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Inventor diasporas and the internationalization of technology

"Patent Statistics for Decision Makers 2013"

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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

- Firms internationalize innovation activity to exploit markets and technological advantages of foreign countries.
- For developing countries, int'l cooperation provides access to frontier knowledge and possibilities to catch-up (Hall, 2011)
- BUT, **co-invention** shows strong border effects: geography, institutions, language, social capital,…
- Do high-skilled **migration** affect international transaction costs?

Outline

- Research questions
- Literature review
- Methods
- Data
- Estimation results
- Conclusions

Research Questions

- What drives int'l co-inventorship and R&D offshoring b/ developed-developing countries?
- How does inventor int'l mobility look like?
- Is there evidence of an association between highly-skilled migration and co-inventorship?
- Do ethnic inventors in firms facilitate R&D offshoring to countries associated with that ethnicity?
- When do country pairs benefit the most of migration flows?
- Is all about China and India after all?

Literature Review

- Internationalization of R&D and inventive activities and int'l co-patenting (Patel & Vega, 1999; Guellec & van Pottelberghe, 2001; Picci, 2010)
- Geography, culture, history, language, economic linkages, trust, soc. capital, market regulations, weak institutions (incl. IPRs)… hamper int'l co-patenting.
- Main conclusions: co-invention is a national phenomenon
  - Only 4.7% EPO & 6.2% USPTO - 1995 (Guellec & van Pottelberghe, 2001)
  - 8% European patents in 2005 (Picci, 2010)
  - 8-9% of PCT co-patents during the 2000s
- Few papers look at developed-developing countries co-patenting – despite its implications (Montobbio and Sterzi, 2013)

Literature Review

- Standard trade models (Heckscher–Ohlin), free movement of factors substitutes free movement of goods (Egger et al., 2012)
- Migration reduces sending country HK endowments and negatively affect FDI (Kugler & Rapoport, 2007)
- Less skilled workers in sending countries reduces incentives to set up business (including co-patenting?) - & reduces incentives to migrate

Literature Review

- BUT migrants integrate to the business community of the host country: **Network externalities** are present (Kapur & McHale, 2005)

- Migrant communities may reduce **incomplete information** problems: provide info. about business opportunities in both countries

- Migrants reduce **asymmetric information** problems: substitute for trust – where contracts enforcement is weak (& institutions, such IPRs) - & provides info. about past opportunistic behavior

- **Overcome barriers**: cultural, linguistic, institutional, administrative or geographical

Literature Review

- Migration increase trade by 1-3% (Gould, 1994; Rauch & Trindade, 2002; Head & Ries, 1998; Rauch, 2001, 2003; …)
- Are pivotal in trade of more heterogeneous products, for which non-disclosed (and tacit) information is more relevant – and prices do not convey all relevant information
- Migration & FDI: 3-5% (Gao, 2003; Tong, 2005; Javorcick et al., 2011)
- Census-based data of tertiary educated migrants are used:
  - no annual variation – census every 10 years!
  - Heterogeneity on quality of the education received
  - Rough differentiation across skills (3 levels of schooling)
- Migration and knowledge flows, particularly for inventors (Kerr, 2008; Agrawal et al., 2011; Breschi and Lissoni, 2013)
  - Homogeneity of skills
  - Upper tail of skills distribution
  - Patents are registered: large # of countries, regions, years and sectors

Literature Review

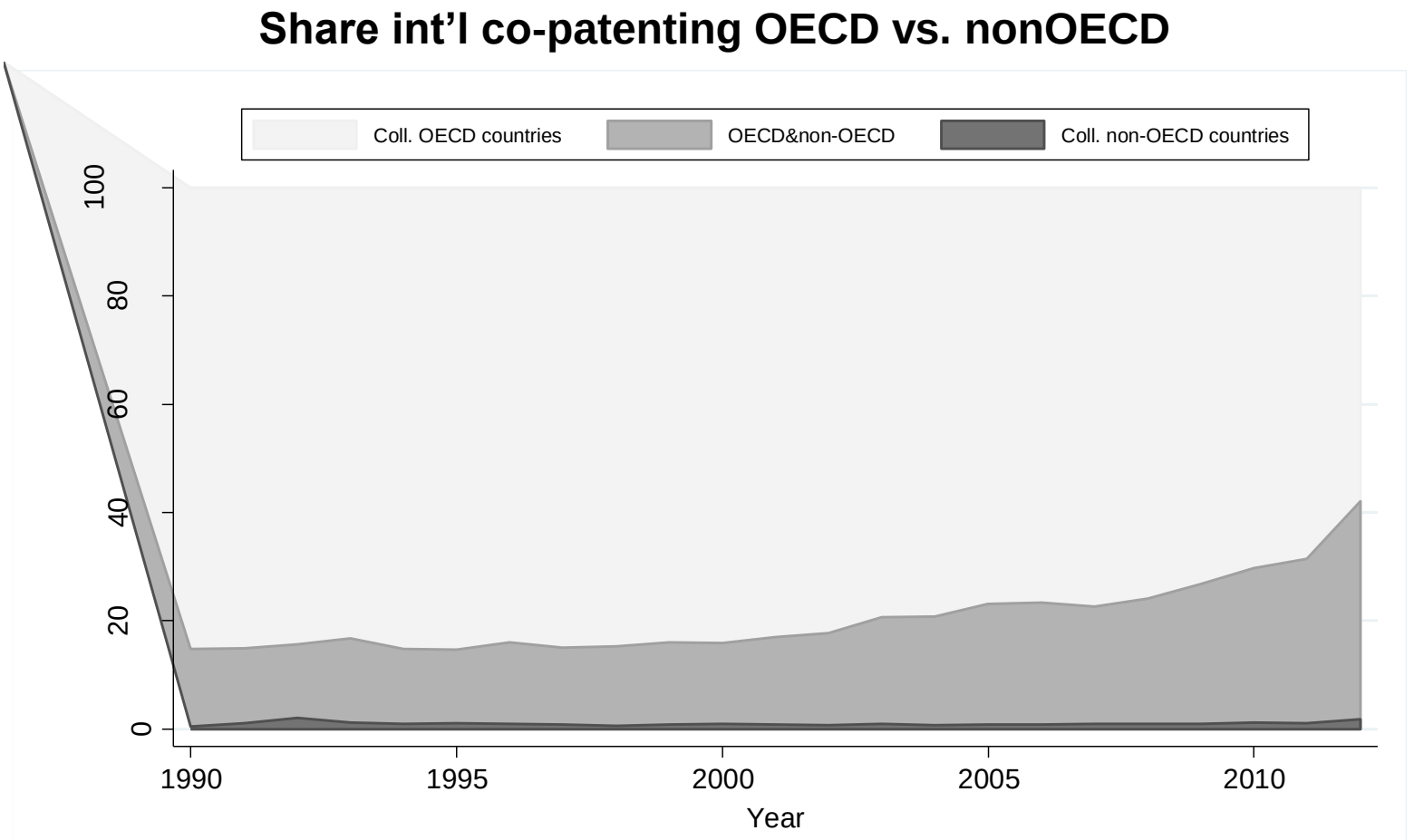
- Migration – int'l technology, less studied (e.g., Foley & Kerr, 2013)
- Majority of migration-innovation studies, the US (Breschi et al., 2013)
- FDI/trade/knowledge-diaspora studies: US, China, India,…
- Maybe the Indian and Chinese diasporas are so famous for being the exception rather than the rule (Gibson and McKenzie, 2011)
- **Is all about China and India (and the US) after all?**

Methods

- **Gravity model** the determinants of inventor-to-inventor and applicant–to-inventor international co-patenting
- Between a group of developed (20) and a group of developing countries (99).
- Annual data from 1990 to 2010
- Specific role of inventor migration in favoring international co-patenting
- **PPML**: large list of controls and fixed-effects included

$$COPAT_{ijt} = e^{\beta_0} \cdot MIGRATION_{ijt}^{\beta_1} \cdot Z_{ijt}^{\gamma_n} \cdot e^{\tau_i} \cdot e^{\tau_j} \cdot e^{\delta_t} \cdot \varepsilon_{ijt}$$

