
US Ethnic Scientists and FDI Placement Patterns

William Kerr

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Introduction

- R&D and innovation are critical to US economy
- Technology diffusion is necessary for widespread economic development
- Analysis of foreign-sourced R&D decision: distribution of firms undertaking and new entry
 - Census Bureau / NSF Industry R&D Survey
 - Comprehensive view of US R&D firms
- Role of US ethnic scientists and engineers for facilitating foreign R&D and FDI placement
 - BEA FDI Survey + Ethnic Patents
 - Analysis of country-level FDI placements

Foreign-Sourced R&D Decision:
Distribution of Firms
Undertaking and New Entrants

Foreign-Sourced R&D Decision

- Growth in foreign sourcing of R&D by US MNEs
 - Findings of Dalton, Serapio, and Yoshida (1999)
 - US R&D overseas: \$5b in 1987 to \$14b in 1998
 - 5%→11% of total R&D expenditure by US MNEs
 - 169 US-owned facilities abroad in 1998
 - >50% in Germany, France, Japan, Canada, and UK
 - Big increase in Asia ex Japan starting in 1998
- Compares to \$20b of foreign R&D in US
 - 715 facilities in US in 1998
 - 116k R&D workers

Foreign-Sourced R&D Decision

- Industry concentration of foreign-sourced R&D
 - Transportation equipment (28%)
 - Chemicals and pharmaceuticals (23%)
 - Computers and electronic products (25%)
 - High profile cases ~ Microsoft's Beijing R&D Center
- Relative to MNE's home-country R&D
 - Chemicals/Pharma ~30% outbound, ~49% inbound
 - Transportation ~25% outbound, ~5% inbound
- Motivations for foreign-sourced R&D
 - Access to foreign markets and demand
 - Access to foreign technologies
 - Access to foreign scientists and engineers (recent)

Foreign-Sourced R&D Decision

- Industry R&D Survey
 - Collected by the Census Bureau for the NSF
 - Annual files since 1972 available at CES
 - Complete coverage of major R&D firms in US
 - De facto hurdle of \$1m in US R&D expenditure
 - Sampling coverage of firms with <\$1m
 - Public and private firms
 - Foreign firms undertaking R&D in the US
- Linked to plant-level operations for universe of US establishments

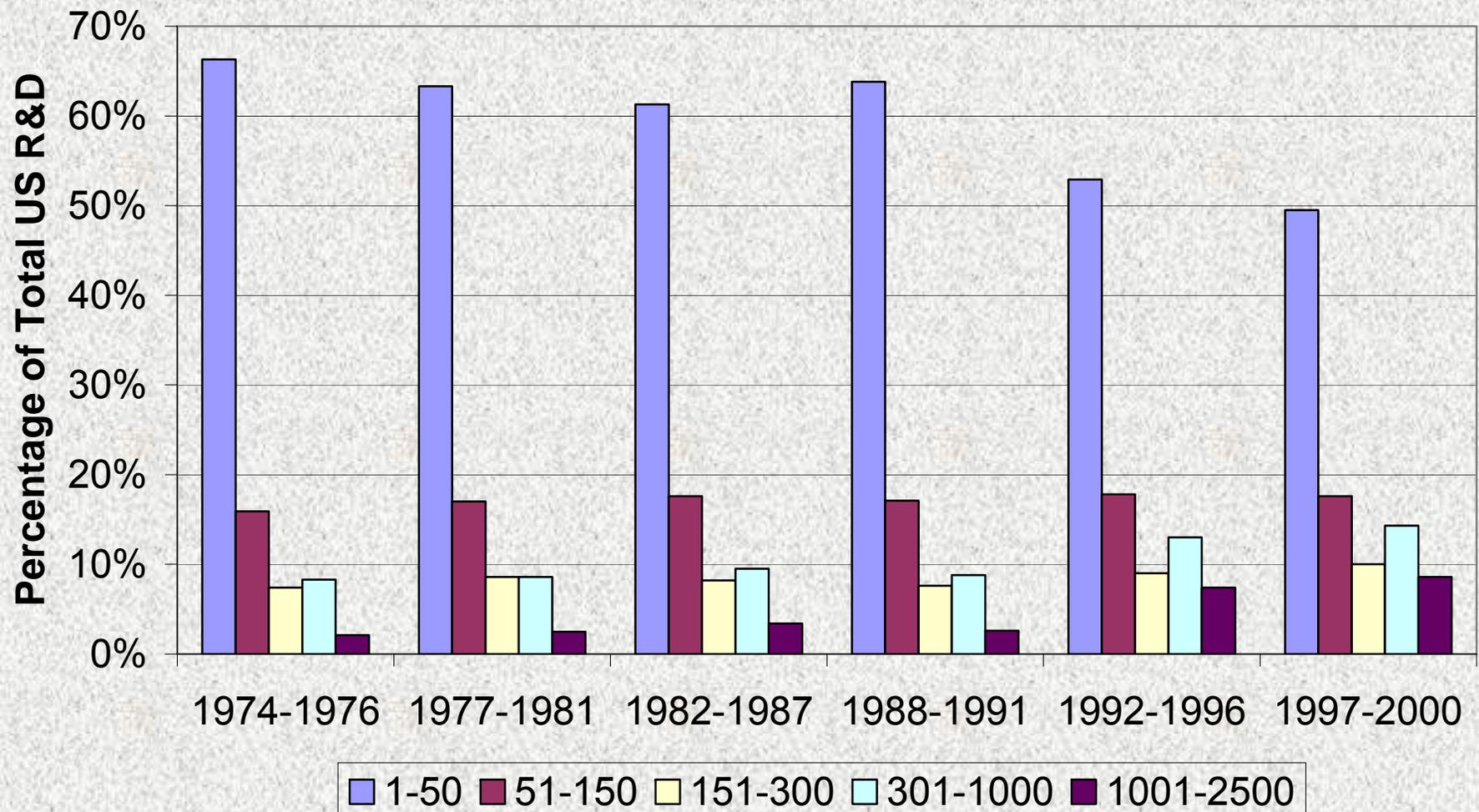
Foreign-Sourced R&D Decision

- Study foreign-sourced R&D decision over time
 - Create cells for the five years preceding a Census of Manufactures (i.e., 1977-1981 for 1982)
 - Average firm's total R&D and foreign-sourced R&D for five-year blocks, without sample restrictions
 - Rank order firms by total R&D and separate into bins: 1-50, 51-150, 151-300, 301-1000, 1001-2500
 - For 1987-1991, the thresholds for these bins are ~\$500m, ~\$100m, ~\$50m, ~\$7m, ~0.5m (\$2000)
 - Note the raw number of records past 2500 changes significantly across years
 - Diagonal transition probabilities for these bins are ~80% for 1-50 declining to ~50%

