorkshire	0.044
BE	Vlaams-Brabant	0.159	LV	Latvija	0.044

MSA	Imm. Rate Europe+Engl.	MSA	Imm. Rate rest World
Stockton	0.180	Evansville	0.271
Athens-Clarke County	0.116	Champaign-Urbana	0.247
San Diego	0.113	San Diego	0.237
Santa Barbara	0.111	San Jose-Santa Clara	0.206
San Francisco	0.108	Albany-Schenectady-Troy	0.205
Trenton-Ewing	0.106	Gainesville	0.197
New Haven-Milford	0.102	State College	0.191
San Jose-Santa Clara	0.099	College Station-Bryan	0.189
Boston	0.096	Trenton-Ewing	0.189
Des Moines-West Des Moines	0.092	Ame	0.187
Santa Cruz-Watsonville	0.088	Ithaca	0.187
Greensboro-High Point	0.086	Lansing-East Lansing	0.185
New York	0.086	Columbia	0.183
Oxnard-Thousand Oaks-Ventura	0.083	Columbus	0.183
Burlington-South Burlington	0.083	New Haven-Milford	0.181

Immigration diversity





Top regions by diversity index, 2001-2010

Country	NUTS2 region	Diversity
DE	Berlin	0.951
GB	Outer London	0.951
FI	Etelä-Suomi	0.949
GB	Inner London	0.945
GB	Gloucestershire, Wiltshire and Bristol	0.944
DE	Stuttgart	0.943
GB	Greater Manchester	0.941
NL	Utrecht	0.940
DE	Düsseldorf	0.940
GB	Hampshire and Isle of Wight	0.940
FR	Île de France	0.939
DE	Karlsruhe	0.939
SE	Stockholm	0.938
GB	East Anglia	0.938
GB	West Yorkshire	0.938
GB	West Midlands	0.937
DE	Rheinhessen-Pfalz	0.935
DE	Hamburg	0.934
DE	Braunschweig	0.934
GB	South Western	

MSA	Diversity
Miami	0.940
Reno-Sparks	0.923
Tucson,	0.922
Los Angeles	0.922
Santa Cruz-Watsonvill	0.919
Tulsa	0.919
Rochester	0.918
Cincinnati-Middletown	0.916
Denver-Aurora-Broomfield	0.915
Springfield	0.914
Tampa-St. Petersburg-Clearwater	0.911
Little Rock-North Little Rock-Conway	0.911
Washington-Arlington-Alexandria	0.911
Jacksonville	0.909
Boston	0.907
Houston	0.906
Milwaukee-Waukesha-West Allis	0.905
New Orleans	0.905
Colorado Springs	0.904
Seattle	0.903
San Francisco	0.903
Santa Barbara	0.900
Providence-New Bedford-Fall River	0.899
Nashville-Davidson--	

OLS determinants of immigration rates and immigration diversity. Europe, 2001-2010.

Dependent variable	Immig. Rate 2001-2010	Diversity 2001-2010	Immig. Rate 2001-2010	Diversity 2001-2010	Immig. Rate 2001-2010	Diversity 2001-2010
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Ln(Stock Immig. 1991-2000)			0.0405***	-0.00673		
			(0.00533)	(0.0160)		
Immg. Rate 1991-2000					0.438***	0.0124
					(0.135)	(0.191)
Ln(Population 2000)	-0.0460***	0.182***	-0.0544***	0.183***	-0.0343***	0.183***
	(0.00735)	(0.0156)	(0.00353)	(0.0149)	(0.00697)	(0.0184)
Ln(Pop. density 2000)	0.0185***	-0.00289	0.0100**	-0.00110	0.0169***	-0.00308
	(0.00508)	(0.0113)	(0.00447)	(0.0114)	(0.00423)	(0.0114)
Capital	0.0685*	0.00128	0.0632**	0.00233	0.0308	0.000267
	(0.0375)	(0.0559)	(0.0269)	(0.0570)	(0.0237)	(0.0567)
Coastal access	0.00577	0.0661**	0.00814	0.0668**	0.00693	0.0658**
	(0.0146)	(0.0333)	(0.0116)	(0.0332)	(0.0108)	(0.0323)
Share population tertiary education	0.435*	1.146*	-0.107	1.215**	0.285	1.146*
	(0.253)	(0.635)	(0.183)	(0.584)	(0.189)	(0.633)
Ln(R&D per inhab. 2000)	0.0122**	0.0897***	-0.0158***	0.0950***	0.0124**	0.0897***
	(0.00593)	(0.0168)	(0.00594)	(0.0250)	(0.00548)	(0.0168)
Constant	0.682***	-1.142***	0.535***	-1.107***	0.517***	-1.148***
	(0.138)	(0.369)	(0.0828)	(0.424)	(0.116)	(0.406)
Observations	277	253	277	253	274	253
Adjusted-R2	0.371	0.758	0.536	0.757	0.617	0.757
Log-likelihood	312.9	96.22	355.5	96.44	378.3	96.23