Data: dependent variable



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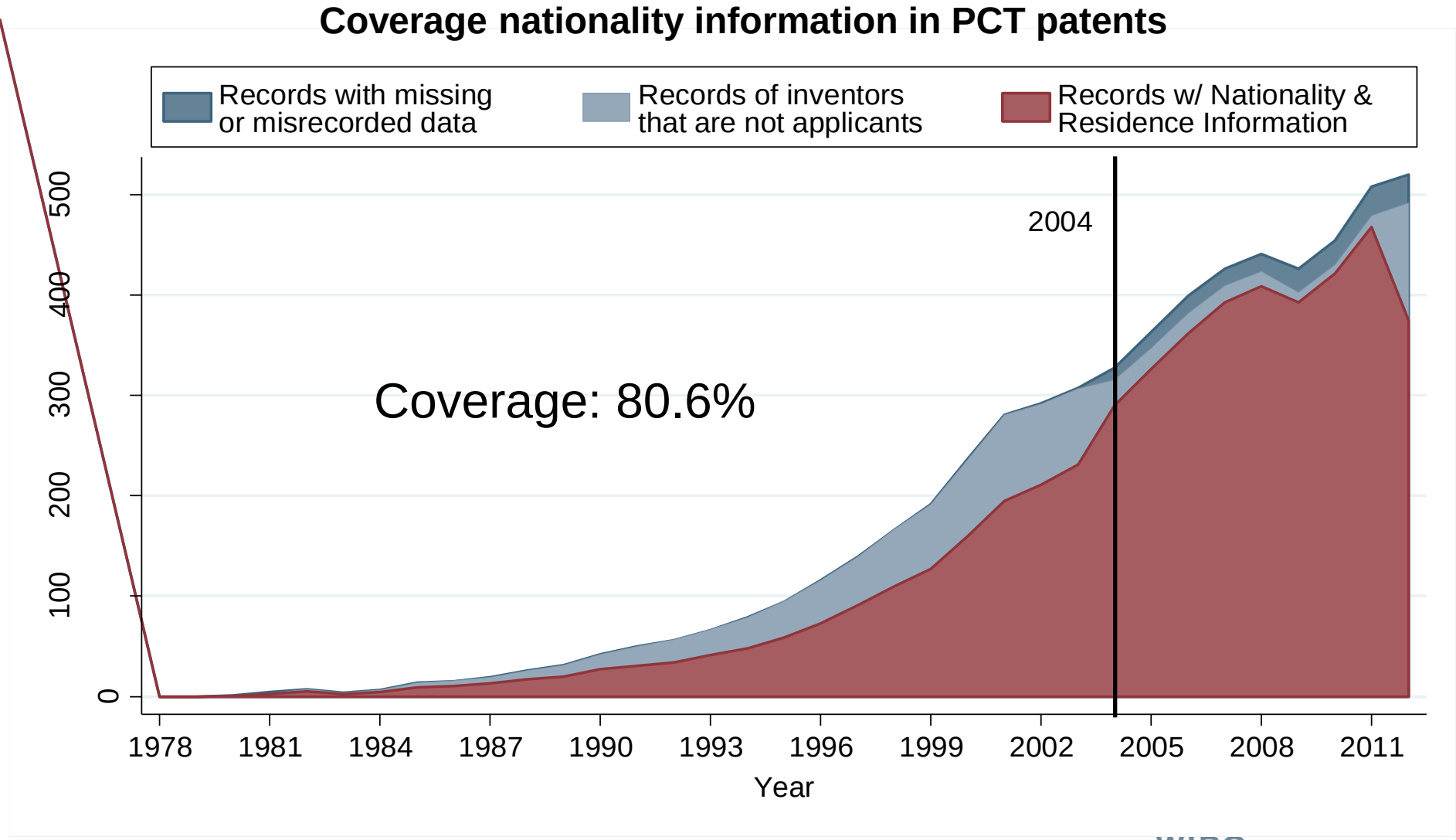
- Inventors' migratory background from PCT patents
- In order to apply for PCT patents, the applicants should be either nationals or residents of a PCT country member
- Until 2012, US laws bind the applicant also to be the inventor
- If the US was a designated state (quite frequently), nationality information was available.
- Not inferred cultural origin of inventors' names (like Kerr, 2008)
- 'Who is Who' in these patents? Not known.
- Individuals are inventor-patent pairs

Data



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Top-10 most populated corridors, 2001-2010

Largest inventor migration corridors

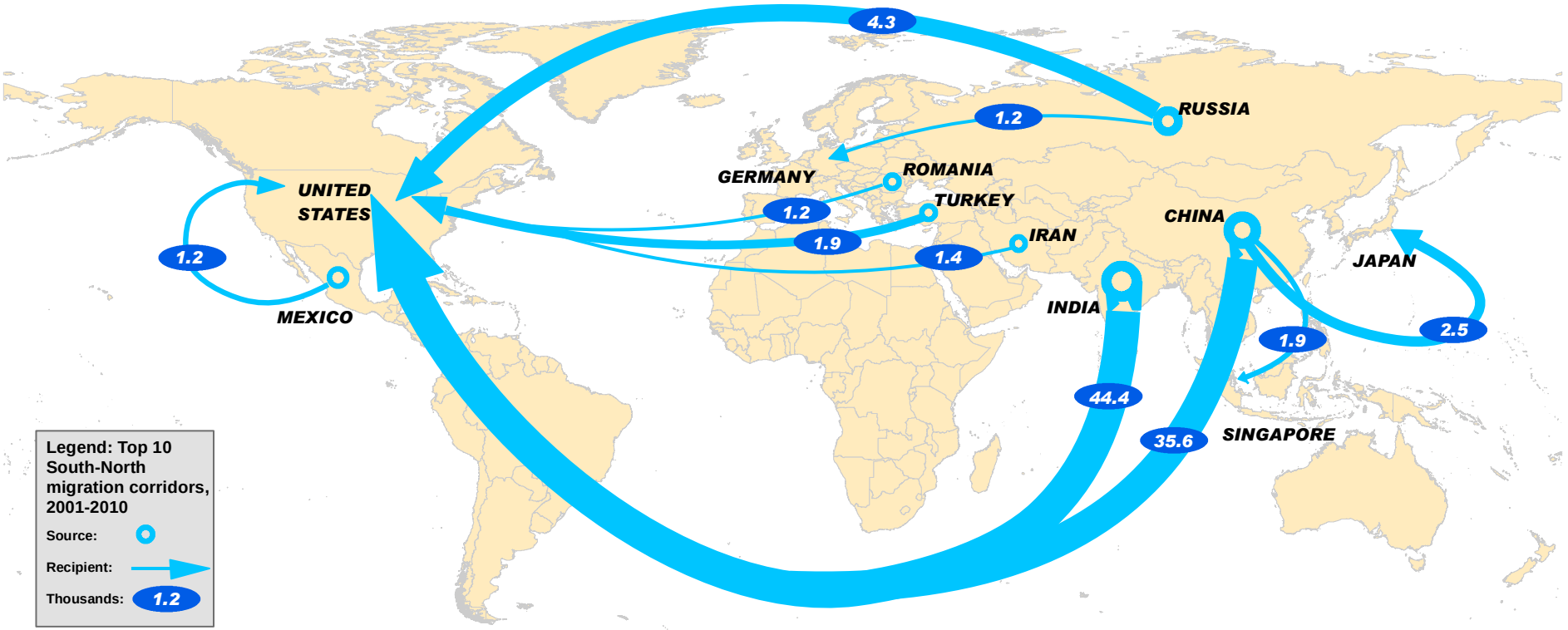
Origin	Destination	Counts
China	United States	44,444
India	United States	35,607
Canada	United States	18,745
U.K.	United States	14,897
Germany	United States	10,290
Germany	Switzerland	8,199
R. of Korea	United States	7,264
France	United States	6,540
Japan	United States	5,065
Russia	United States	4,347

Largest inventor migration corridors, limited to non-OECD sending countries

Origin	Destination	Counts
China	United States	44,444
India	United States	35,607
Russia	United States	4,347
China	Japan	2,514
China	Singapore	1,925
Turkey	United States	1,923
Iran	United States	1,442
Romania	United States	1,229
Russia	Germany	1,217
Mexico	United States	1,164

Data

Top 10 South-North migration corridors, 2001-2010



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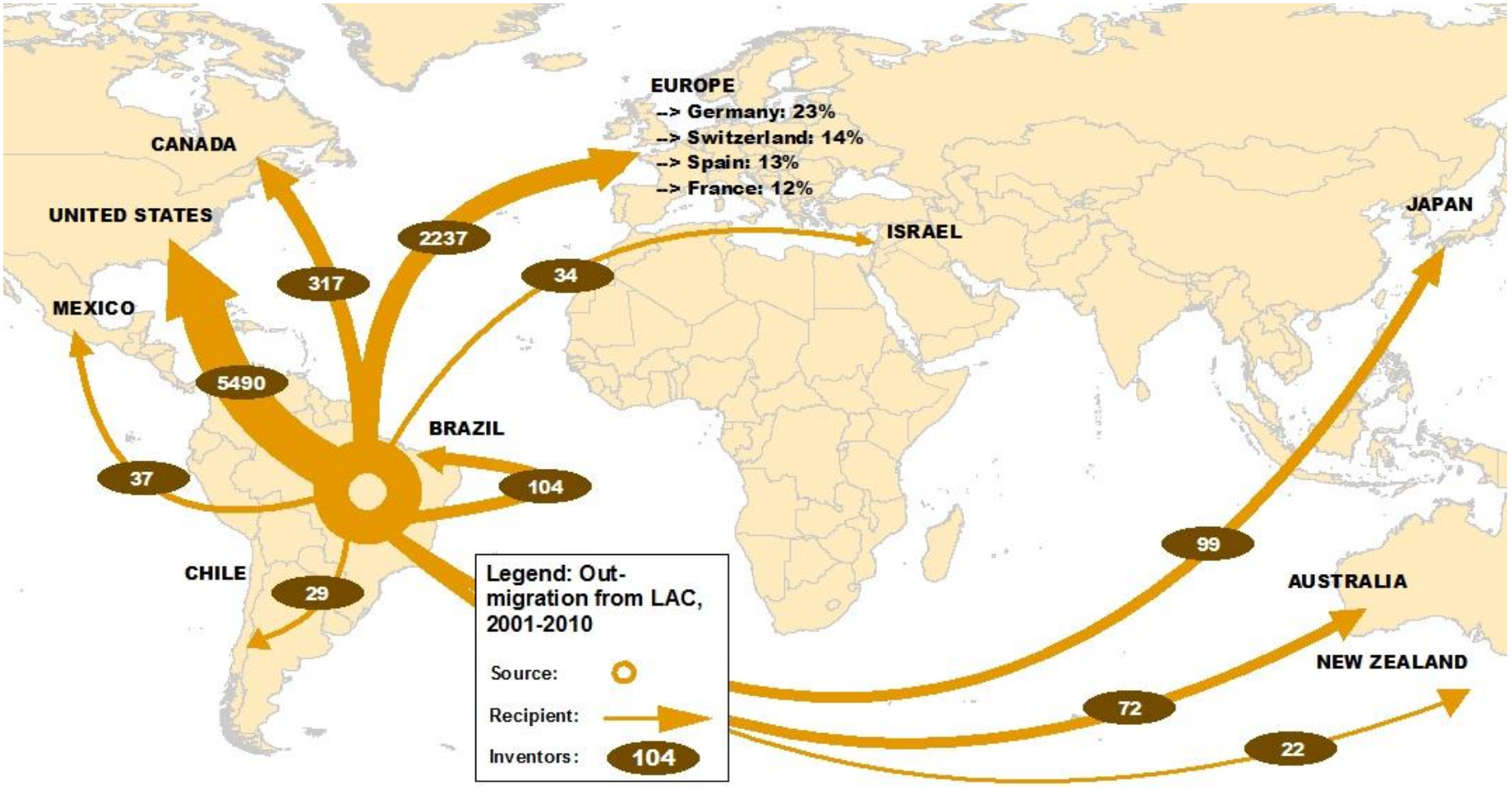
Where do Latin American inventors go?



