Heterogeneity in Knowledge Flows of Regions: Impact on Invention Quality

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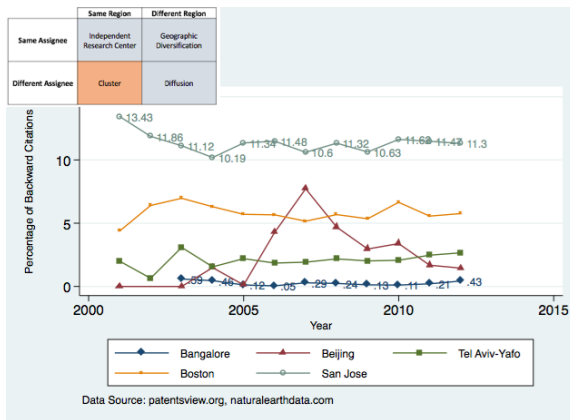# Knowledge flows as outcome of search?

Region and firm boundaries

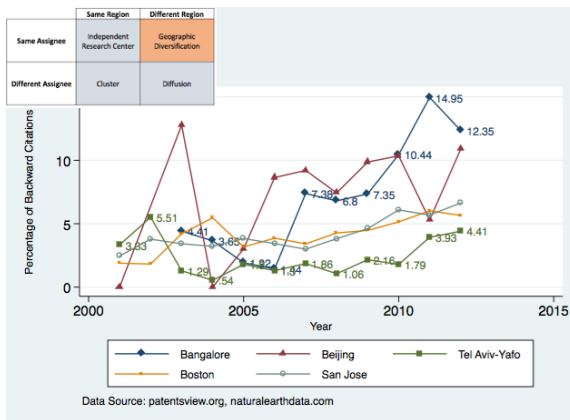|	Same Region	Different Region
Same Assignee	Independent Research Center	Geographic Diversification
Different Assignee	Cluster	Diffusion

Categories of knowledge flows

Research Question
How do the **nature** *of knowledge flows in a region affect the* **quality** *of inventions generated in the region?*

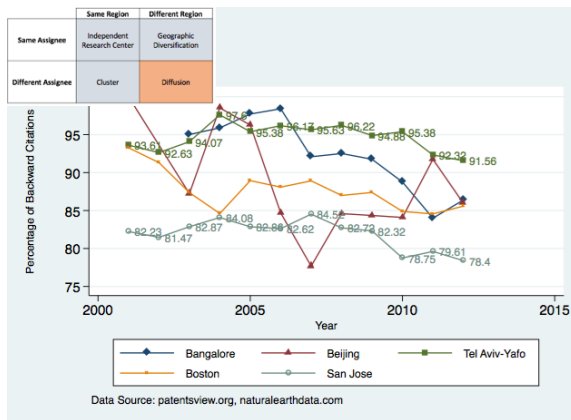# Heterogeneity in knowledge flows of clusters

Clusters

Heterogeneity in knowledge flows in geographic diversification
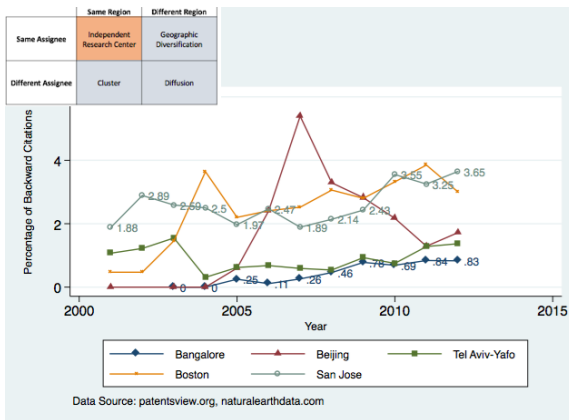

Geographic Diversification

Heterogeneity in knowledge flows under diffusion

Diffusion

Heterogeneity in knowledge flows of independent research centers

Independent Research Centers

Research Question

How do the **nature** *of knowledge flows in a region affect the* **quality** *of inventions generated in the region?*

	Same Region	Different Region
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Categories of knowledge flows

Prior art on knowledge flows

Patent citation analysis

Economic Geography Literature

- Knowledge spillovers are localized (Jaffe, Trajtenberg, & Henderson, 1993)

