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Migration and Innovation: The Innovation's Viewpoint

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THE INNOVATION'S VIEWPOINT

- **DATA NEEDS**

  - « High Skilled » is not enough → what about STEM workers and students?
  - Europe as both origin and destination

- **SPECIFIC TOPICS**

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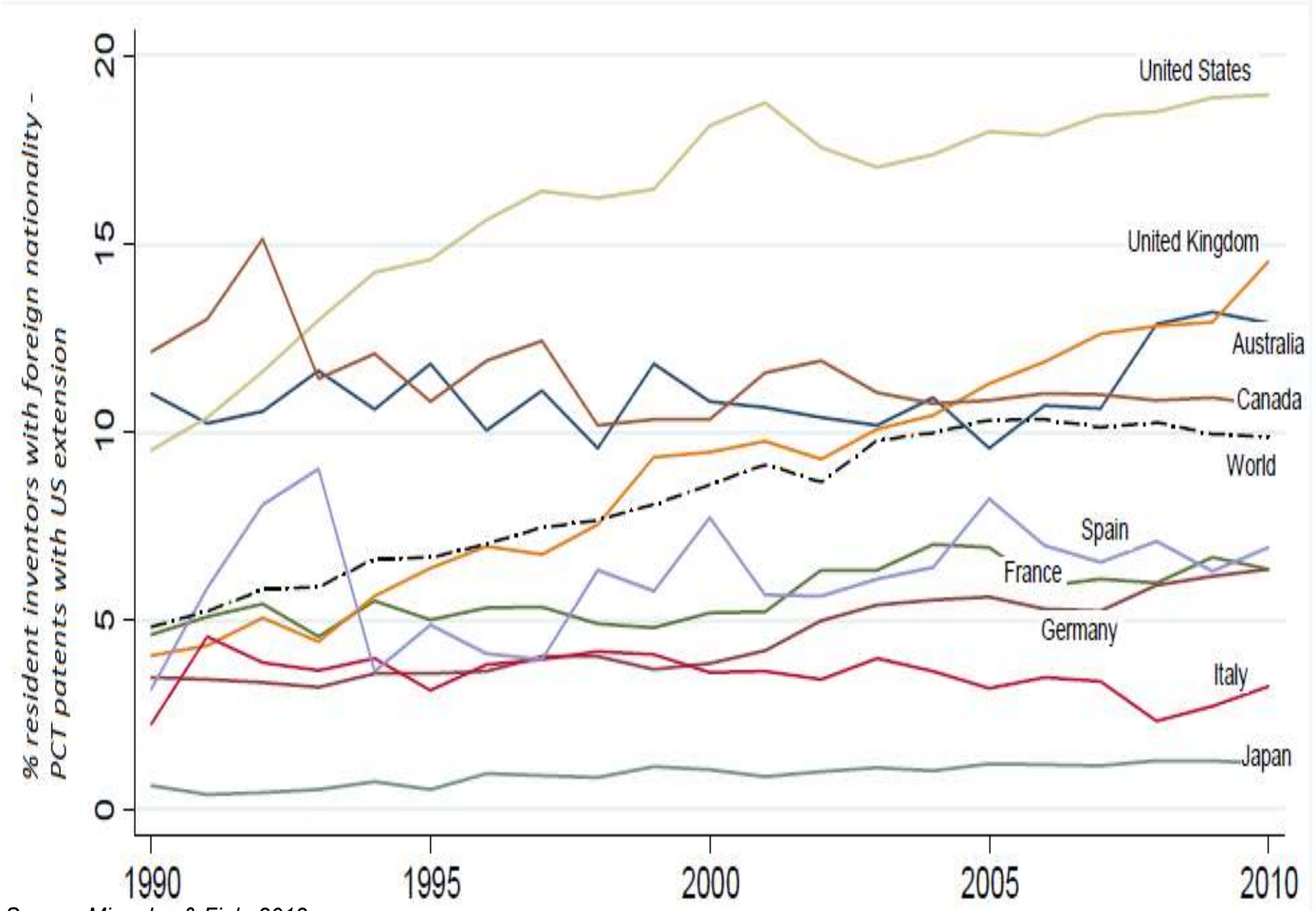
(71) Applicant *(for all designated States except US)*: **APPLE INC.** [US/US]; 1 Infinite Loop M/S 40-PAT, Cupertino, CA 95014 (US).