Foreign-Sourced R&D Decision

Firm Distribution of US R&D

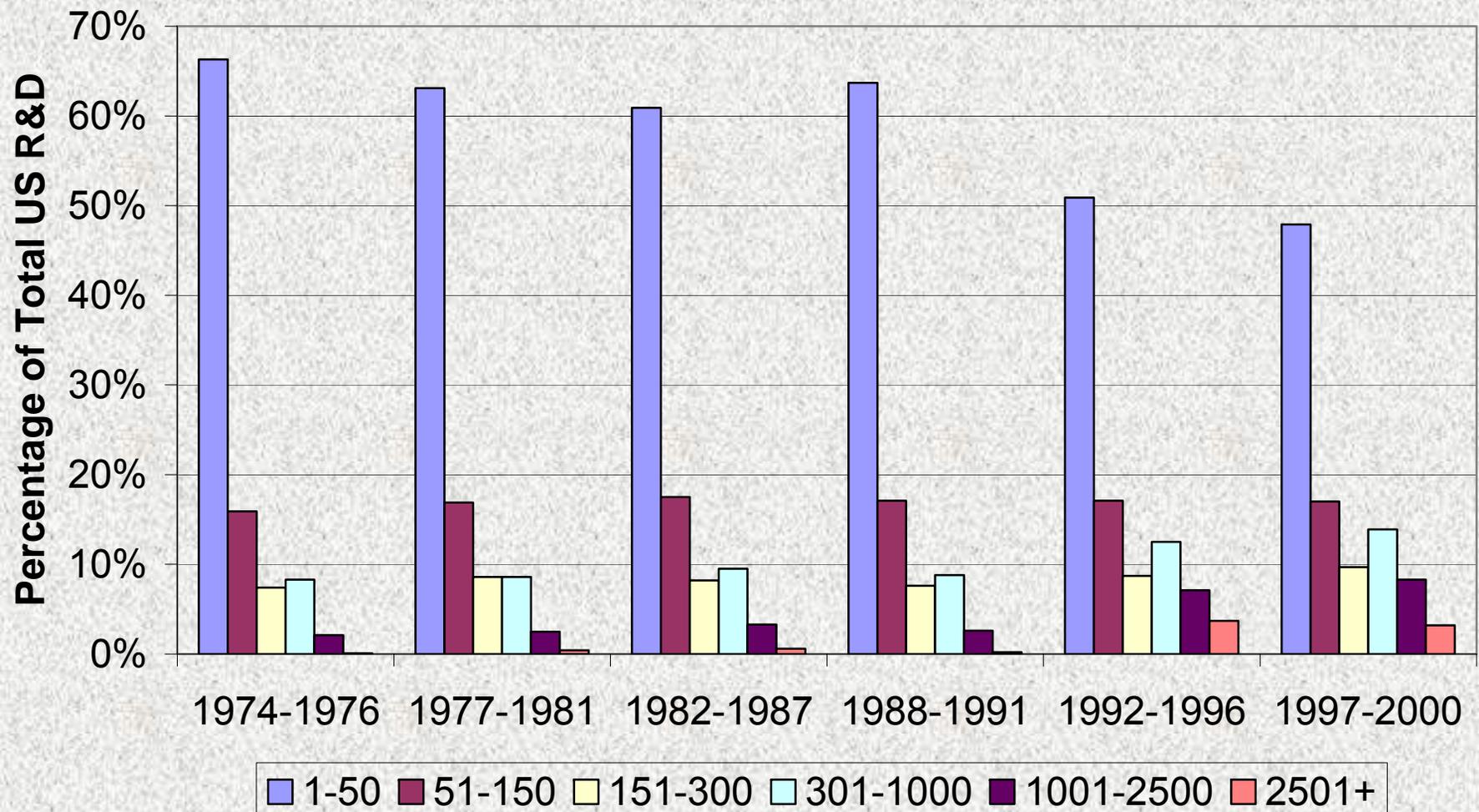
Grouped by Firm Total R&D Rank Order



Foreign-Sourced R&D Decision

Firm Distribution of US R&D

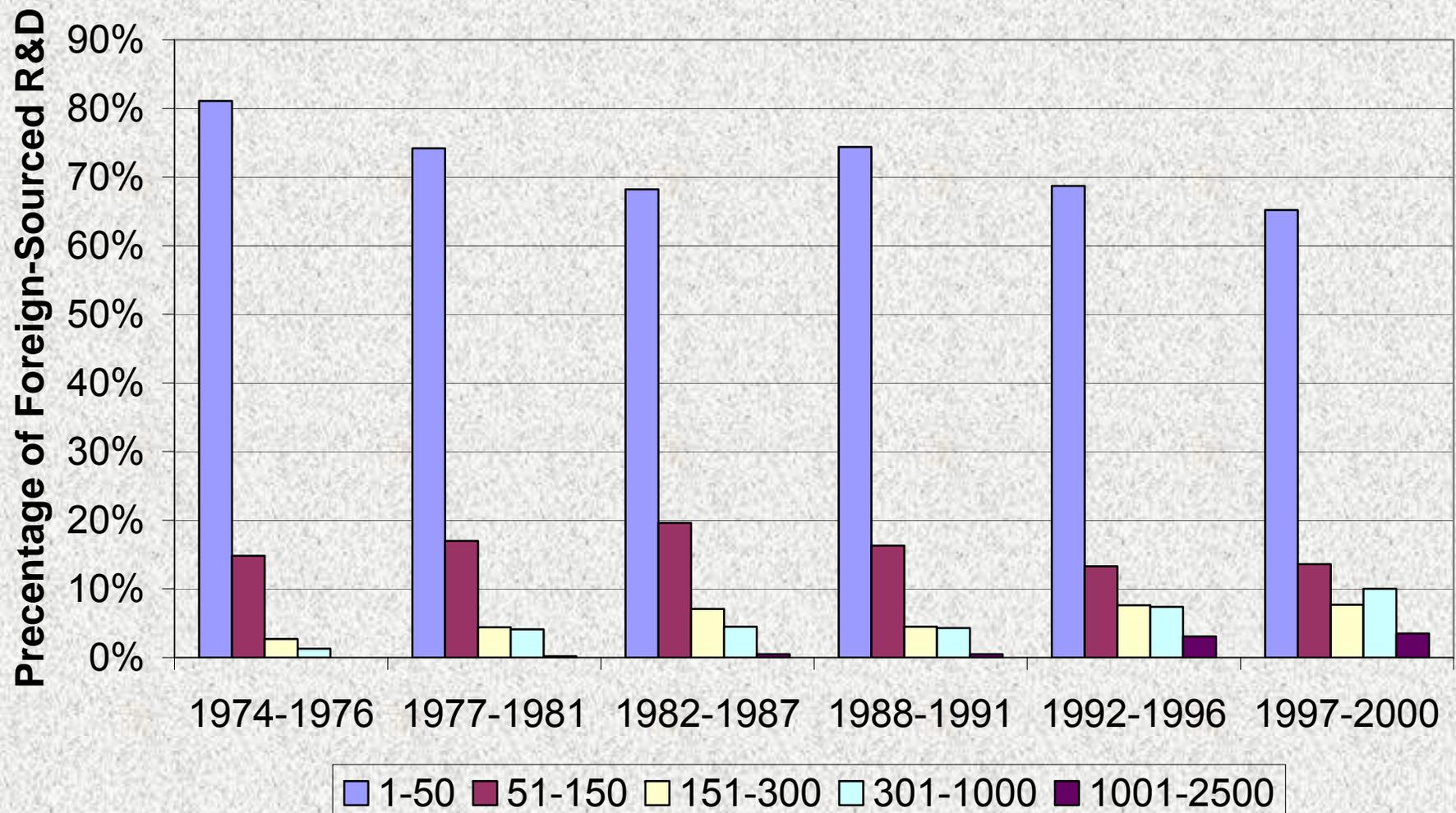
Grouped by Firm Total R&D Rank Order



Foreign-Sourced R&D Decision

Firm Distribution of For.-Sourced R&D

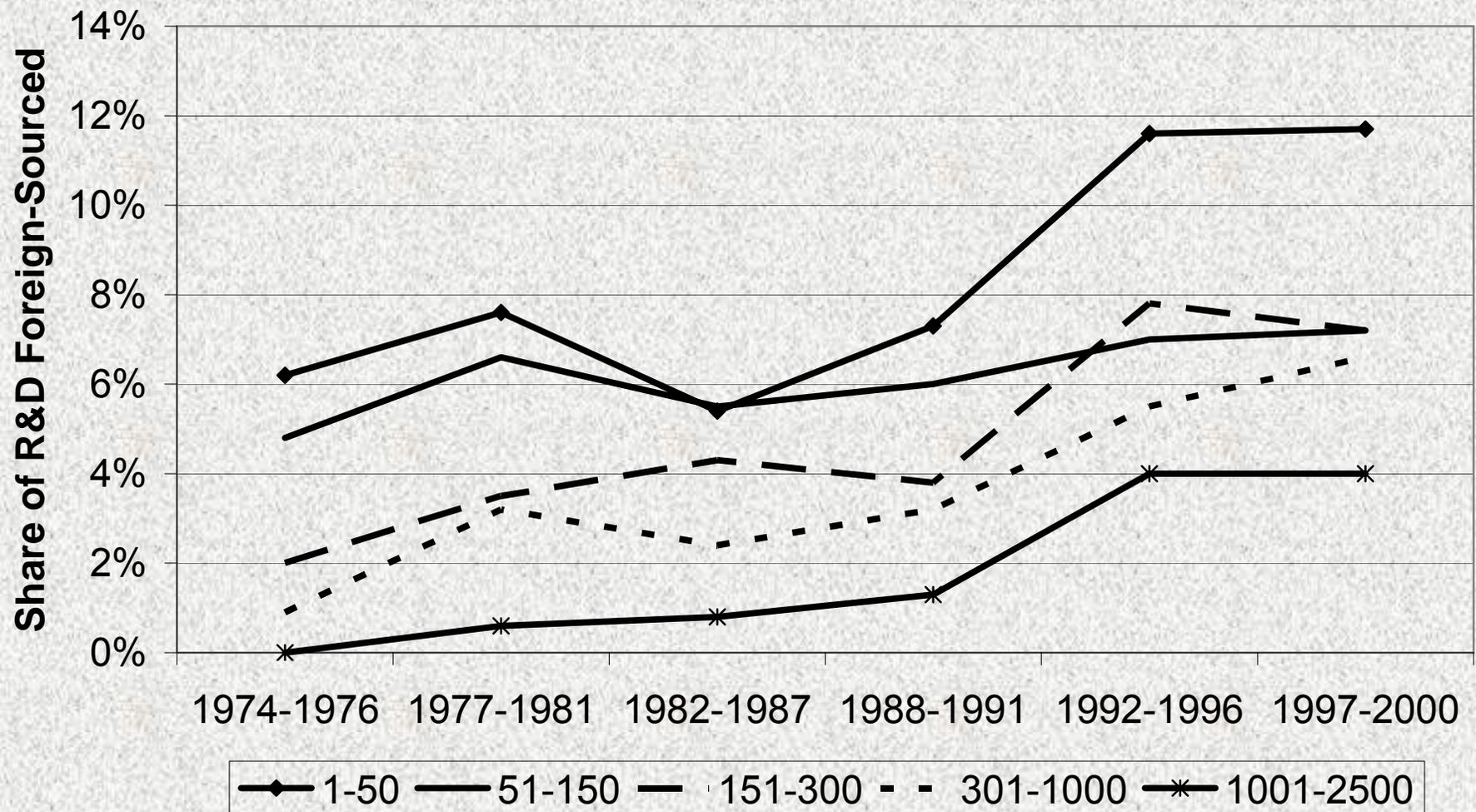
Grouped by Firm Total R&D Rank Order



Foreign-Sourced R&D Decision

For.-Sourced Share of US R&D

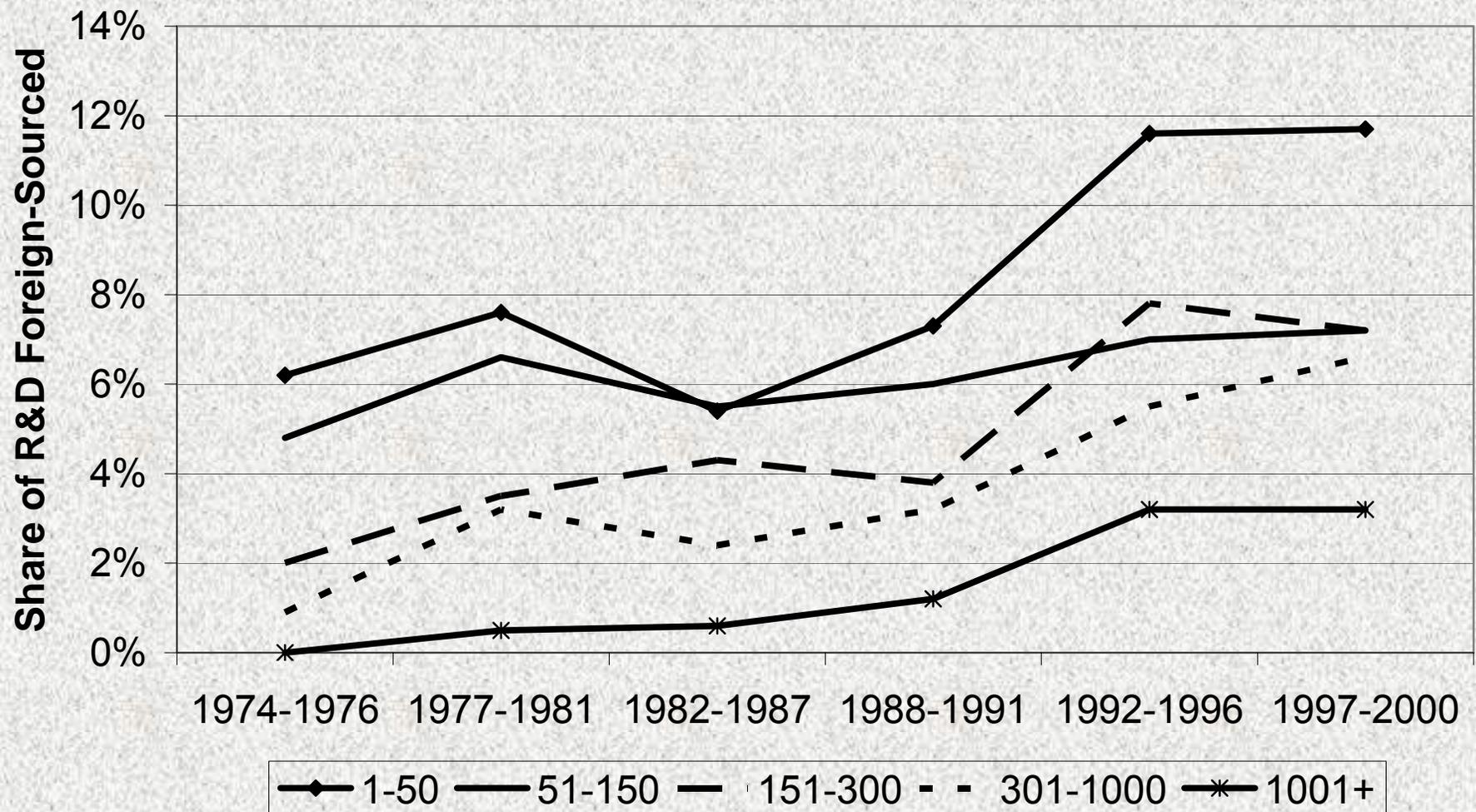
Grouped by Firm Total R&D Rank Order



Foreign-Sourced R&D Decision

For.-Sourced Share of US R&D

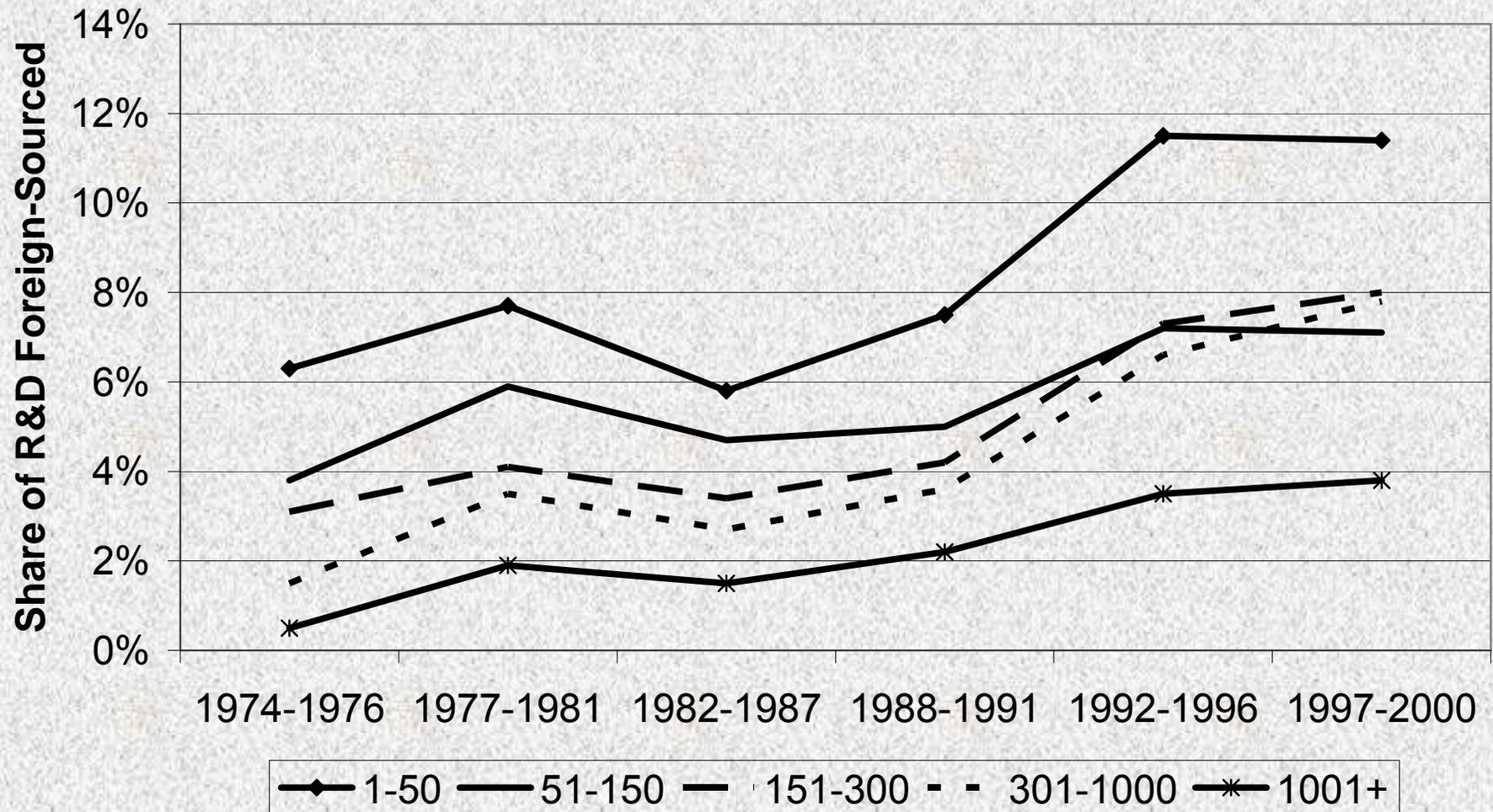
Grouped by Firm Total R&D Rank Order



Foreign-Sourced R&D Decision

For.-Sourced Share of US R&D

Grouped by Firm Total R&D Rank Order within Sector



Foreign-Sourced R&D Decision

- Further findings
 - Foreign-sourced R&D by US MNEs is more skewed to largest R&D performers than US-sourced R&D
 - Small, positive correlation of growth in US-sourced R&D with foreign-sourced R&D
 - US plant-level productivity benefit to foreign-sourced R&D, to some extent localized within states where US-sourced R&D is being undertaken
- Next steps
 - Analysis of firm productivity distribution for entry margin into foreign-sourced R&D
 - Confirm causal relationships

Role of US Ethnic Scientists and Engineers for Foreign-Sourced R&D and FDI

US Ethnic Scientists and Engineers

- Technology adoption critical for raising worker productivity and achieving economic growth
- Inventive activity concentrated in advanced economies like the US
- How do new technologies diffuse? Baseline of a worldwide technology frontier
- Uneven and/or slow diffusion of innovations from technology leaders to technology followers (especially for tacit knowledge)
- Role of ethnic scientific and entrepreneurial networks in heterogeneous technology frontiers?