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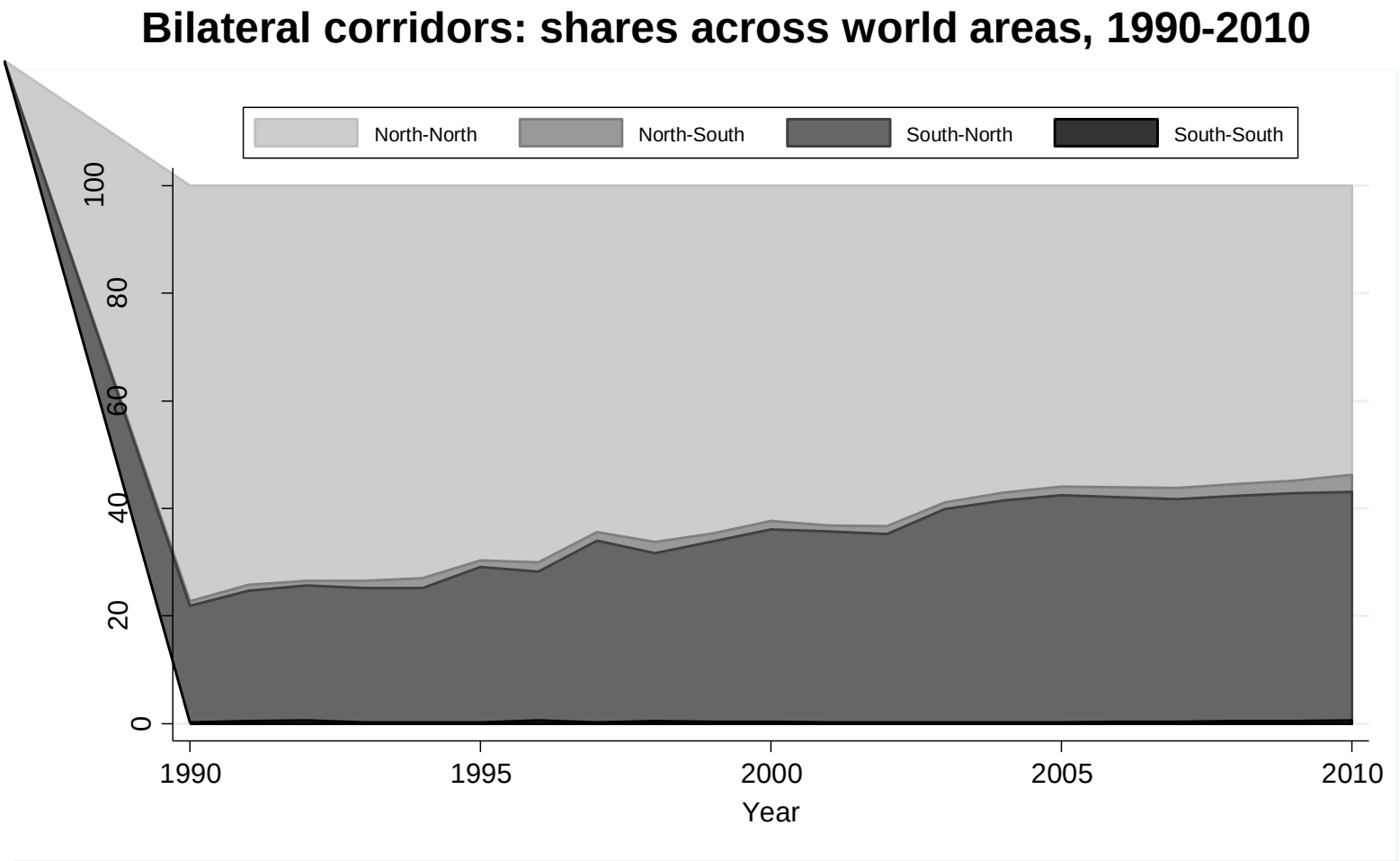

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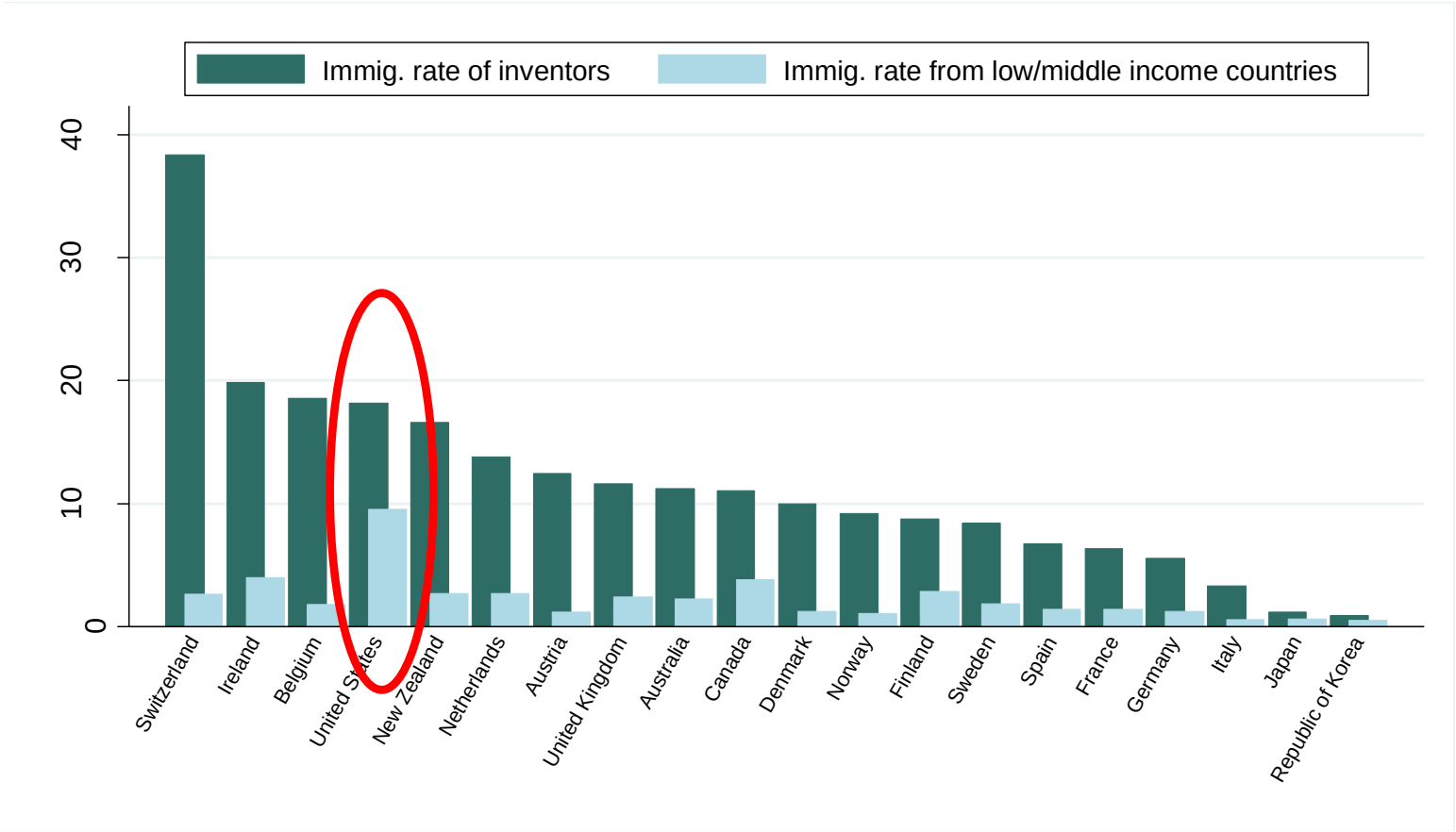
Net migration position, 2001-2010