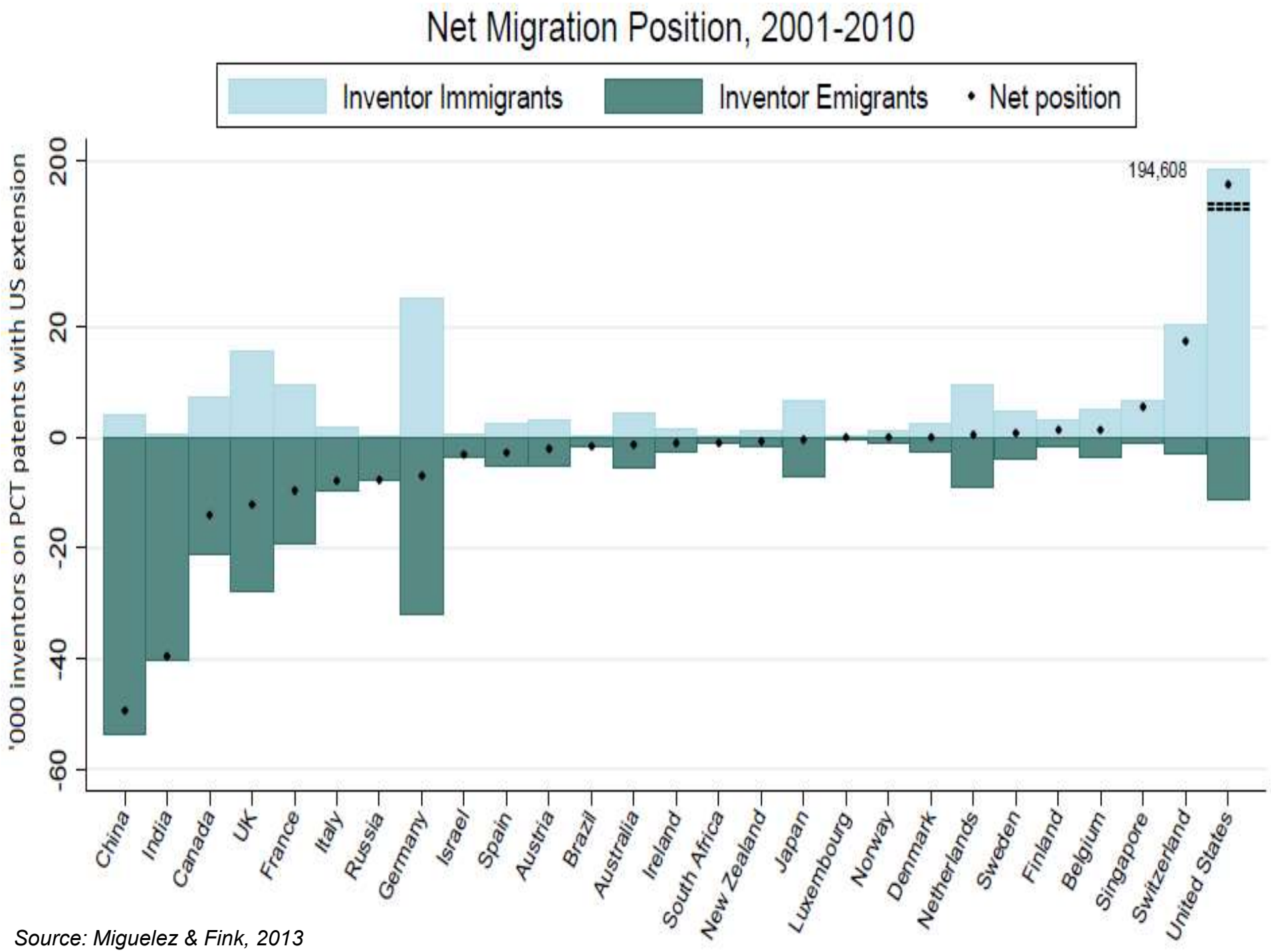
(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **CHIANG, Bing** [CN/US]; 1 Infinite Loop M/S 40-PAT, Cupertino, CA 95014 (US). **KOUGH, Douglas, Blake** [US/US]; 1 Infinite Loop M/S 40-PAT, Cupertino, CA 95014 (US). **AYALA VAZQUEZ, Enrique** [MX/US]; 1 Infinite Loop M/S 40-PAT, Cupertino, CA 95014 (US). **CAMACHO, Eduardo, Lopez** [MX/US]; 1 Infinite Loop M/S 40-PAT, Cupertino, CA 95014 (US). **SPRINGER, Gregory, Allen** [US/US]; 1 Infinite Loop M/S 40-PAT, Cupertino, CA 95014 (US).