- Innovation is more spatially concentrated than is production (Feldman, 1994)

International Business Literature

- Firms profit from offshoring R&D by leveraging better organizational linkages (Zhao, 2006)

- Subsidiary - MNC parent flows are as strong as MNC parent - Subsidiary knowledge flows (Singh, 2007)

# Underlying effects across region and firm boundaries

	Same Region	Different Region
Same Assignee	(+) Specialization (-) Lack of Related Variety	(+) Agglomeration Benefits (+) Complementary Assets
Different Assignee	(+/-) Marshallian Externalities (+/-) Jacobs Externalities (-) Incremental Innovation (Schumpeter 1942)	(+/-) Social proximity (+/-) Complexity of search

Underlying effects affecting of knowledge flows

On the Localization of Knowledge Spillovers

- Proximity is beneficial due to lower costs of collaboration, opportunities for serendipitous encounters
- Tacit knowledge is not easily transferred across long distances
- Institutions and Regional innovation systems contribute to localization of knowledge flows
- Related variety (Boschma & Iammarino, 2009; Frenken, Oort, & Verburg, 2007; Jacobs, 1969) in urban clusters promotes generation of new ideas
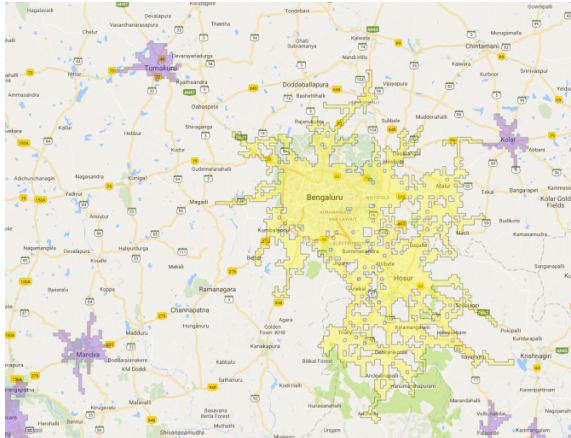
Geographic Mapping
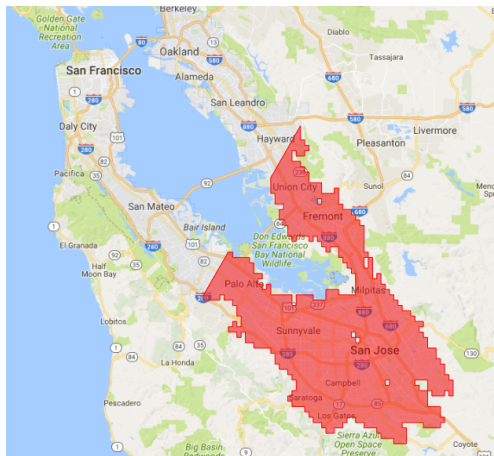
San Jose

Geographic Definition of San Jose, CA
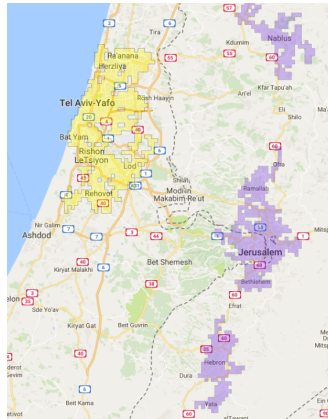
Geographic Mapping

Bangalore

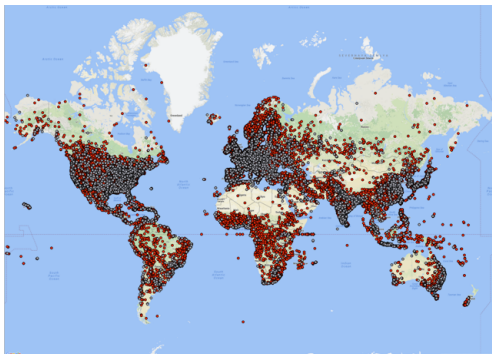Geographic Definition of Bangalore

Geographic Mapping
Tel Aviv-Yafo

Geographic Definition of Tel Aviv-Yafo

Patenting in Urban Centers

128,044 inventor locations since 1976

Colored Gray - 31,208 urban center locations
Colored Red - 96,836 locations outside of urban centers