Total migrants			South-North migrants		
Country code	**Immigrants**	**Share total immigrants**	**Country code**	**Immigrants**	**Share total immigrants**
United States	194,609	57.17%	United States	105,336	74.87%
Germany	25,341	7.44%	Germany	6,031	4.29%
Switzerland	20,416	6.00%	Singapore	4,375	3.11%
U.K.	15,758	4.63%	Japan	3,927	2.79%
Netherlands	9,665	2.84%	U.K.	3,729	2.65%
France	9,540	2.80%	Canada	2,503	1.78%
Canada	7,257	2.13%	France	2,230	1.59%
Singapore	6,720	1.97%	Netherlands	2,128	1.51%
Japan	6,715	1.97%	Switzerland	1,451	1.03%
Belgium	5,042	1.48%	Finland	1,265	0.90%

Data

Immigration rates of inventors, 2001-2010, receiving countries



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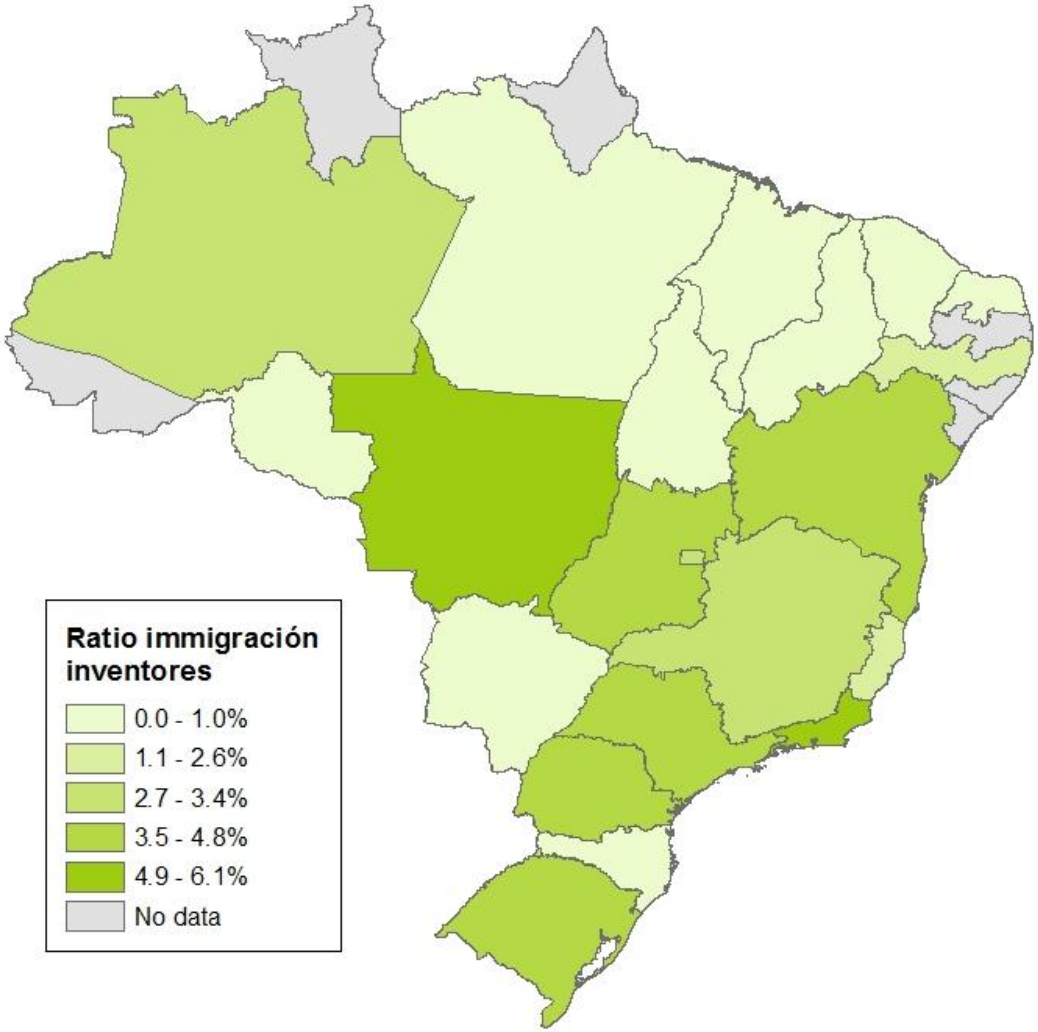
Immigration rates of inventors, 2001-2010, Brazilian states



Estado	Tasa inmigración
Rio de Janeiro	6.1
Mato Grosso	5.9
São Paulo	4.8
Bahia	4.7
Rio Grande do Sul	4.2
Paraná	4.1
Goiás	4.0

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Dependent variables

- Co-inventorship (inventor-to-inventor int'l collab.)
- R&D offshoring (applicant-to-inventor int'l collab.)

Explanatory variables

- **Immigrant inventors (# patent-inventor pairs 5-year time window)**
- **Immigrant inventors as share of destination country inventors**
- Costs: distance, contiguity, common language, colonial past (Head, Mayer and Ries, 2010, CEPII)
- Trade (COMTRADE data)
- Technological distance (correlation between IPC codes, PCT pat.)
- # patents at origin and destination
- GDP pc at origin and destination

Estimation results: PPML

	Inventor to inventor		Applicant to inventor	
ln(Diaspora)	0.181***		0.0858**	
	(0.0248)		(0.0402)	
ln(Diaspora share)		0.286***		0.170***
		(0.0268)		(0.0493)
ln(Distance)	-0.275***	-0.239***	-0.0977	-0.0684
	(0.0686)	(0.0674)	(0.0885)	(0.0890)
Contiguity	-0.0248	0.0122	-0.143	-0.103
	(0.125)	(0.122)	(0.220)	(0.224)
Common language	0.534***	0.501***	0.743***	0.715***
	(0.115)	(0.112)	(0.187)	(0.189)
Colonial links	0.166	0.148	0.374**	0.356**
	(0.131)	(0.126)	(0.172)	(0.181)
ln(EXP+IMP)	0.0720***	0.0552***	0.0901***	0.0748**
	(0.0236)	(0.0204)	(0.0305)	(0.0291)
ln(Tech.distance)	-0.0963**	-0.0887**	-0.277***	-0.269***
	(0.0431)	(0.0431)	(0.0567)	(0.0563)
ln(# patents) orig.	0.321***	0.331***	0.344***	0.343***
	(0.0581)	(0.0513)	(0.0734)	(0.0696)
ln(# patents) dest.	0.0297	0.0994	0.368	0.408
	(0.135)	(0.139)	(0.254)	(0.266)
ln(GDP p.c.) orig.	1.224***	1.218***	1.851***	1.834***
	(0.241)	(0.197)	(0.335)	(0.310)
ln(GDP p.c.) dest.	-0.394	-0.933	-0.925	-1.247
	(0.593)	(0.607)	(0.873)	(0.870)
Observations	31,680	31,680	32,400	32,400
Pseudo R2	0.959	0.960	0.915	0.913
Origin FE	Yes	Yes	Yes	Yes
Destination FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

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Estimation results: PPML country trends

	Inventor to inventor		Applicant to inventor	
ln(Diaspora)	0.227***		0.121***	
	(0.0260)		(0.0396)	
ln(Diaspora share)		0.263***		0.121***
		(0.0256)		(0.0441)
ln(Distance)	-0.0263	-0.0707	0.137*	0.114
	(0.0599)	(0.0608)	(0.0784)	(0.0802)
Contiguity	-0.168	-0.182	-0.299	-0.312
	(0.115)	(0.113)	(0.207)	(0.208)
Common language	0.316***	0.320***	0.540***	0.548***
	(0.0976)	(0.0944)	(0.161)	(0.161)
Colonial links	0.158	0.180*	0.334**	0.348**
	(0.106)	(0.108)	(0.146)	(0.145)
ln(EXP+IMP)	0.257***	0.239***	0.307***	0.306***
	(0.0390)	(0.0397)	(0.0534)	(0.0552)
ln(Tech.distance)	-0.185***	-0.200***	-0.341***	-0.349***
	(0.0501)	(0.0504)	(0.0719)	(0.0723)
Constant	-1.089*	2.117***	-3.214***	-1.655**
	(0.607)	(0.596)	(0.760)	(0.831)
Observations	20,757	20,757	23,300	23,300
Pseudo R2	0.978	0.977	0.953	0.953
Origin FE	Yes	Yes	Yes	Yes
Destination FE	Yes	Yes	Yes	Yes
Year FE	No	No	No	No
Origin FE*Time FE	Yes	Yes	Yes	Yes
Destination FE*Time FE	Yes	Yes	Yes	Yes

Estimation results: PPML

	No BRICS	No US	No BRICS, no US	No BRICS, no US
ln(Diaspora)	0.159***	0.204***	0.188***	0.191***
	(0.0392)	(0.0372)	(0.0433)	(0.0469)
ln(Distance)	-0.381***	-0.323***	-0.465***	-0.265***
	(0.0680)	(0.0617)	(0.0706)	(0.0827)
Contiguity	-0.128	-0.224	-0.284*	-0.332**
	(0.124)	(0.145)	(0.160)	(0.157)
Common language	0.667***	0.285**	0.293*	0.216
	(0.166)	(0.128)	(0.157)	(0.150)
Colonial links	0.139	0.360***	0.407***	0.341**
	(0.160)	(0.120)	(0.148)	(0.142)
ln(EXP+IMP)	0.108***	0.0281	0.0595**	0.226***
	(0.0259)	(0.0211)	(0.0240)	(0.0468)
ln(Tech.distance)	-0.122**	-0.0163	0.0309	-0.0121
	(0.0604)	(0.0667)	(0.0685)	(0.0816)
Controls	Yes	Yes	Yes	No
Observations	33,620	32,680	30,799	15,820
Origin FE	Yes	Yes	Yes	Yes
Destination FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	No
Origin FE*Time FE	No	No	No	Yes
Destination FE*Time FE	No	No	No	Yes
Destination FE*Time FE	No	No	No	Yes