Share of Immigrant Inventors, 1990-2010 (nationality)



Source: Miguelez & Fink, 2013



Source: Miguelez & Fink, 2013

EU15 Inventors by Main Metropolitan Regions

Native

Metropolitan Region	Inventors	Percent
Paris	26,666	7.66
London	18,074	5.19
Stuttgart	13,343	3.83
Munich	12,810	3.68
Eindhoven	11,027	3.17
Berlin	8,167	2.35
Frankfurt	7,640	2.19
Copenhagen	7,522	2.16
Stockholm	7,077	2.03
Helsinki	7,016	2.02
Ruhr district	6,435	1.85
Mannheim - Ludwigshafen	5,738	1.65
Milan	5,544	1.59
Nuremberg	5,423	1.56
Cambridge	5,322	1.53
Other	200,327	57.52
Total	348.131	100.00

Immigrant

Metropolitan Region	Inventors	Percent
Eindhoven	1,674	14.35
London	1,076	9.22
Paris	842	7.22
Munich	390	3.34
Cambridge	384	3.29
Stockholm	356	3.05
Helsinki	285	2.44
Stuttgart	248	2.13
Copenhagen	242	2.07
Berlin	237	2.03
Mannheim - Ludwigshafen	206	1.77
Brussels	204	1.75
Frankfurt	175	1.50
Achen	169	1.45
Vienna	148	1.27
Other	5,028	43.11
Total	11,664	100.00

*Given the definition of Metropolitan Regions (i.e. agglomerations of at least 250,000 inhabitants) 110,444/2,448 observations were not assigned.)

CONTEXT & MOTIVATION

- **DATA NEEDS**

- « High Skilled » is not enough → what about STEM workers and students?
- Europe as both origin and destination

- **TOPICS**
  - **MIGRATION & THE MARKET FOR STEM WORKERS**
  - **BRAIN DRAIN VS BRAIN GAIN**
  - **MIGRATION & KNOWLEDGE DIFFUSION**
  - **MIGRATION & LOCATIONAL ADVANTAGE (VARIETY)**