US Ethnic Scientists and Engineers

- Surveys of immigrant scientists and entrepreneurs in Silicon Valley (Saxenian)
 - Strong evidence of global networks to home countries
 - 82% exchange technical information
 - 50% travel home annually for business
 - 40% help arrange business contracts
 - 18% have invested in business partnerships
- Among those who have started a US company
 - 50% have established business operations in their home countries ...
 - and the other 50% would consider doing so!

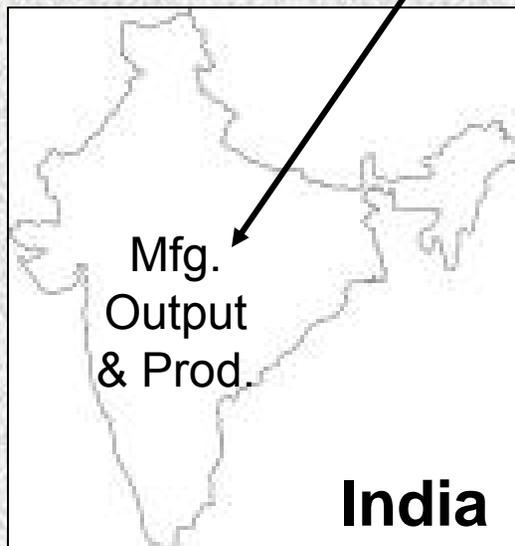
US Ethnic Scientists and Engineers



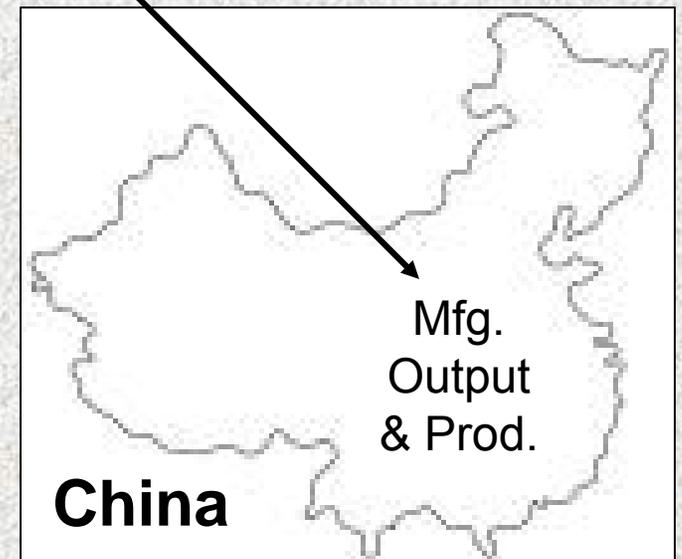
Analyzed 40 countries and 20 mfg. industries