Estimation results: cultural proximity

- Which countries benefit the most of their emigrant inventors abroad?
- **Hypothesis:** impact of migration on technology internationalization is strongest where information problems are more acute (more culturally distant countries)
- Potential for migration to alleviate informational frictions is higher for culturally distant countries.
- Evidence of **causal effects**

	(1)	(2)	(3)
	Inventor-to-inventor co-patents		
	PPML	PPML	PPML
ln(Diaspora)	0.187***	0.174***	0.182***
	(0.0260)	(0.0252)	(0.0260)
ln(Distance)	-0.249***	-0.257***	-0.252***
	(0.0555)	(0.0546)	(0.0555)
Contiguity	0.0141	0.0185	0.0336
	(0.122)	(0.118)	(0.119)
Common language	0.657***	0.528***	0.639***
	(0.199)	(0.113)	(0.201)
Colonial links	0.126	0.626**	0.583**
	(0.139)	(0.246)	(0.262)
ln(Diaspora)* Language	-0.0216		-0.0189
	(0.0224)		(0.0228)
ln(Diaspora)*Colonial		-0.120**	-0.117**
		(0.0486)	(0.0497)
Other controls	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes

Estimation results: GMM

5 Instruments

1. Bilateral migration 1960
2. Square bilateral migration 1960
3. Temporary guest-worker agreement 1960s & 1970s
4. Bilateral **unskilled** migration 1990
5. Square bilateral **unskilled** migration 1990

	(4)	(5)
	Inventor-to-inventor	Applicant-to-inventor
	GMM	GMM
ln(Diaspora)	0.226***	0.106
	(0.0759)	(0.141)
ln(Distance)	-0.207***	-0.152*
	(0.0637)	(0.0886)
Contiguity	0.00230	-0.147
	(0.123)	(0.204)
Common language	0.497***	0.714***
	(0.115)	(0.208)
Colonial links	0.169	0.302*
	(0.125)	(0.173)
ln(EXP+IMP)	0.100***	0.0772*
	(0.0335)	(0.0400)
ln(Tech.distance)	-0.0992**	-0.279***
	(0.0463)	(0.0601)
Other controls	Yes	Yes
Fixed effects	Yes	Yes

Estimation results: robustness

	(1)	(2)	(3)	(4)
	OLS	Zero-inflated Poisson	PPML	PPML
ln(Diaspora)	0.233***	0.251***	0.219***	0.261***
	(0.0159)	(0.0252)	(0.0476)	(0.0591)
ln(Distance)	0.00813	-0.0846		
	(0.0146)	(0.0600)		
Contiguity	0.318	0.122		
	(0.204)	(0.117)		
Common language	0.00133	0.489***		
	(0.0286)	(0.111)		
Colonial links	-0.0151	-0.0459		
	(0.0400)	(0.118)		
ln(EXP+IMP)	0.0129***	0.0694***	0.0825***	0.316***
	(0.00310)	(0.0266)	(0.0237)	(0.0561)
ln(Tech.distance)	-0.148***	-0.0663	0.0533	-0.167*
	(0.0343)	(0.0424)	(0.0531)	(0.0911)
Individual country controls	No	Yes	Yes	No
Observations	37,540	37,540	21,301	17,619
Pseudo R2	0.638		0.963	0.986
Origin FE	Yes	Yes	No	No
Destination FE	Yes	Yes	No	No
Year FE	No	Yes	Yes	No
Origin FE*Time FE	Yes	No	No	Yes
Dest. FE*Time FE	Yes	No	No	Yes
Country-Pair FE	No	No	Yes	Yes

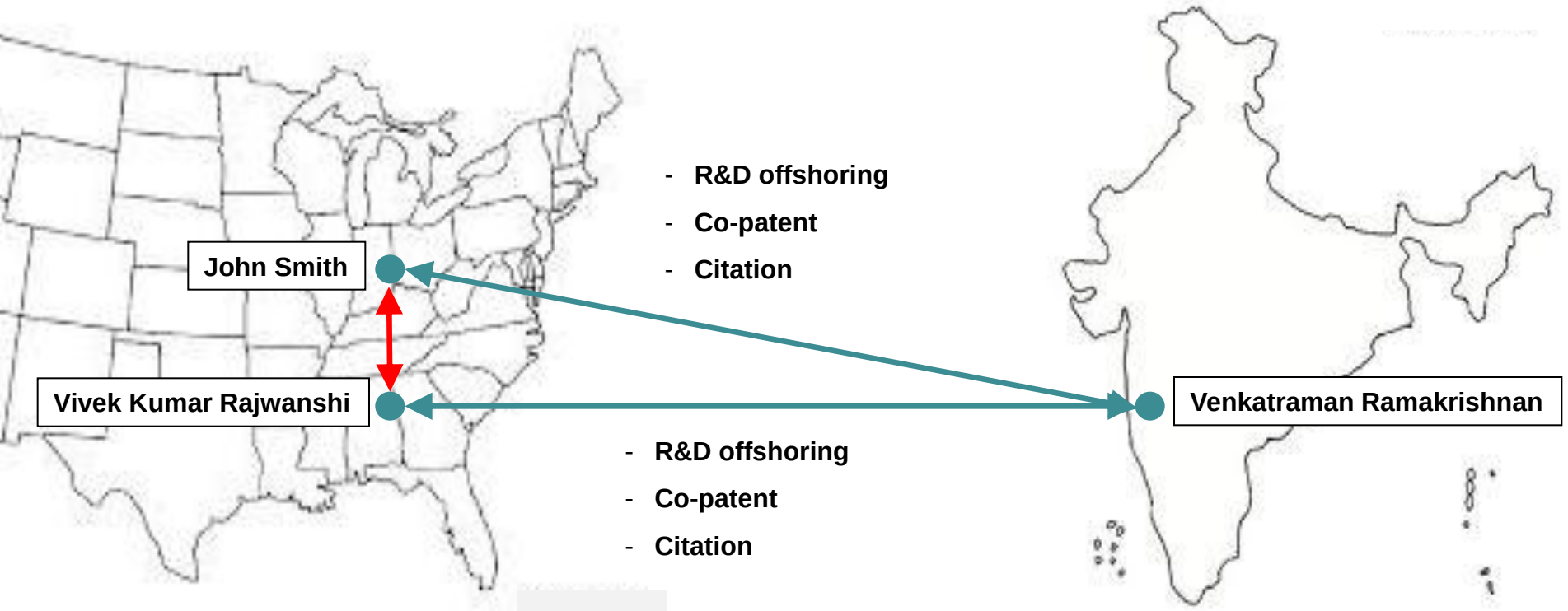
Conclusions

- Robust positive relation b/ inventor migration & co-inventorship
- Not dependent on India, China or the US (not in Kerr, 2008)
- Larger impact for country pairs with high informational frictions
- Other dimensions of cultural proximity: language similarity, religion similarity, values (Hofstede, World Values Survey),…
- **Implications:** loss of human capital, partially mitigated
- BUT weaker for R&D offshoring: more formal and hierarchical relations, contracts less tacit and contract enforcement is possible – **not brain *gain***
- *Ernest Miguélez & Carsten Fink (2013) "Measuring the International Mobility of Inventors: A New Database" WIPO WP8*

Future steps

- Migrants' ***direct effect:*** foreign inventor direct interaction with his homeland

- Migrants' ***indirect effect:*** foreign inventor's role in leveraging their home country reputation in int'l business (EXTERNALITIES)



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Thanks!