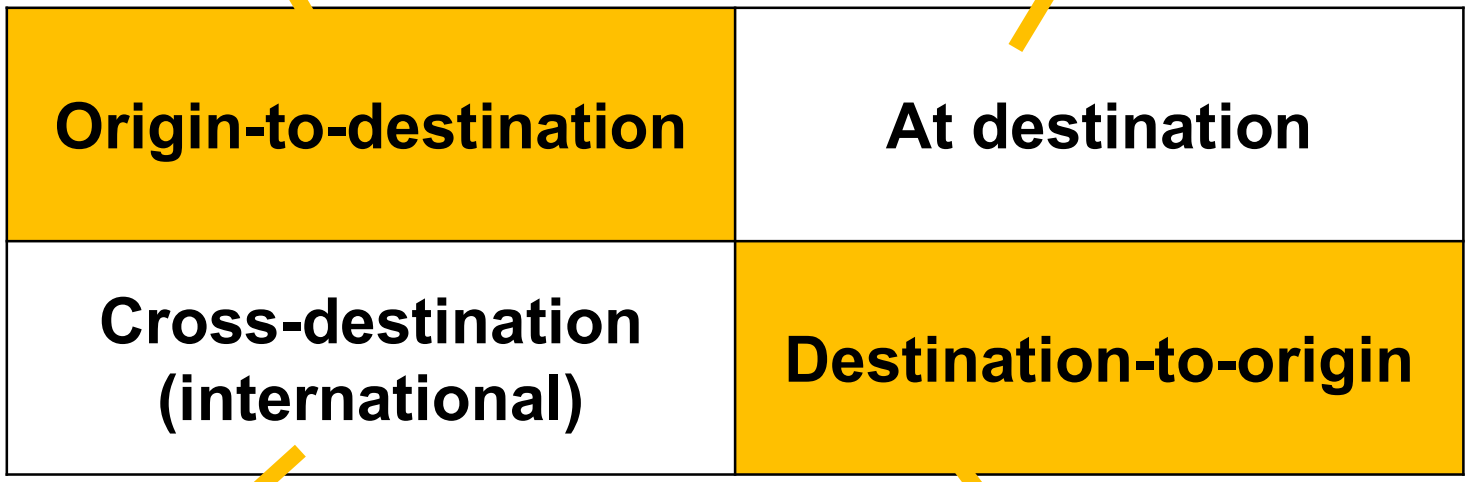
DIFFUSION

(survey by Lissoni, 2017)

MIGRATION AND DIFFUSION /1

- Classic historiography on modern Europe
- Cliometric revisitations:
- Tests of « knowledge tacitness » hp

- Sociology of minorities
- Geography: spatial limits of knowledge diffusion
- Social networks in S&T



International trade

International knowledge diffusion
Migrants and FDIs

MIGRATION AND DIFFUSION /2

Destination-to-origin

Collaborations *(Miguelez, World Bank Econ Rev, 2018)*

- WIPO-PCT patent data on inventors
- Observations are South-North "corridors", 1990-2010
- Quasi-likelihood "log-gravity model":

$$Co\text{-}inventorship_{South\text{-}North} =$$

$$= f\,(Stock\ of\ migrant\ inventors_{South \rightarrow North}\ ;\ Controls)$$

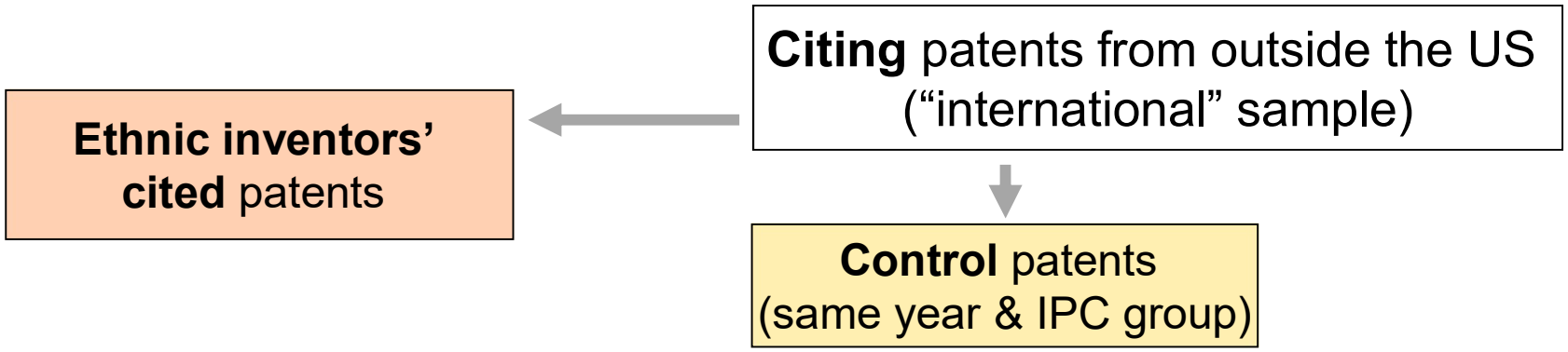
- **Δ10% migration $\rightarrow$ Δ2.0% co-inventorship**

MIGRATION AND DIFFUSION /3

Destination-to-origin

Citations *(Breschi et al., JoEG, 2017)*

- Disambiguated EP data on US-resident inventors, 1980-2010
- Name-analysis of inventors → "Ethnic" inventors from 10 important Countries of Origin (CoO)
- Social distance between inventors (co-inventorship networks)



DIRECTION OF DIFFUSION FLOWS /4

Destination-to-origin

$$Prob(y = 1) =$$
$$= f(home\ country | co - ethnicity, same\ company, social\ distance)$$