Technology Transfer to India

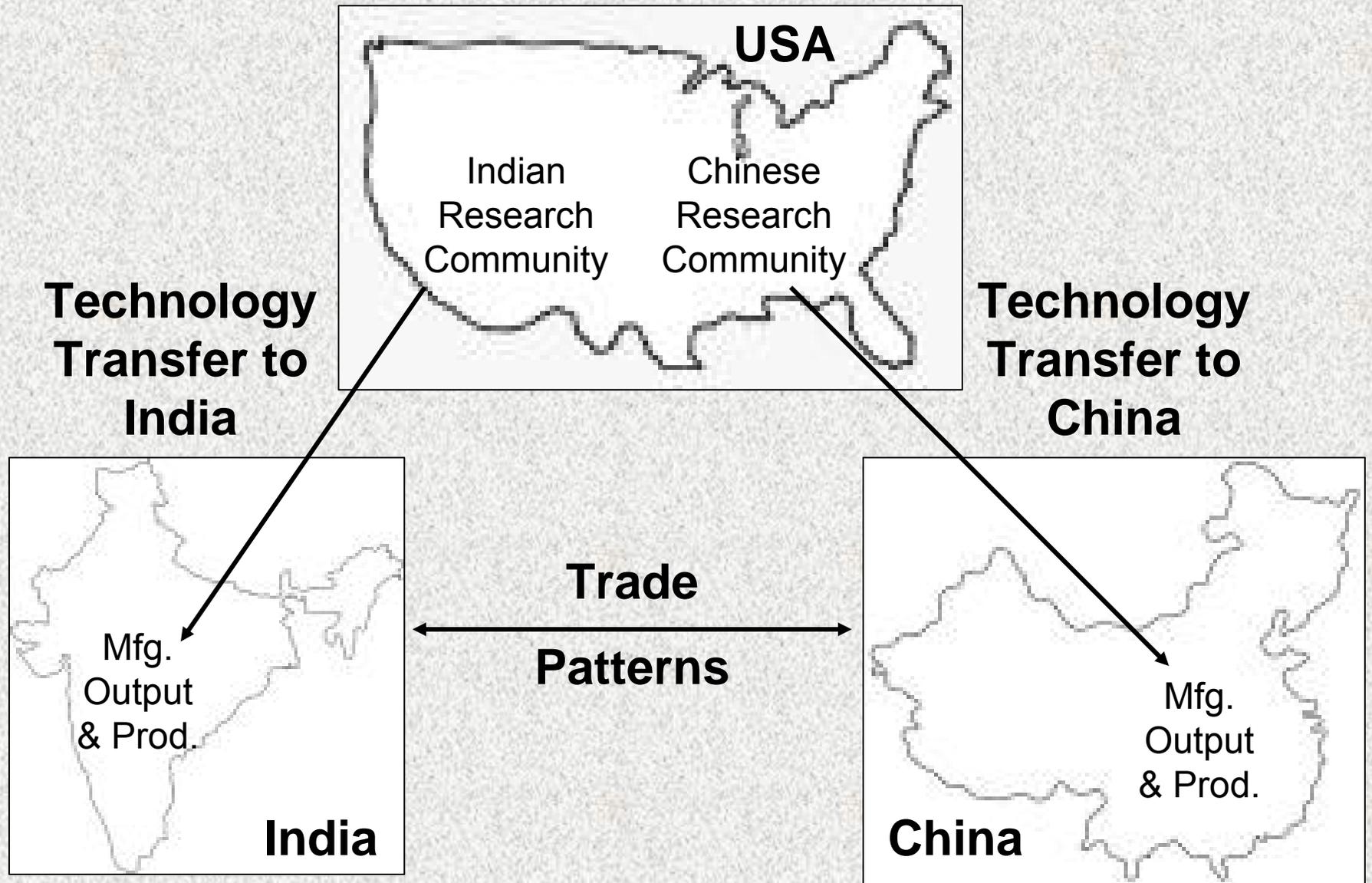
Technology Transfer to China



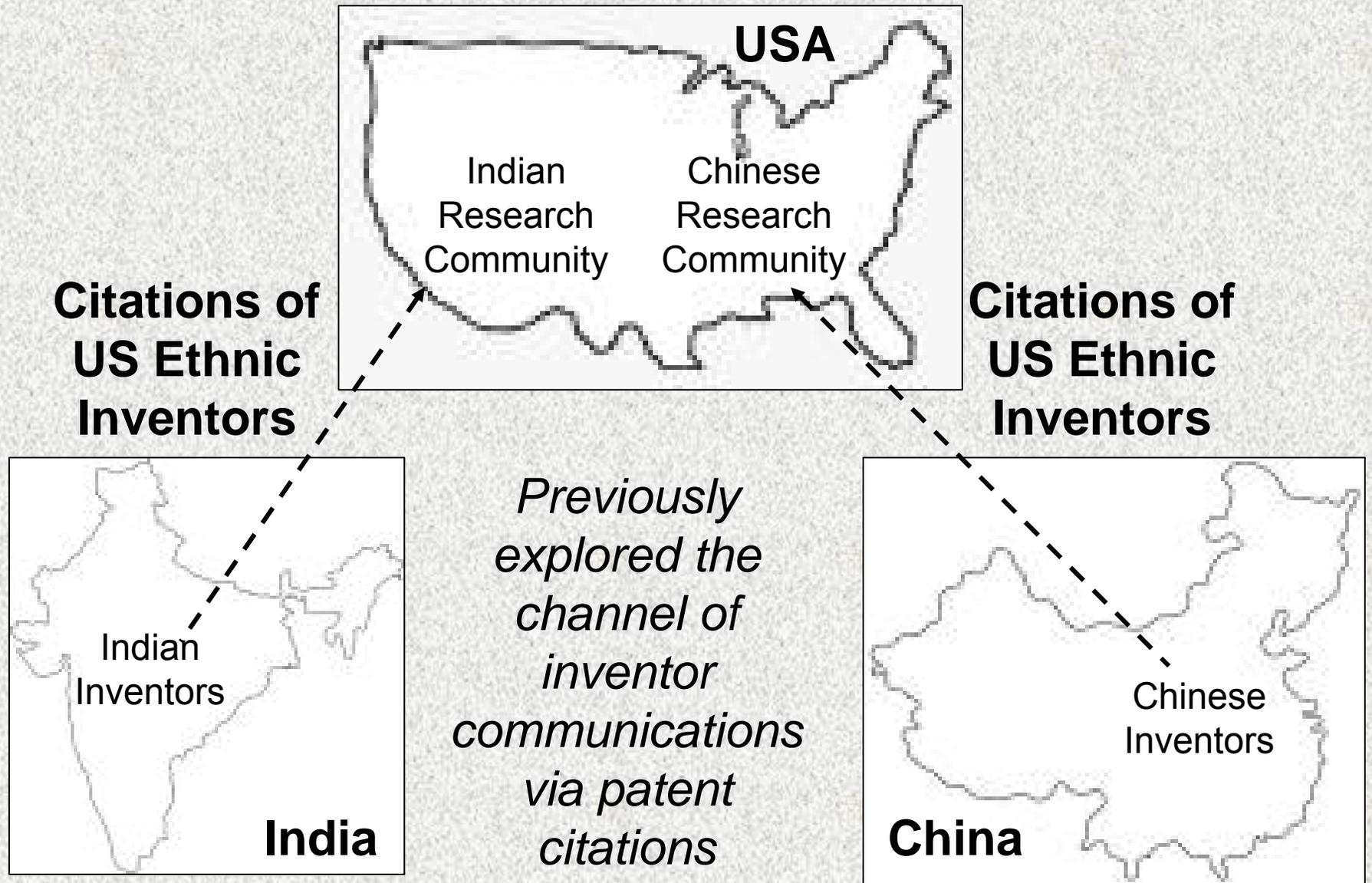
Earlier research found output growth from stronger US ethnic research presence