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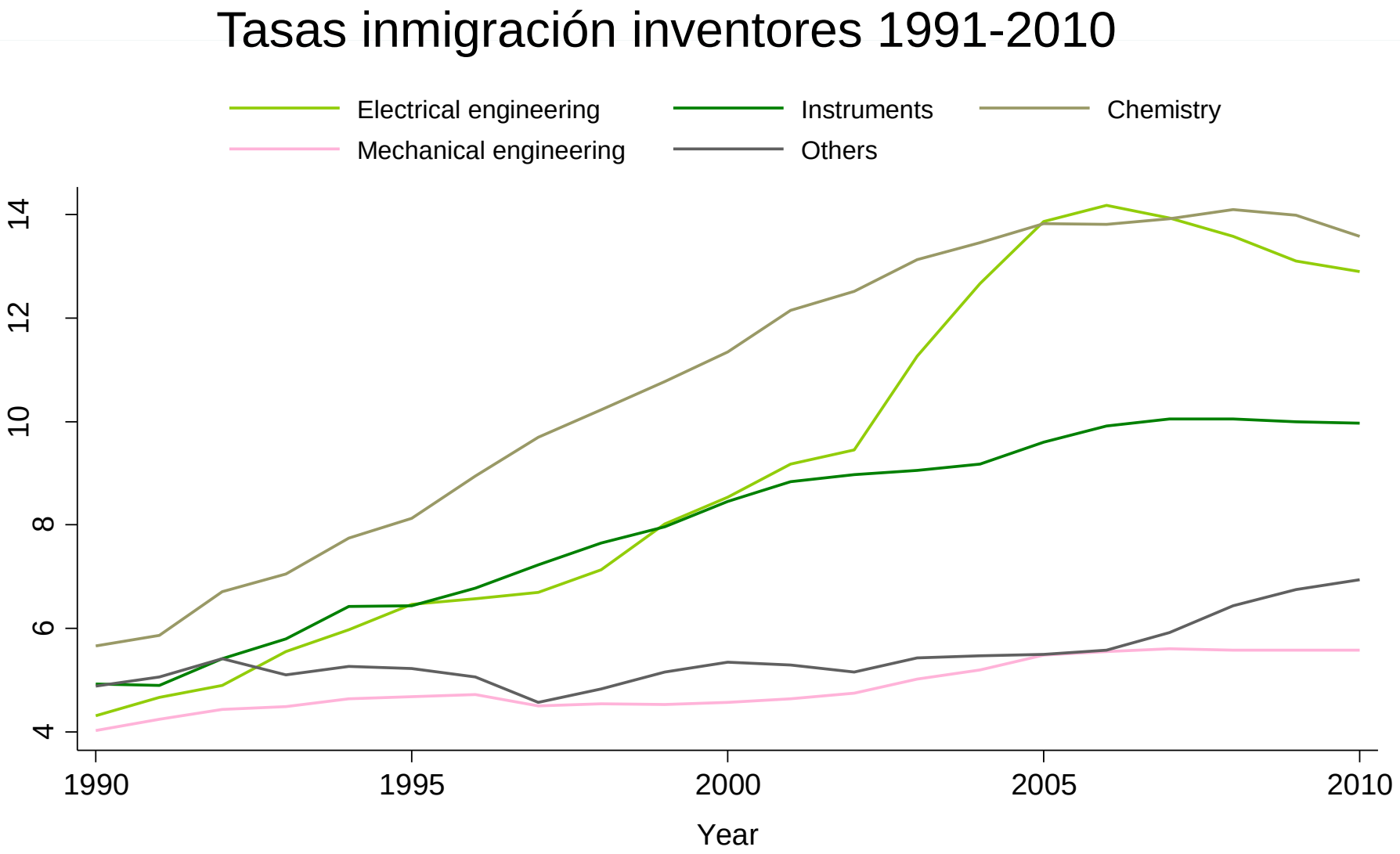
Estimation results: SECTORS

	Electrical engineering	Instruments	Chemistry	Mechanical
ln(Diaspora)	0.221***	0.169***	0.161***	0.159***
	(0.0443)	(0.0290)	(0.0238)	(0.0367)
ln(Distance)	-0.0931	-0.391***	-0.298***	-0.434***
	(0.0881)	(0.0673)	(0.0695)	(0.0826)
Contiguity	0.0308	0.289*	-0.240	0.310
	(0.247)	(0.151)	(0.177)	(0.198)
Common language	0.255	0.834***	0.455***	0.545***
	(0.216)	(0.123)	(0.118)	(0.137)
Colonial links	0.104	-0.0714	0.266*	0.159
	(0.188)	(0.155)	(0.158)	(0.164)
ln(EXP+IMP)	0.166***	0.0628*	0.0719***	0.0234
	(0.0537)	(0.0357)	(0.0265)	(0.0467)
ln(Tech.distance)	-0.230***	0.0149	0.0485	-0.0599
	(0.0719)	(0.0527)	(0.0517)	(0.0696)
Controls	Yes	Yes	Yes	Yes
Observations	25,920	25,600	33,200	24,660
Pseudo R2	0.933	0.891	0.912	0.808
Origin FE	Yes	Yes	Yes	Yes
Destination FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Diferencias tecnologías



Electrical engineering	Electrical machinery, energy	Chemistry	Organic fine chemistry
Electrical engineering	Audio-visual technology	Chemistry	Biotechnology
Electrical engineering	Telecommunications	Chemistry	Pharmaceuticals
Electrical engineering	Digital communication	Chemistry	Macromolecular chemistry, polymers
Electrical engineering	Basic communication processes	Chemistry	Food chemistry
Electrical engineering	Computer technology	Chemistry	Basic materials chemistry
Electrical engineering	IT methods for management	Chemistry	Materials metallurgy
Electrical engineering	Semiconductors	Chemistry	Surface tech coating
Instruments	Optics	Chemistry	Micro-structure and nano-technology
Instruments	Measurement	Chemistry	Chemical engineering
Instruments	Analysis of bio materials	Chemistry	Environmental technology
Instruments	Control apparatus	Mechanical engine.	Handling
Instruments	Medical technology	Mechanical engine.	Machine tools
		Mechanical engine.	Engines, pumps, turbines
		Mechanical engine.	Textile and paper
		Mechanical engine.	Other spec machines
		Mechanical engine.	Thermal processes and apparatus
		Mechanical engine.	Mechanical elements
		Mechanical engine.	Transport

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH,

[Continued on next page]

(54) Title: APPARATUS AND METHOD FOR CALCULATING A SHA-2 HASH FUNCTION IN A GENERAL PURPOSE PRO-

Data: inventorship in the US

In the United States, a patent application must be filed in the name of the inventors. This requirement that a patent be issued in the name of the inventors is derived from the intellectual property clause of the United States Constitution:

The Congress shall have power . . . To promote the progress of science and useful arts, by securing for limited times to authors and ***inventors*** *the exclusive right to their respective writings and discoveries. (emphasis added)*

The requirement that the applicant for a patent be the inventor is a characteristic of U.S. patent law not generally shared by other countries.

Up to now, corporations were never considered patent applicants. Rather, inventors were the applicants. Even when the ultimate rights were owned by a corporate entity, the USPTO still focused on the inventors as the patent applicants. Under the new rules being implemented on September 16, 2012, the status of "patent applicant" will no longer be keyed to inventorship but instead ownership. Thus, any juristic entity who can show a proprietary interest will be permitted to file and prosecute a patent application as the patent applicant.

On 16 September 2011, the United States of America (U.S.) enacted changes to its patent law under the Leahy-Smith America Invents Act (AIA). The AIA changes, among other things, who is entitled to be an applicant in U.S. national applications.

For international applications filed on or after 16 September 2012, inventors no longer have to be indicated as applicants for the purposes of the U.S. designation. Instead, the assignee or other person to whom the inventor is under an obligation to assign the invention, or who otherwise shows sufficient proprietary interest in the matter, may be indicated as the applicant for the U.S. designation.

Estimation results: robustness

	(1)	(2)	(3)	(4)
	Inventor-to-inventor co-patents			
ln(Diaspora)	0.208***	0.188***	0.208***	0.247***
	(0.0252)	(0.0247)	(0.0252)	(0.0289)
ln(Diaspora share)	-0.287***	-0.264***	-0.287***	-0.276***
	(0.0612)	(0.0555)	(0.0612)	(0.0585)
ln(Distance)	0.0312	0.0211	0.0312	0.0441
	(0.126)	(0.123)	(0.126)	(0.126)
Contiguity	0.567***	0.545***	0.567***	0.534***
	(0.122)	(0.115)	(0.122)	(0.118)
Common language	0.137	0.151	0.137	0.134
	(0.133)	(0.131)	(0.133)	(0.129)
Colonial links	0.0303	0.0549**	0.0303	0.0166
	(0.0355)	(0.0250)	(0.0355)	(0.0336)
ln(EXP+IMP)	-0.0341	-0.0632	-0.0341	-0.0227
	(0.0585)	(0.0517)	(0.0585)	(0.0586)
ln(Tech.distance)	0.208***	0.188***	0.208***	0.247***
	(0.0252)	(0.0247)	(0.0252)	(0.0289)
ln(pat_ori+pat_dest)	0.112			
	(0.0939)			
ln(pat_ori*pat_dest)		0.216***		
		(0.0532)		
(pat_ori - pat_dest)			0.112	0.0666
			(0.0939)	(0.0967)
ln[(pat_ori+pat_dest)/2]				1.06e-06***
				(4.10e-07)
ln(GDP p.c.) orig.	1.705***	1.352***	1.705***	1.650***
	(0.248)	(0.259)	(0.248)	(0.228)
ln(GDP p.c.) dest.	0.122	-0.0915	0.122	-0.106
	(0.650)	(0.626)	(0.650)	(0.680)
Observations	35,600	35,600	35,600	35,600