Inventors in citing (control) patent reside in the cited inventor's CoO

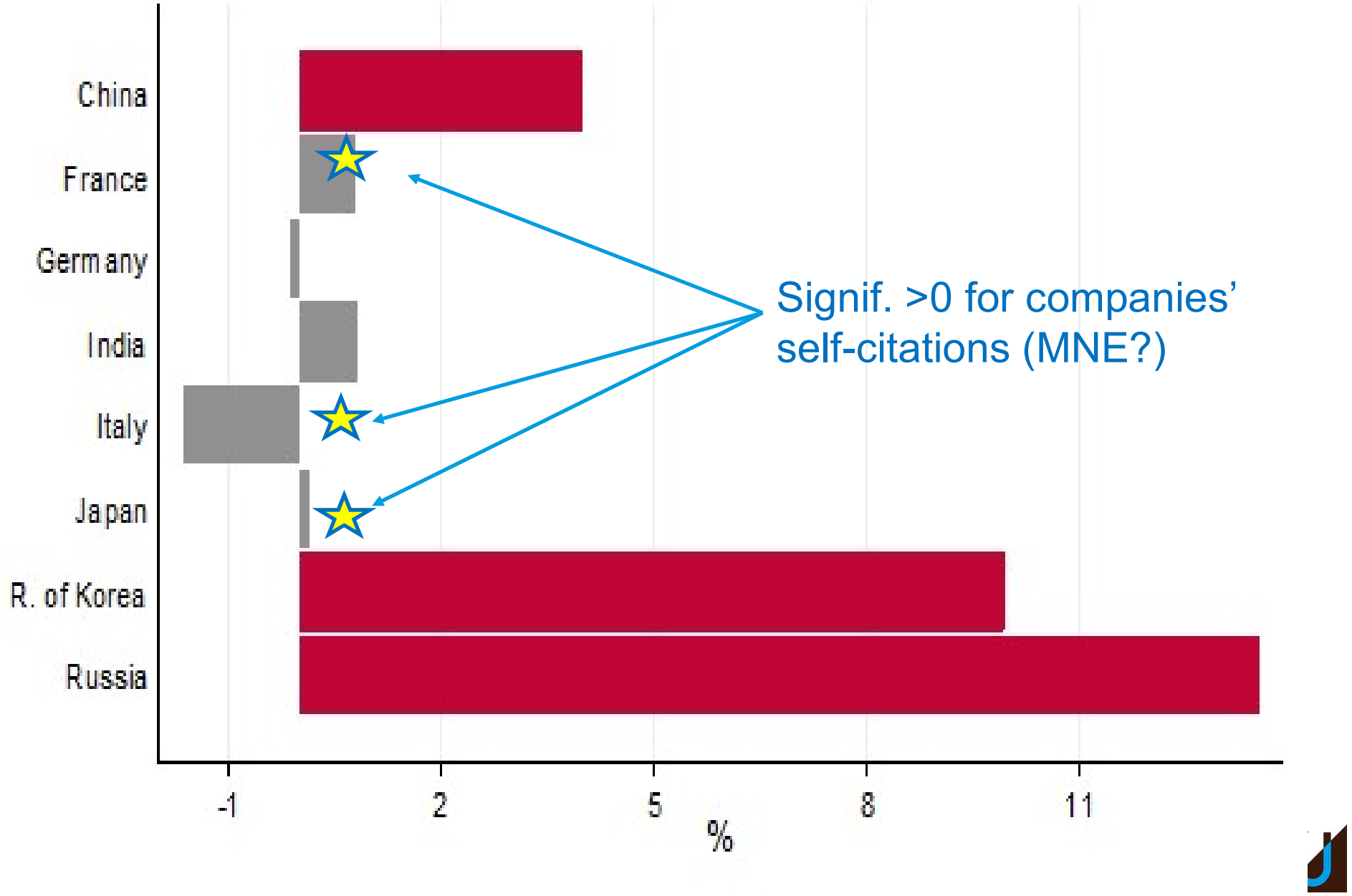
Inventors in the patent pair from the same CoO

The patents in the pair belong to the same company or business group

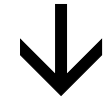
Min geodesic distance between patents in the pair, as measured on the inventor network

…

% increase of citation probability if one inventor resides in the US and the other in..