OLS determinants of immigration rates and immigration diversity. Europe, 2001-2010.

Dependent variable	Immig. Rate 2001-2010	Diversity 2001-2010	Immig. Rate 2001-2010	Diversity 2001-2010	Immig. Rate 2001-2010	Diversity 2001-2010
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Ln(Stock Immig. 1991-2000)			0.0332***	0.0142		
			(0.00617)	(0.0200)		
Immg. Rate 1991-2000					0.389***	0.159
					(0.147)	(0.186)
Ln(Population 2000)	-0.0215	0.171***	-0.0497***	0.158***	-0.0195**	0.175***
	(0.0135)	(0.0366)	(0.0135)	(0.0324)	(0.00837)	(0.0378)
Ln(Pop. density 2000)	0.0127*	0.00622	0.00848	0.00516	0.0122**	0.00475
	(0.00650)	(0.0134)	(0.00596)	(0.0132)	(0.00549)	(0.0139)
Capital	0.0997**	4.99e-05	0.0981***	-0.00254	0.0590*	-0.0175
	(0.0440)	(0.0448)	(0.0343)	(0.0450)	(0.0316)	(0.0507)
Coastal access	0.0208	0.0759**	0.0243	0.0769**	0.0121	0.0682**
	(0.0183)	(0.0356)	(0.0178)	(0.0355)	(0.0123)	(0.0342)
Share population tertiary education	0.0737	1.457**	-0.147	1.391**	0.0660	1.471**
	(0.265)	(0.644)	(0.224)	(0.597)	(0.204)	(0.636)
Ln(R&D per inhab. 2000)	0.0177	0.0217	0.000311	0.0112	0.0258	0.0215
	(0.0115)	(0.0241)	(0.0127)	(0.0331)	(0.0163)	(0.0248)
Unemployment rate1999-2002	-0.00190	-0.0125**	-0.000754	-0.0117**	-0.00149	-0.0120**
	(0.00230)	(0.00545)	(0.00203)	(0.00568)	(0.00158)	(0.00529)
Ln(GDP per capita 2005)	-0.0232	0.105**	-0.0399*	0.0996*	-0.0386	0.109**
	(0.0236)	(0.0527)	(0.0236)	(0.0531)	(0.0320)	(0.0535)
Constant	0.368*	-1.155*	0.481***	-1.110*	0.333***	-1.187*
	(0.188)	(0.639)	(0.155)	(0.597)	(0.121)	(0.640)
Observations	228	208	228	208	226	208
Adjusted-R2	0.198	0.566	0.321	0.566	0.467	0.567
Log-likelihood	267.7	69.92	287.3	70.47	311.0	70.80

CONCLUSIONS

- We compiled a unique dataset on inventors with migratory background residing in OECD regions, spanning a large number of years (1990-2010).
- We described the main patterns of immigrant inventors' settlement across regions, which is likely to have strong implications for regional economic development.
- In particular:
  - Both in Europe and in the US, that the settlement of foreign inventors is very uneven, above and beyond the underlying distribution of native inventors.
  - The diversity is also different across regions. Nevertheless there is a distinct pattern between European and US regions
- To the best of our knowledge, very few scholars have shed light on this issue. We therefore make available the dataset and encourage other to analyze these phenomena.

THANK YOU!