Data sources and estimation

- Data Source: Patents from USPTO, source: patentsview.org
- Data Source: Regions using Remote Sensing Data, source: naturalearthdata.com
- Unit of Analysis: Region-Year
- Dependent Variables: Total Citations Received, Non-Self Citations Received
- Independent Variables: Share of citations made within/outside region, within/outside assignee
- Control Variables: Technology subcategories (Hall, Jaffe, & Trajtenberg, 2001), Region fixed effects, Year effects
- Estimation Method: Negative Binomial

Results

Applicant citations

	(1) Total Citations Received	(2) Total Citations Received	(3) Total Citations Received	(4) Non-Self Citations Received	(5) Non-Self Citations Received	(6) Non-Self Citations Received
Share Citations Made[Same Region, Same Assignee]	-0.125	-0.156	-0.0437	-0.0698	-0.0575	-0.113
	(0.372)	(0.468)	(0.809)	(0.613)	(0.782)	(0.560)
Share Citations Made[Same Region, Different Assignee]	-0.0501	-0.250	0.0494	0.214	0.0341	0.267
	(0.677)	(0.305)	(0.704)	(0.052)	(0.889)	(0.035)
Share Citations Made[Different Region, Same Assignee]	0.260	0.316	0.326	0.215	0.209	0.247
	(0.002)	(0.015)	(0.003)	(0.013)	(0.105)	(0.040)
Share Citations Made[Different Region, Different Assignee]	0.00251	0.0382	0.0123	0.0426	0.0336	0.0615
	(0.933)	(0.383)	(0.760)	(0.160)	(0.447)	(0.143)
Log (Total Citations Made)	0.0194	0.0126	0.0220	0.0131	0.00662	0.0152
	(0.000)	(0.031)	(0.000)	(0.002)	(0.258)	(0.012)
Log (Num Patents)	0.788	0.860	0.830	0.799	0.826	0.849
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log (Patent Pool Size)	-0.124	-0.303	-0.110	-0.0871	-0.157	-0.108
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	-0.911	0.510	-1.368	-1.296	-0.557	-1.677
	(0.000)	(0.002)	(0.000)	(0.000)	(0.002)	(0.000)
Observations	9358	3974	5384	9037	3868	5169
Groups	1359	539	820	1255	503	752
Sample	All Locations	U.S. Locations	Non-U.S. Locations	All Locations	U.S. Locations	Non-U.S. Locations

p-values in parentheses

All models include region fixed effects, year dummies and technology subcategory controls

Contributions

- Addresses the question of the relative effects various types of knowledge flows affect invention quality

- Extends past work that have looked at single industry, cross-section or a sample of regions by analyzing patents from all industries, from all regions over the duration for which data is available

- Extends a line of inquiry on clusters, attempting to explore reasons why not all regions seem to benefit from the clustering effect

Boschma, R., & Iammarino, S. 2009. Related variety, trade linkages, and regional growth in italy. **Economic Geography**, 85(3): 289–311.

Feldman, M. P. 1994. **The geography of innovation**. Boston: Kluwer Academic Publishers.

Frenken, K., Oort, F. V., & Verburg, T. 2007. Related variety, unrelated variety and regional economic growth. **Regional Studies**, 41(5): 685–697.

Hall, B. H., Jaffe, A. B., & Trajtenberg, M. 2001. **The NBER patent citation data file: Lessons, insights and methodological tools**. Working Paper 8498, National Bureau of Economic Research.

Jacobs, J. 1969. **The economy of cities**. New York: Random House.

Jaffe, A. B., Trajtenberg, M., & Henderson, R. 1993. Geographic localization of knowledge spillovers as evidenced by patent citations. **The Quarterly Journal of Economics**, 108(3): 577–598.

Rosenkopf, L., & Nerkar, A. 2001. Beyond local search: Boundary-spanning, exploration, and impact in the optical disk industry. **Strategic Management Journal**, 22(4): 287–306.

Singh, J. 2007. Asymmetry of knowledge spillovers between mncs and host country firms. **Journal of International Business Studies**, 38(5): 764–786.

Zhao, M. 2006. Conducting R&D in countries with weak intellectual property rights protection. **Management Science**, 52(8): 1185–1199.