LOCATIONAL ADVANTAGE



MIGRATION-INDUCED VARIETY

Migration-induced variety → Innovation /1

- **Regional economics** : ethnic/cultural diversity of cities/regions → innovation output (productivity growth, patent counts etc.) *(survey by Kemeny, 2017)* →*TWO ISSUES*

  - Is migration-induced analysis a local public good or a firm's organizational asset, or both?

  - No separate modelling/measuring of
    - ✓ « variety » → fractionalization index (reciprocal of HH and adjustments)
    - ✓ « separation » → Polarisation indexes of beliefs and norms as per organization/human resource literature

Migration-induced variety → Innovation /2

Database

- PCT applications,1990-2010 with:
- ✓ at least at least 2 inventors + info on nationality
- ✓ all inventors residing either in the US (~400k patents) or in a country within EU15 (~486k patents)

Sample

- ~165k patents by ~347k US-resident inventors
- ~247k patents by ~472k EU15-resident inventors

Patent quality : 3*to*5*to*ALL-year forward citations, at patent family level

Inventors' migrant status:

- Foreign inventor in the US = non-US national
- Foreign inventor in EU15 = resident in country X, but not X-national

DOES DIVERSITY AFFECT INNOVATION? /1

- **Ferrucci and Lissoni (2018)** *:*
  - *do variety effects co-exist at team vs local vs firm levels?*
  - *experiment with separation measurement*

$$E(citations_i) = \beta_0 + \beta_1 team\ diversity_i + \beta_2 firm\ diversity_i + \\ + \beta_3 location\ diversity_i + \gamma C_i + \delta f_i + \epsilon_i$$

$$E(citations_i) = \beta_0 + \beta_1 team\ diversity_i + \beta_2 separation + \gamma C_i + \delta f_i + \epsilon_i$$

- ✓ $diversity_i = 1 - \sum_{m=1}^{M} s_m^2$
- ✓ $separation_i$ = Esteban&Ray's (1994) polarization index, based on Hofstede's "int'l differences in work-related values"
- ✓ s_m = share of inventors from country *m*

Table 6: Patent quality and inventor diversity at the team, firm, and location level (adjusted diversity). Negative binomial regressions (Europe and United States).

	(1) EU15	(2) US
diversity	1.198***	1.144***
	(0.0159)	(0.0109)
firm. diversity	1.295***	0.874***
	(0.0285)	(0.0185)
location diversity	1.339***	1.057*
	(0.0316)	(0.0276)
Constant	0.323***	0.810***
	(0.00637)	(0.0157)
Controls	Yes	Yes
Year dummies	Yes	Yes
Tech dummies	Yes	Yes
N	215606	143167
r2_p	0.0410	0.0432
chi2	26770.3	25623.1
ll	-403068.2	-360335.8

Exponentiated coefficients; robust standard errors in parentheses

Patent quality and inventor diversity (variety) vs separation (Negative Binomial regressions, US vs EU15)

	EU15	US
diversity	1.495***	1.291***
	(0.0428)	(0.0247)
separation	1.216	0.785***
	(0.187)	(0.0497)
Constant	0.360***	0.796***
	(0.00653)	(0.0131)
α	1.148***	1.002
Controls	Yes	Yes
Year dummies	Yes	Yes
Tech dummies	Yes	Yes
N	243460	160433
Pseudo - R^2	0.0412	0.0436
Log-likelihood	-448376.1	-404183.0

Exponentiated coefficients; Standard errors in parentheses

LESSONS FOR ITALY?