Estimation results: robustness

DEPENDENT VARIABLE:	(1)	(2)	(3)	(4)	(5)
	# co-patents			# co-patents/ [(# patents) orig+ (# patents)dest]	
Diaspora as % of all emigrants	0.0115***				
	(0.00163)				
Diaspora as % of all emigrants (*100)		1.151***			
		(0.163)			
ln(Diaspora as % of all emigrants)			0.124***		
			(0.0173)		
lndiaspora5				0.286***	0.288***
				(0.0600)	(0.0598)
ln(Distance)	-0.289***	-0.289***	-0.215***	-0.472***	-0.457***
	(0.0523)	(0.0523)	(0.0594)	(0.0826)	(0.0801)
Contiguity	-0.100	-0.100	-0.0173	-0.270	-0.227
	(0.126)	(0.126)	(0.123)	(0.249)	(0.258)
Common language	0.494***	0.494***	0.515***	0.407**	0.410**
	(0.111)	(0.111)	(0.115)	(0.204)	(0.207)
Colonial links	0.245*	0.245*	0.163	0.684***	0.690***
	(0.127)	(0.127)	(0.131)	(0.207)	(0.214)
ln(EXP+IMP)	0.0887***	0.0887***	0.105***	-0.0312	-0.0369
	(0.0222)	(0.0222)	(0.0232)	(0.0475)	(0.0491)
ln(Tech.distance)	-0.105**	-0.105**	-0.0960**	-0.0745	-0.0453
	(0.0454)	(0.0454)	(0.0443)	(0.0630)	(0.0700)
ln(# patents) orig.	0.345***	0.345***	0.360***	0.0957*	
	(0.0506)	(0.0506)	(0.0483)	(0.0537)	
ln(# patents) dest.	0.0886	0.0886	-0.0520	-0.887***	
	(0.111)	(0.111)	(0.115)	(0.195)	
ln(GDP p.c.) orig.	1.224***	1.224***	1.259***	1.005***	1.153***
	(0.244)	(0.244)	(0.220)	(0.218)	(0.230)
ln(GDP p.c.) dest.	-0.294	-0.294	-0.235	1.583	-0.468
	(0.535)	(0.535)	(0.555)	(1.352)	(1.280)
Observations	30,780	30,780	30,780	35,600	35,600

Estimation results: robustness

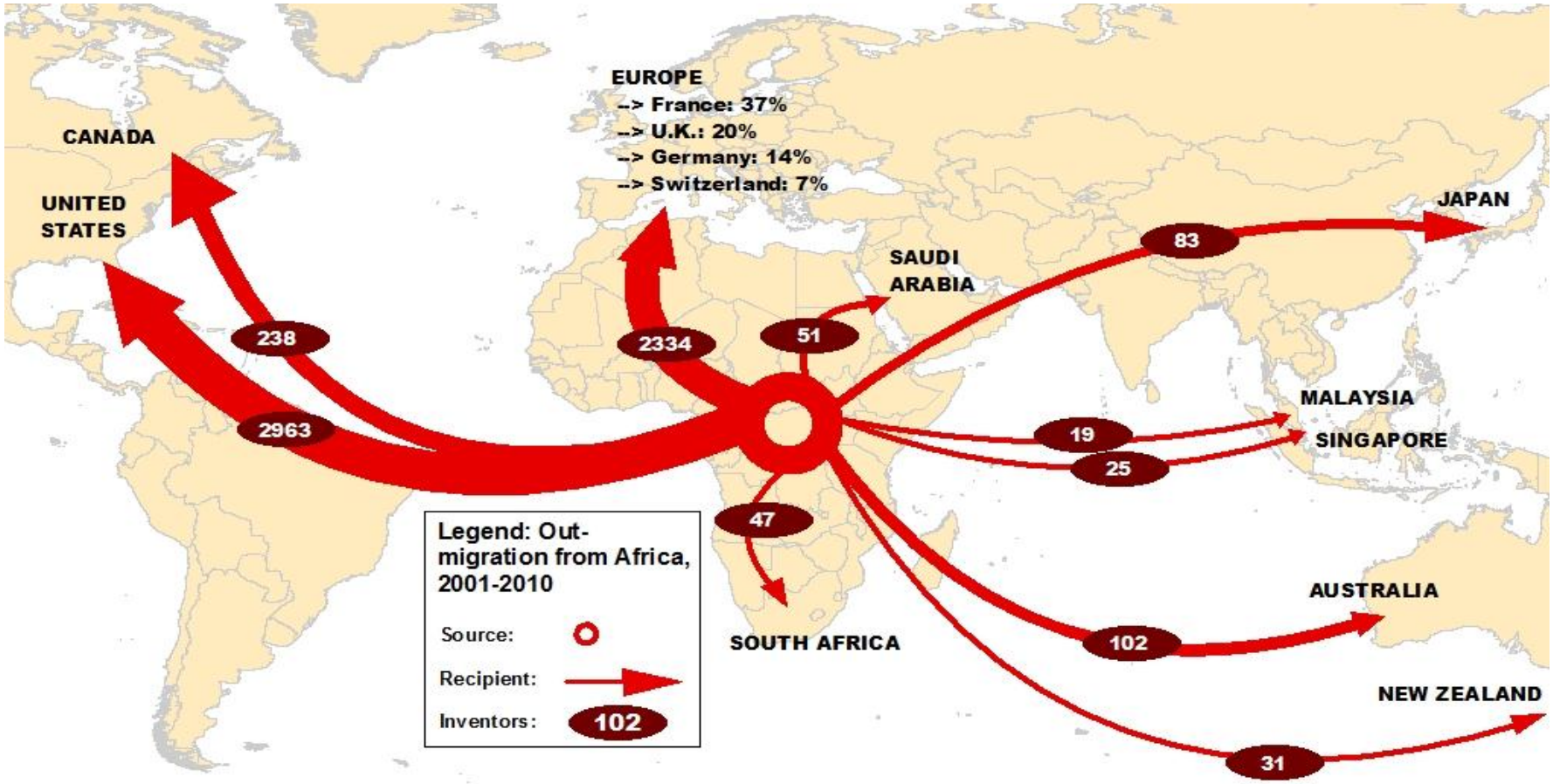
	Applicant-applicant collaboration	Inventor-inventor collab.		
ln(Diaspora)	-0.149			
	(0.157)			
Diaspora		1.48e-05***		
		(4.69e-06)		
ln(Diaspora+0.00001)			0.0374***	
			(0.00779)	
ln(Diaspora) 10 years				0.185***
				(0.0262)
ln(Distance)	-0.306	-0.336***	-0.292***	-0.251***
	(0.394)	(0.0583)	(0.0628)	(0.0546)
Contiguity	0.730	-0.0426	-0.0454	-0.00605
	(0.780)	(0.133)	(0.135)	(0.120)
Common language	0.306	0.643***	0.599***	0.525***
	(0.597)	(0.114)	(0.122)	(0.114)
Colonial links	1.312***	0.219	0.203	0.162
	(0.493)	(0.150)	(0.147)	(0.128)
ln(EXP+IMP)	-0.0243	0.0992***	0.103***	0.0704***
	(0.117)	(0.0243)	(0.0243)	(0.0236)
ln(Tech.distance)	-0.282	-0.137***	-0.0933**	-0.0821*
	(0.448)	(0.0495)	(0.0471)	(0.0479)
ln(# patents) orig.	0.159	0.333***	0.344***	0.328***
	(0.144)	(0.0511)	(0.0489)	(0.0560)
ln(# patents) dest.	0.709***	0.107	-0.0136	0.0730
	(0.215)	(0.118)	(0.116)	(0.118)
ln(GDP p.c.) orig.	2.669***	1.116***	1.229***	1.119***
	(0.962)	(0.244)	(0.215)	(0.246)
ln(GDP p.c.) dest.	-2.001	-0.122	-0.210	-0.0564
	(1.916)	(0.556)	(0.551)	(0.573)
Constant	-9.899	-7.630	-6.149	-9.389
	(20.44)	(6.031)	(5.938)	(6.334)
Origin FE	Yes	Yes	Yes	Yes
Destination FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Estimation results: robustness

	Inventor-inventor collab.		
ln(Diaspora) 1 year	0.153***		
	(0.0203)		
ln(Diaspora) 3-year lag		0.111***	
		(0.0241)	
ln(Diaspora) 5-year lag			0.0875***
			(0.0249)
ln(Distance)	-0.279***	-0.300***	-0.312***
	(0.0539)	(0.0568)	(0.0572)
Contiguity	-0.0269	-0.0419	-0.0618
	(0.125)	(0.127)	(0.130)
Common language	0.543***	0.574***	0.581***
	(0.112)	(0.115)	(0.117)
Colonial links	0.184	0.198	0.211
	(0.132)	(0.136)	(0.139)
ln(EXP+IMP)	0.0830***	0.0843***	0.0926***
	(0.0240)	(0.0243)	(0.0234)
ln(Tech.distance)	-0.0879*	-0.0908*	-0.0972**
	(0.0474)	(0.0479)	(0.0478)
ln(# patents) orig.	0.324***	0.343***	0.353***
	(0.0521)	(0.0557)	(0.0559)
ln(# patents) dest.	0.0827	0.100	0.111
	(0.118)	(0.118)	(0.118)
ln(GDP p.c.) orig.	1.168***	1.106***	1.069***
	(0.238)	(0.244)	(0.243)
ln(GDP p.c.) dest.	-0.187	-0.0712	-0.0991
	(0.569)	(0.566)	(0.563)
Constant	-7.868	-8.702	-8.051
	(6.313)	(6.197)	(6.168)
Origin FE	Yes	Yes	Yes
Destination FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Data

Where do African inventors go?