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Top most populated migration corridors. Europe, 2001-2010

Full Sample				Origin country not high-income economy			
Sending country	Receiving region	Code	Inventors	Sending country	Receiving region	Code	Inventors
Germany	Nordwestschweiz	CH	2925	India	Noord-Brabant	NL	211
Germany	Zürich	CH	1890	China	Noord-Brabant	NL	207
Germany	Noord-Brabant	NL	1637	Romania	Noord-Brabant	NL	179
France	Région Lémanique	CH	1428	Russia	Karlsruhe	DE	177
Germany	Ostschweiz	CH	958	China	Stockholm	SE	176
UK	Nordwestschweiz	CH	879	Russia	Etelä-Suomi	FI	164
Germany	Région Lémanique	CH	736	China	Oberbayern	DE	147
Austria	Oberbayern	DE	708	Ukraine	Düsseldorf	DE	135
UK	Noord-Brabant	NL	705	Russia	Stockholm	SE	132
Netherlands	Köln	DE	643	China	Etelä-Suomi	FI	125
Germany	Espace Mittelland	CH	626	Russia	Köln	DE	123
Germany	Zentralschweiz	CH	493	China	Île de France	FR	121
Germany	Wien	AT	474	China	East Anglia	GB	119
France	Nordwestschweiz	CH	467	India	Inner London	GB	115
France	Région de Bruxelles	BE	459	Tunisia	Île de France	FR	111
UK	Île de France	FR	443	Russia	Rheinhessen-Pfalz	DE	103
UK	Darmstadt	DE	407	Russia	Noord-Brabant	NL	103
Italy	Noord-Brabant	NL	406	India	Karlsruhe	DE	102
Italy	Nordwestschweiz	CH	399	India	Köln	DE	99
UK	Southern and Eastern	IE	389	China	Berkshire, Buckinghamshire and Oxfordshire	GB	97
Netherlands	Île de France	FR	388	Viet Nam	Pohjois-Suomi	FI	96
Germany	Île de France	FR	387	India	Etelä-Suomi	FI	96
Italy	Région Lémanique	CH	376	Belarus	Noord-Brabant	NL	92
Germany	Stockholm	SE	369	Algeria	Île de France	FR	87
Germany	Steiermark	AT	364	Russia	Berlin	DE	86
Netherlands	Prov. Antwerpen	BE	346	Russia	Darmstadt	DE	86

Top most populated migration corridors. US, 2001-2010

Full Sample			Origin country not high-income economy		
Sending country	Receiving region	Inventors	Sending country	Receiving region	Inventors
India	San Jose-Santa Clara	5759	Russia	Boston	506
India	San Diego	5628	Russia	New York	447
China	San Diego	5481	Russia	San Jose-Santa Clara	392
China	New York	5351	Russia	San Francisco	382
China	San Jose -Santa Clara	5235	Russia	San Diego	363
China	San Francisco	3585	Russia	Philadelphia	295
India	New York	3466	Russia	Los Angeles-Santa Ana	265
China	Boston	3431	Russia	Houston	235
India	San Francisco	2509	Russia	Washington-Arlington	232
Canada	San Francisco	2252	Turkey	Boston	230
Canada	San Diego	2225	Iran	San Diego	228
China	Philadelphia	2224	Iran	San Jose-Santa Clara	217
India	Boston	2210	Turkey	San Jose-Santa Clara	196
UK	San Francisco	2040	Turkey	San Diego	195
UK	New York	2018	Iran	Los Angeles-Santa Ana	181
Canada	Boston	1963	Turkey	New York	171
Canada	San Jose-Santa Clara	1873	Argentina	New York	160
China	Chicago	1863	Brazil	New York	156
India	Chicago	1630	Romania	San Jose-Santa Clara	156
Canada	New York	1560	Iran	San Francisco	153
UK	Boston-Cambridge-Quincy	1515	Thailand	San Diego	151
China	Los Angeles-Santa Ana	1471	Egypt	San Diego	138
UK	San Jose-Santa Clara	1350	Malaysia	San Jose-Santa Clara	136
China	Houston	1349	Argentina	Boston	131
UK	San Diego	1259	Russia	Seattle	127
China	Washington-Arlington-Alexandria	1259	Russia	Chicago	121
UK	Philadelphia	1254	Argentina	San Jose-Santa Clara	118
Germany	San Francisco	1236	Romania	Boston	117