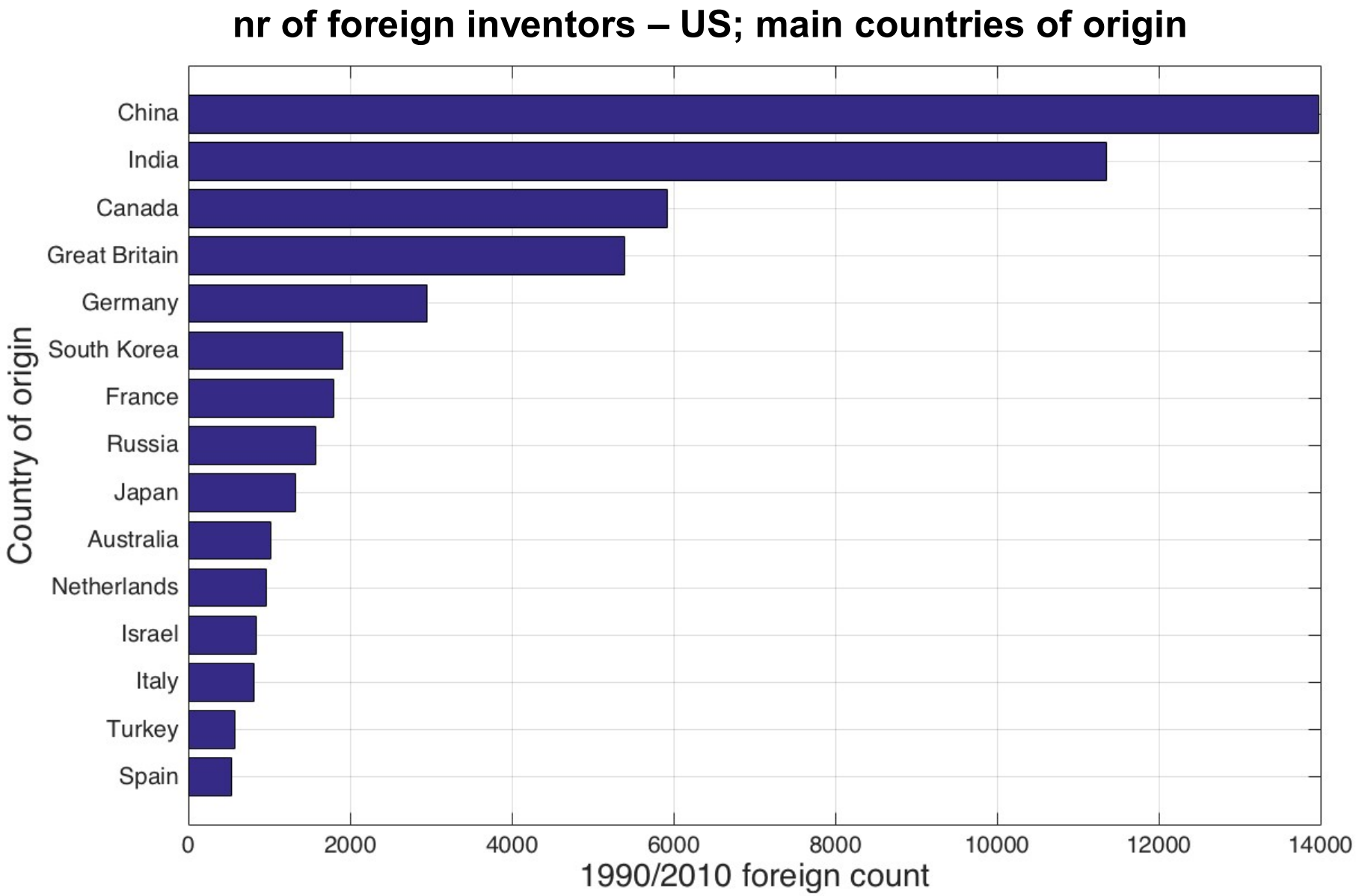
- **DATA NEEDS BEYOND HIGH-SKILLED (AND INVENTORS):**
  - Scientists, Engineers, Hi-Tech entrepreneurs, Liberal professions…

- **ITALY AS A COUNTRY OF ORIGIN**
  - What benefits from the Italian STEM diaspora?
  - Is our diaspora large enough? In Europe? In the US?
  - What emigration channels?

- **A DIVERSITY-BASED VIEW OF LOW-SKILL IMMIGRATION**
  - Does “separation” trumps “variety”?
  - Shall high-skill immigration policies target innovative cities