US Ethnic Scientists and Engineers



US Ethnic Scientists and Engineers

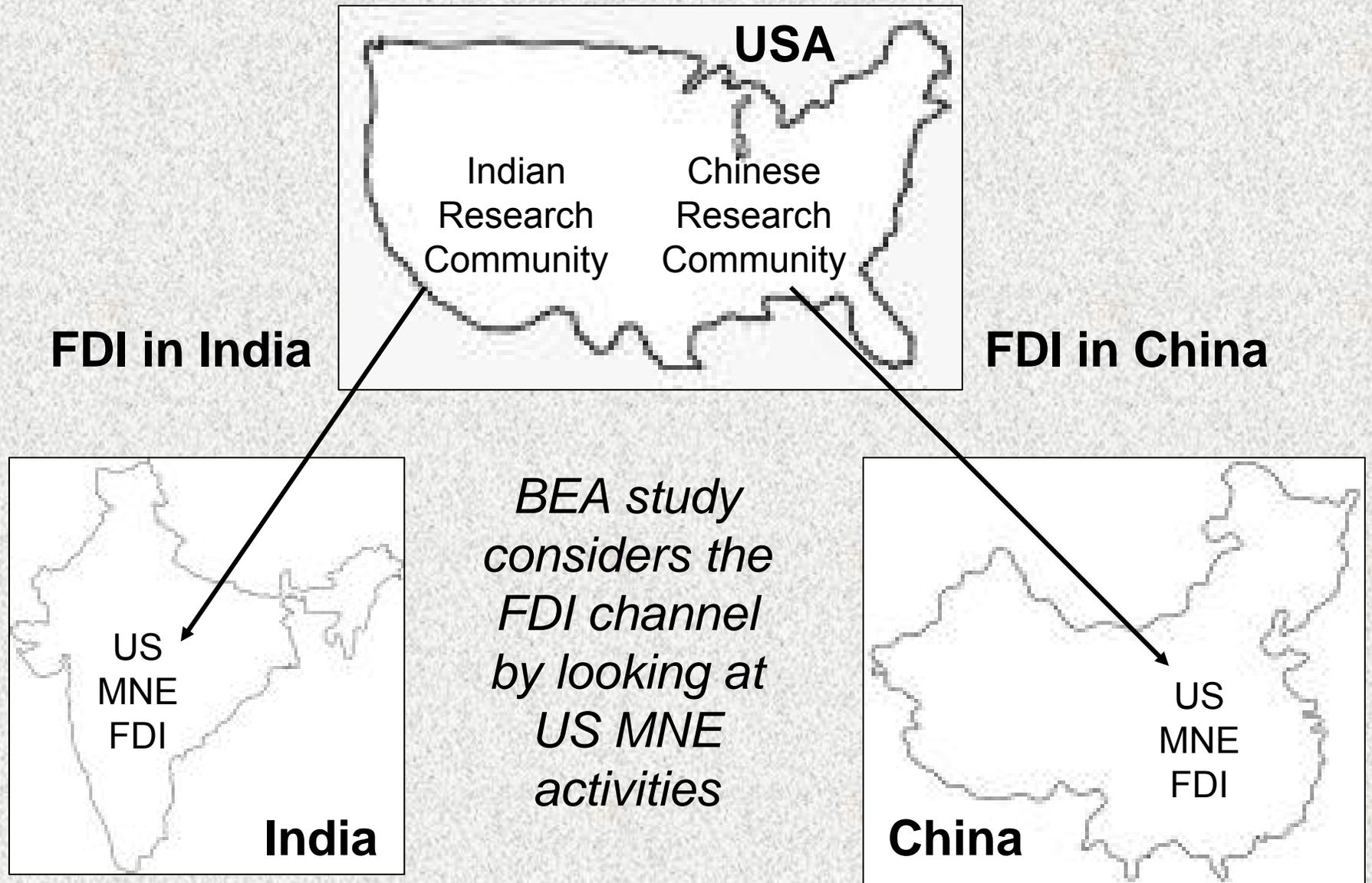


Citations of US Ethnic Inventors

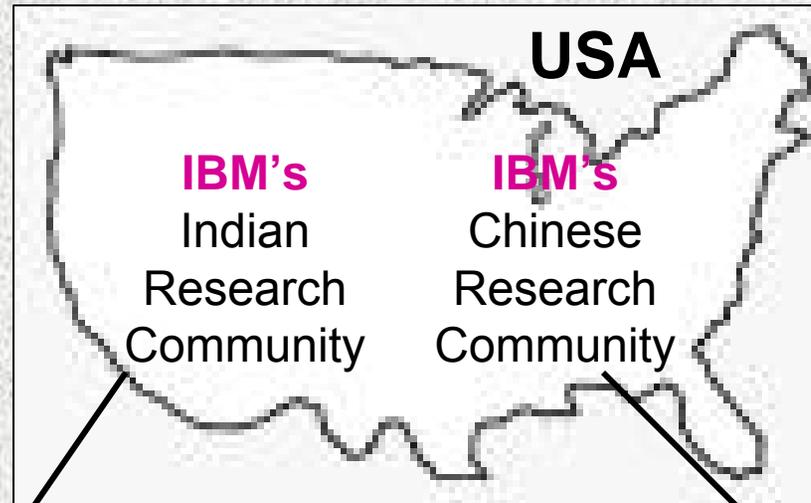
Citations of US Ethnic Inventors

Previously explored the channel of inventor communications via patent citations

US Ethnic Scientists and Engineers

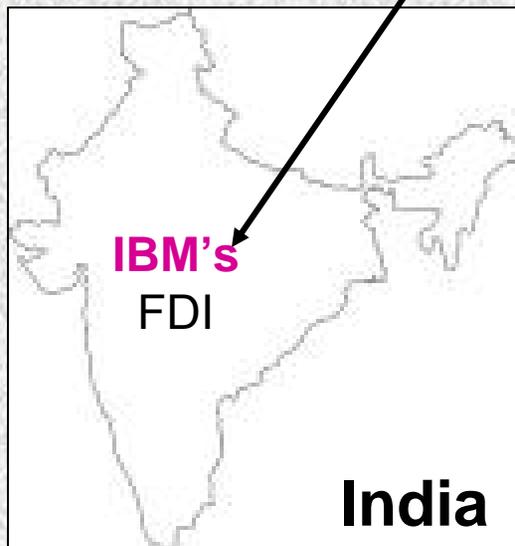


US Ethnic Scientists and Engineers

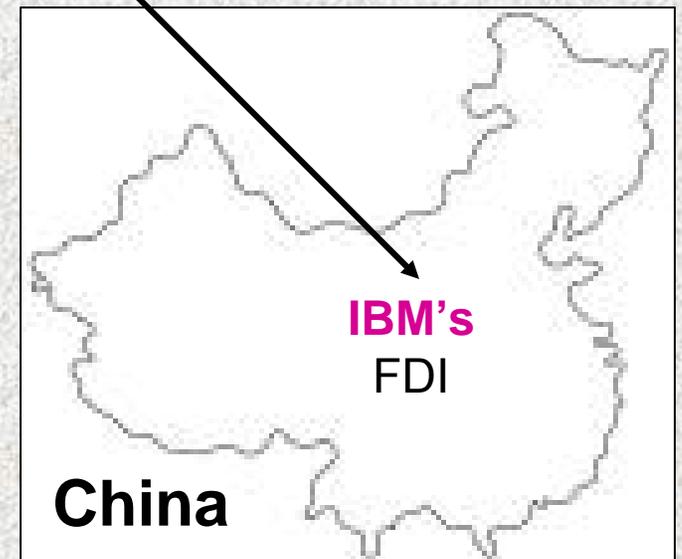


FDI in India

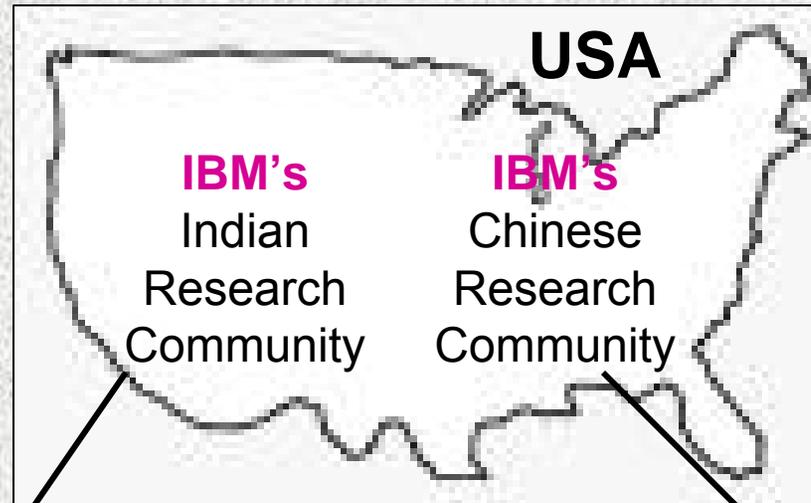
FDI in China



The really cool thing... able to analyze the pattern at the firm level!

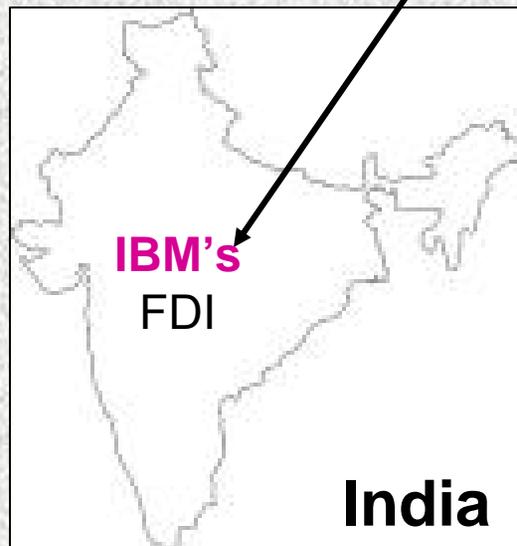


US Ethnic Scientists and Engineers

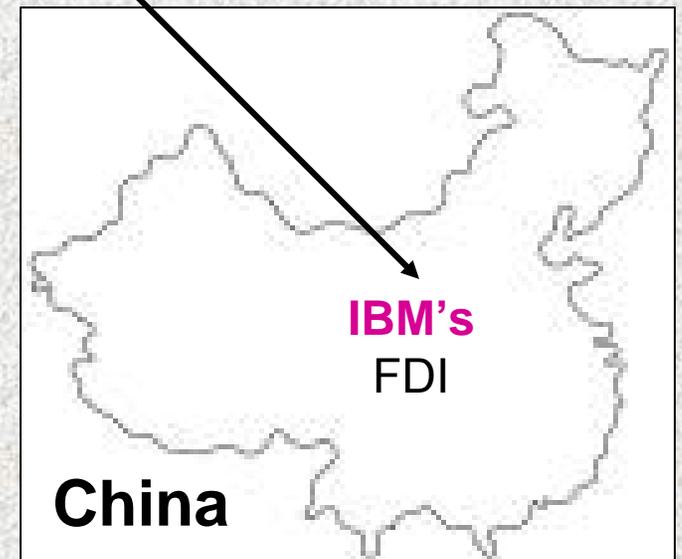


FDI in India

FDI in China



*More broadly
relates US
immigration
policy to FDI
placement*



US Ethnic Scientists and Engineers

- NBER Patent database
 - Hall, Jaffe, and Trajtenberg (2001)
 - Individual patent records for 1975-1999
 - Invention details: technology classification, citations
 - Inventor(s) information: name, city
- Ethnic-name database applied to inventor records (Melissa Data Corporation)
 - 98% match rate to patent records (76% unique)
 - Nine ethnicities identified

Chinese	English	European	Hispanic	Indian
Japanese	Korean	Russian	Vietnamese	

US Ethnic Scientists and Engineers

- Quality assurance exercise with USPTO patents granted to inventors living outside of US

- 97% match rate for countries in sample

- Percentage estimates of own-ethnicity in countries

China	87%	United Kingdom	87%
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India	80%	Russia/USSR	83%
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Japan	99%	Latin America	72%
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Korea	83%	Western Europe	73%
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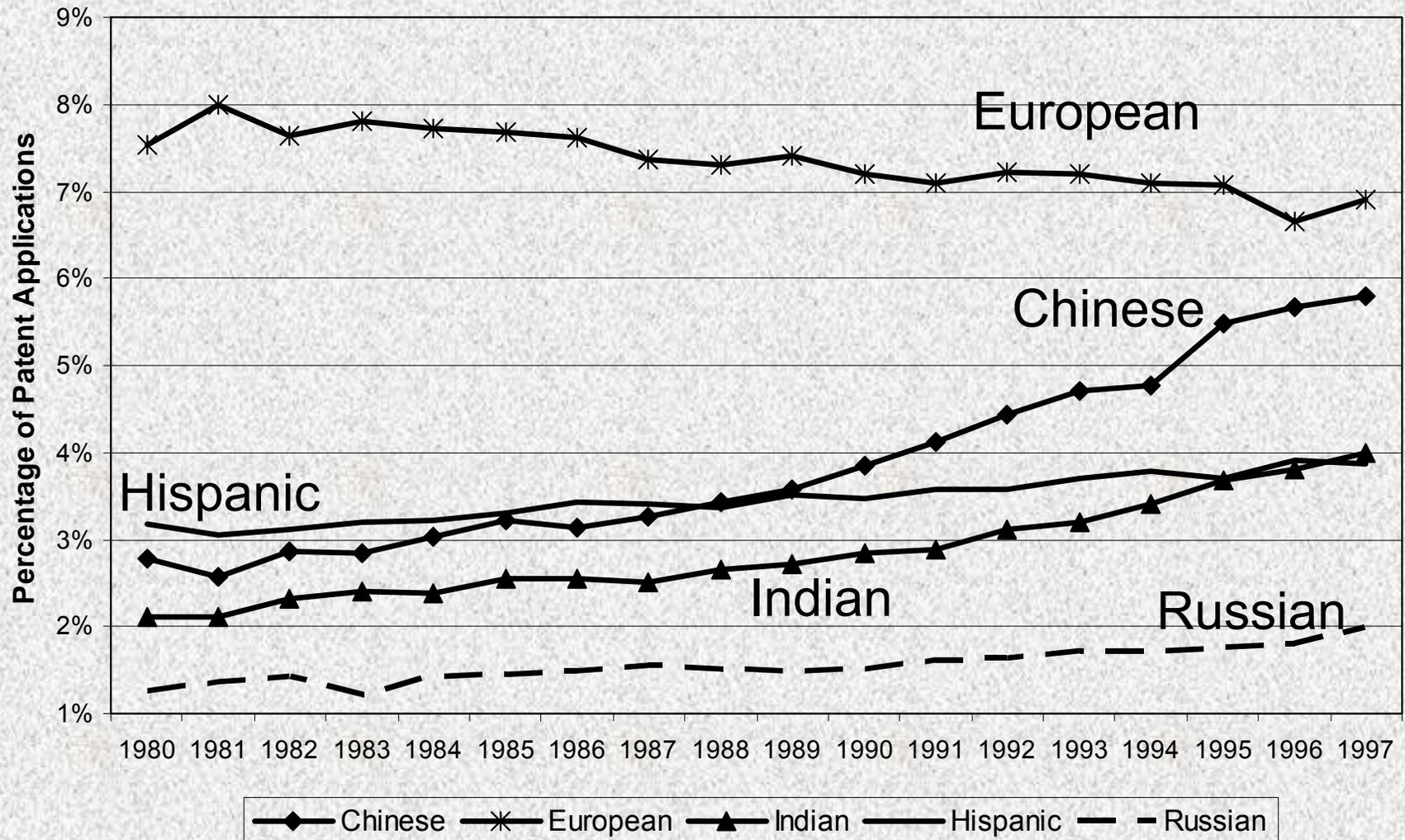
Vietnam	62%		
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- Breaking ties in foreign countries would increase %'s