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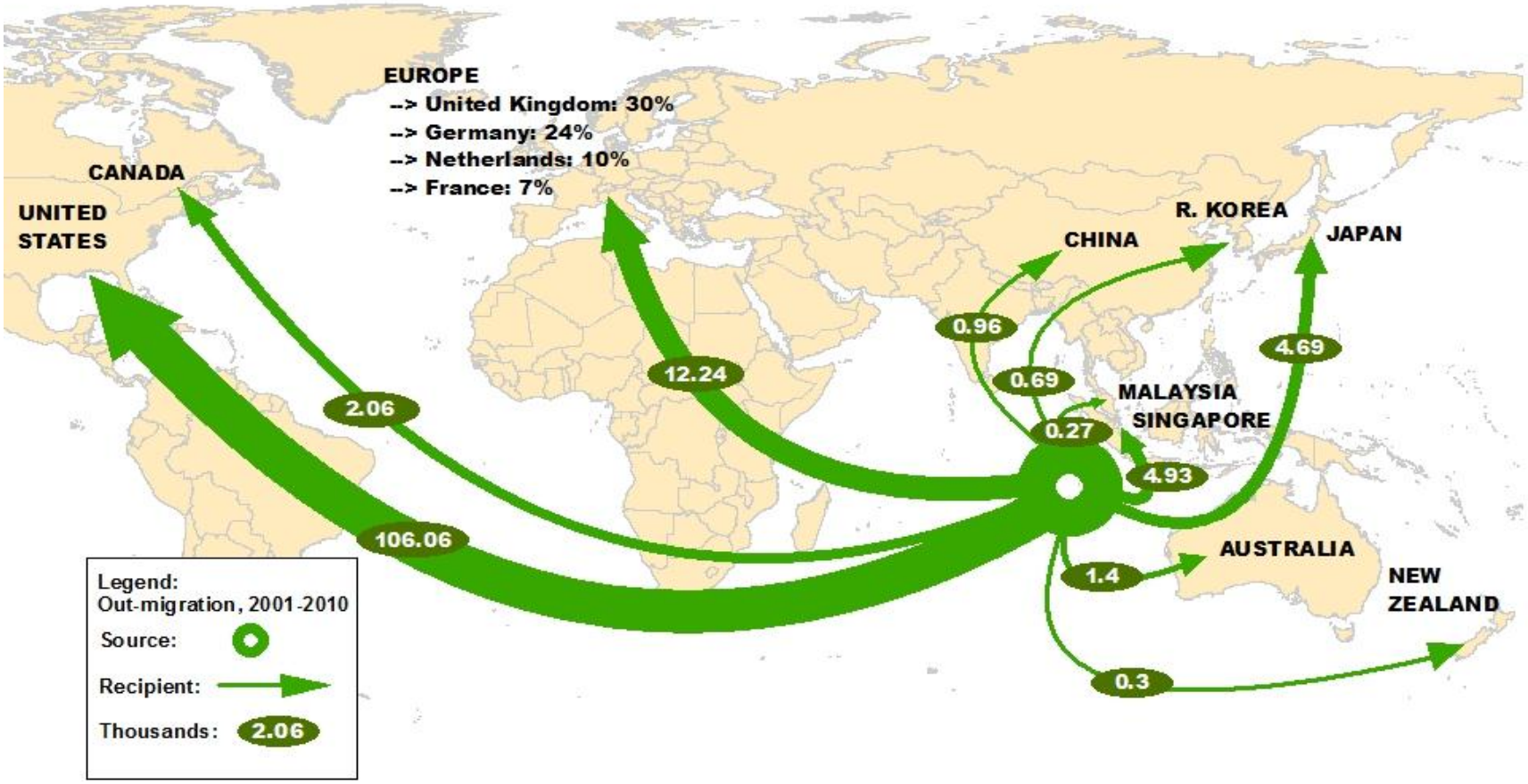
Descriptive Figures

Where do Asian inventors go?



Descriptive Figures

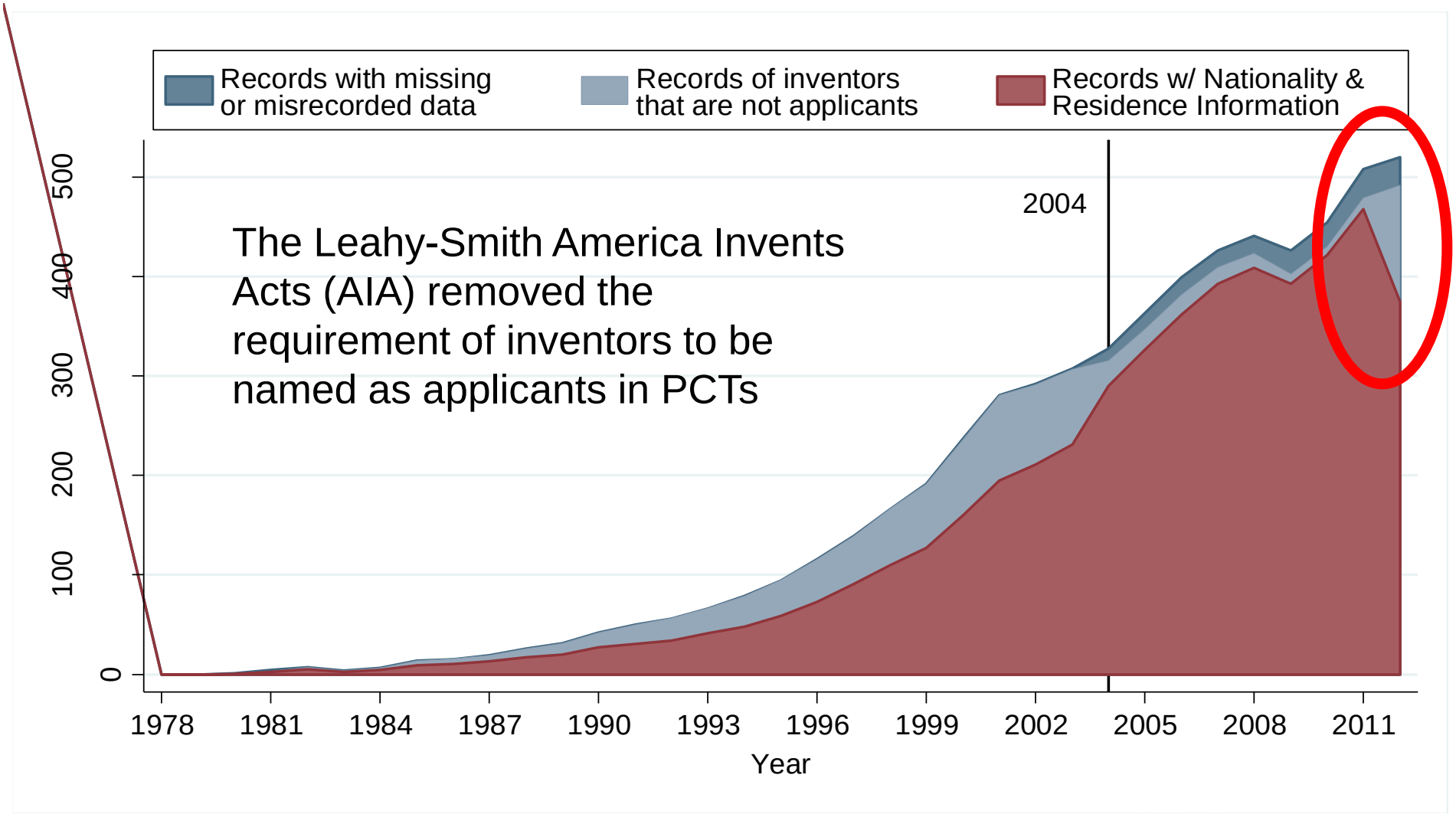
Immigration rates of selected countries, 1991-2000 & 2001-2010

Country	All inventors 1991-2000	All inventors 2001-2010	Non-OECD inventors 1991-2000	Non-OECD inventors 2001-2010	College graduates (census data) 2000	College graduates skilled occupations
	(i)	(ii)	(iii)	(iv)	(v)	
Austria	8.80	12.45	0.59	1.57	14.33	14.99
Australia	10.89	11.20	2.02	2.67	33.17	32.99
Belgium	16.89	18.56	1.58	1.94	10.61	8.53
Canada	11.16	11.03	3.49	4.07	25.84	26.88
Switzerland	28.45	38.41	2.08	3.05	28.38	28.11
Germany	3.76	5.54	0.80	1.39	11.39	
Denmark	5.07	9.98	0.40	1.61	8.00	5.36
Spain	5.95	6.72	1.35	1.43	6.38	5.25
Finland	2.93	8.74	0.94	3.69	2.25	1.48
France	5.12	6.32	1.17	1.52	12.38	9.50
U.K.	7.17	11.62	1.95	3.03	16.00	16.07
Ireland	17.38	19.89	1.62	4.93	18.07	19.60
Italy	3.88	3.27	0.49	0.60	6.11	
Japan	0.87	1.15	0.41	0.68	1.05	1.06
Luxembourg	23.14	35.42	2.10	2.86	49.04	44.64
Netherlands	7.80	13.77	0.74	3.31	11.36	10.79
Norway	4.96	9.17	0.54	1.30	8.09	7.46
N. Zealand	14.72	16.60	1.63	3.24	24.85	27.79
Sweden	4.61	8.44	1.07	2.12	14.26	10.92
U.S.	16.07	18.18	7.87	10.24	13.86	21.08

Notes: Skilled occupations include Physical, mathematical engineering science professionals and associate professional; and life science and health professionals and associate professionals (for the US, it includes: computer and mathematical science occupations, architecture and engineering occupations, and life, physical and social science occupations.

iso2_ori	prio_year	iso2_des	flow
CN	2005	US	4785
DE	2005	US	1107
IN	2005	US	4475
US	2005	US	101009
CN	2006	US	5480
DE	2006	US	1197
IN	2006	US	4460
US	2006	US	109998
CN	2007	US	5510
DE	2007	US	1271
IN	2007	US	4312
US	2007	US	107153

Conclusions



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