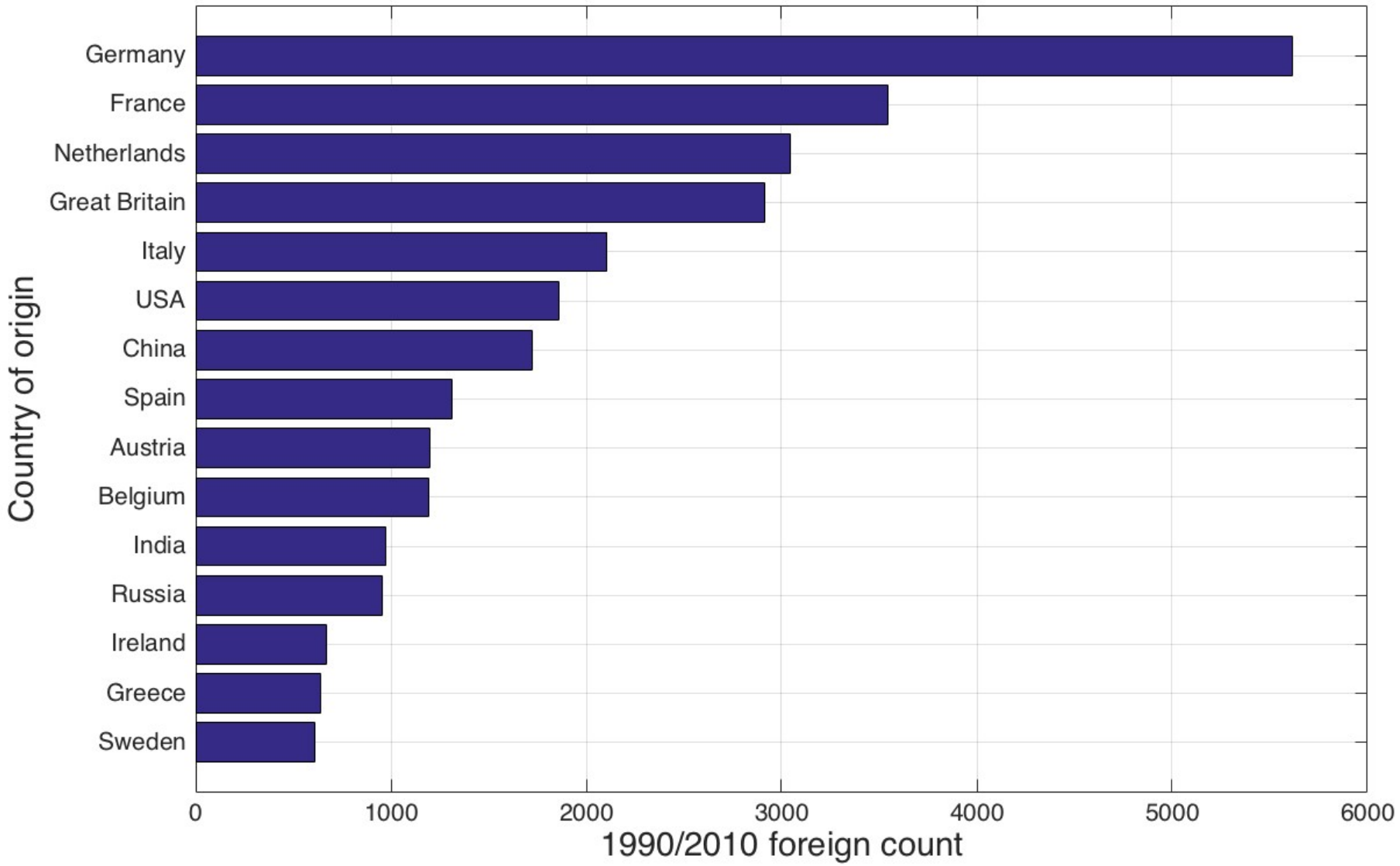
BACK-UP SLIDES

Sampling /6b – Chinese and Indian inventors in the US



Foreign inventors in EU15 are mainly intra-EU

nr of foreign inventors – EU15; main countries of origin



Impact of migrant inventors: estimation strategy

Controls

Team size: nr of inventors on the patent (correlates with presence of migrant inventors & more citations)

University: the patent applicant is an academic institution (correlates with presence of migrant inventors & more citations)

Team experience: max(nr of patents signed by each inventor on the patent at patent's priority date)

Previous collaborations: =1 if at least two co-inventors in the focal patent have been previously co-invented

International extensions: nr documents in DOCDB family of the focal patent

Triadic: =1 if patent extended in JP, US and EP

Regions: =1 if the inventors are located in different NUTS3 regions (→ spatially dispersed inventors may suffer from lack of interaction)