- Composition should be <100% due to foreign workers

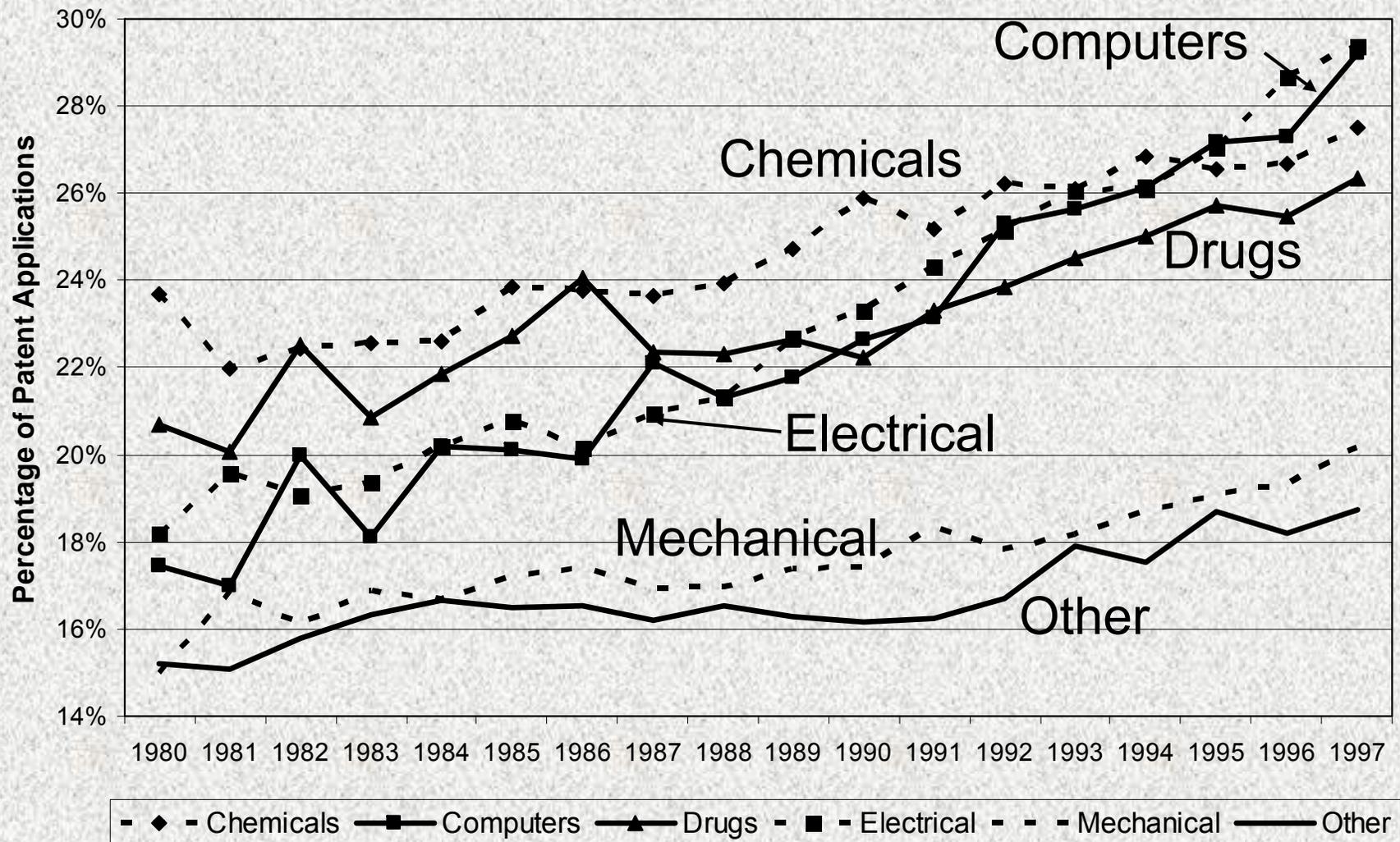
US Ethnic Scientists and Engineers

Figure 2: US Ethnic Patenting



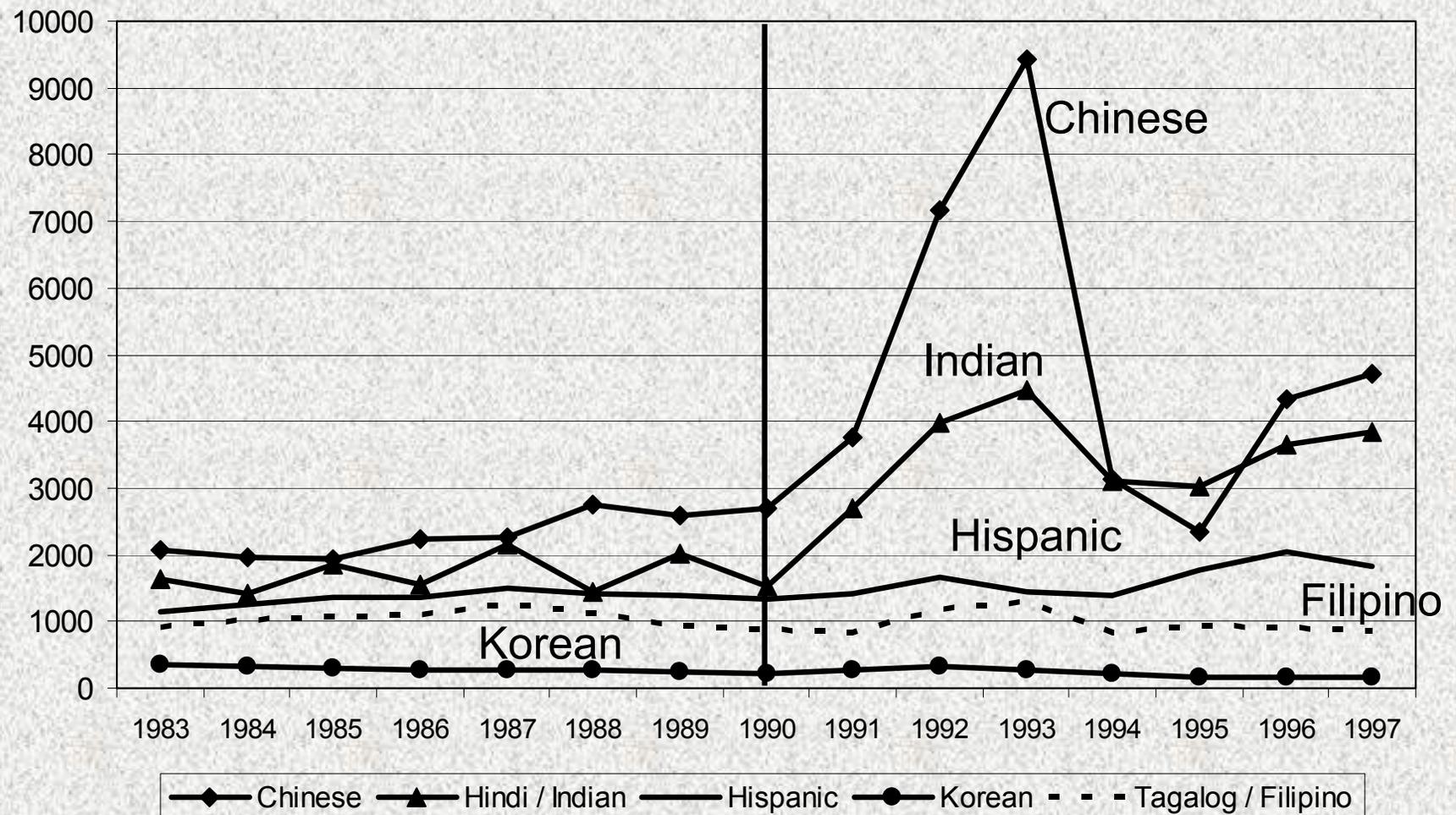
US Ethnic Scientists and Engineers

Figure 3: Ethnic Share by Technology



US Ethnic Scientists and Engineers

Figure 4: Science & Engineering Immigration



BEA FDI Database

- BEA FDI Database
 - Firm-level database US MNE investment abroad
 - Organized by affiliates ... country-industry-year variation captured
 - Sales, assets, employment, R&D, and so on
 - Benchmark years: 1982, 1989, 1994, 1999, (2004)
 - Hurdle rates of \$3m-\$10m in FDI
- Matching of PAT and BEA
 - PAT: Assignee→CUSIP→EIN ↔ BEA Match
 - Manual correction for major BEA omissions
 - Current plan is to restrict sample to Compustat firms

BEA FDI Database

- *Single mappings:* India, Japan, South Korea, Russia/USSR, Vietnam
- *Chinese:* Mainland China, Hong Kong, Macao, Singapore, Taiwan
- *European:* Austria, Belgium, Denmark, Finland, France, Germany, Italy, Luxembourg, Netherlands, Norway, Poland, Sweden, Switzerland
- *Hispanic:* Argentina, Bolivia, Brazil, Chile, Columbia, Costa Rica, Cuba, Ecuador, Honduras, Mexico, Panama, Peru, Philippines, Portugal, Spain, Uruguay, Venezuela

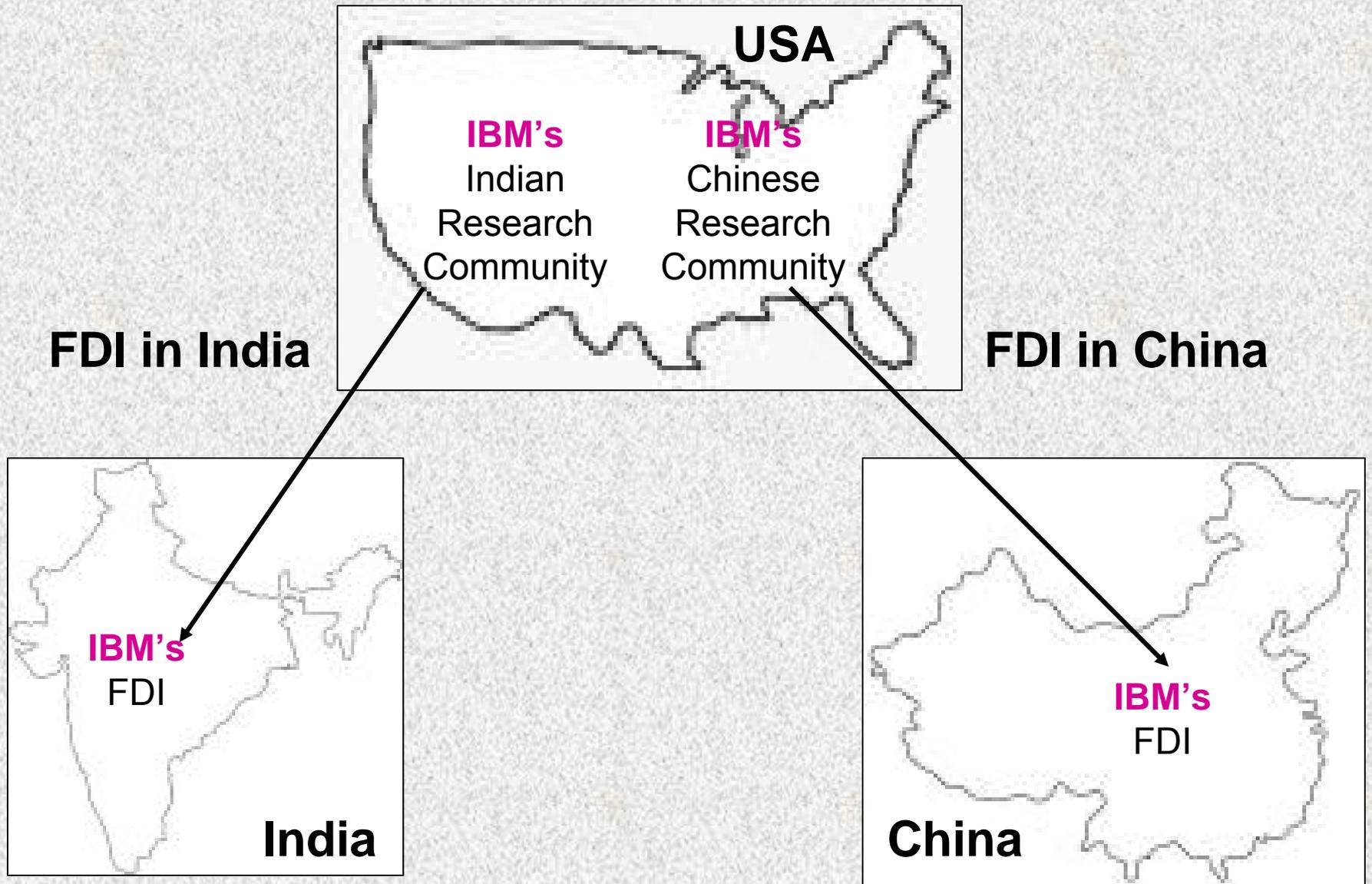
FDI Estimations

- The core estimating equation

$$\ln(\text{FDI}_{fct}) = \alpha + \beta \cdot \ln(\text{PAT}_{fet}) + \varphi_{fc} + \eta_t + \varepsilon_{fct}$$

- FDI_{fct} is FDI by firm f in country c of ethnicity e
- PAT_{fet} models firm f 's ethnic composition of scientists and engineers in US
- Standard error clustering at firm-ethnicity-year level to reflect multiple country-to-ethnicity mappings
- Panel fixed effects $\varphi + \eta$ critical for interpretation
- Regressions are unweighted

FDI Estimations



FDI Estimations

$$Y_{fct} = \alpha + \beta \cdot \ln(\text{PAT}_{fet}) + \varphi_{fc} + \eta_t + \varepsilon_{fct}$$

BEA FDI Estimations

	Log Assets	Log Sales	Log Wage Bill
	Foreign Affiliate + Year FE		
Log US Ethnic Research	0.043 (0.013)	0.084 (0.017)	0.069 (0.013)
Observations	23,733	22,685	21,396

FDI Estimations

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BEA FDI Estimations

	Log Assets	Log Sales	Log Wage Bill
	Foreign Affiliate + Year FE		
Log US Ethnic Research	0.043 (0.013)	0.084 (0.017)	0.069 (0.013)
	Foreign Affiliate + ETH-Year + IND-Year FE		
Log US Ethnic Research	0.039 (0.012)	0.075 (0.017)	0.059 (0.013)
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FDI Estimations

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	Foreign Affiliate + ETH-Year + IND-Year FE		
Log US Ethnic Research	0.039 (0.012)	0.075 (0.017)	0.059 (0.013)
	Firm-IND-Year FE		
Log US Ethnic Research	0.058 (0.017)	0.094 (0.024)	0.111 (0.020)
Observations	23,733	22,685	21,396

FDI Estimations

$$Y_{fct} = \alpha + \beta \cdot \ln(\text{PAT}_{fet}) + \varphi_{fc} + \eta_t + \varepsilon_{fct}$$

BEA FDI Estimations

	Log 1+R&D	(0,1) Do R&D	Log 1+Royalties
	Foreign Affiliate + Year FE		
Log US Ethnic Research	0.027 (0.028)	0.006 (0.004)	0.008 (0.031)
	Foreign Affiliate + ETH-Year + IND-Year FE		
Log US Ethnic Research	0.024 (0.028)	0.005 (0.004)	0.007 (0.028)
	Firm-IND-Year FE		
Log US Ethnic Research	0.120 (0.030)	0.016 (0.003)	0.062 (0.027)
Observations	20,844	20,844	24,053

FDI Estimations

- Evidence of greater entry through wholly-owned subsidiaries than joint ventures with stronger US ethnic researcher presence
- Results are robust to multiple specification tests and sample decompositions
- Next Steps
 - Incorporate 2004 benchmark when available
 - Study FDI organizational forms further
 - Refine R&D entry specifications
 - Looking at within-firm trade patterns too
 - Examining exogenous variation around liberalizations

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