



Observing Regional Divergence in China: Spatial Analysis of Nanotechnology Patents

Do centers of nanotechnology diffuse geographically or become more concentrated in key regions over time?

Regional convergence theory (e.g., Co 2002) suggests that nanotech patents will diffuse over time, such that regions become increasingly similar with regard to patent production, while **regional divergence theory** (e.g., O'hUallachain 1999) suggests increased spatial clustering of patents into dominant regions. The focus of this case study is to identify which processes are dominant.

findings & implications

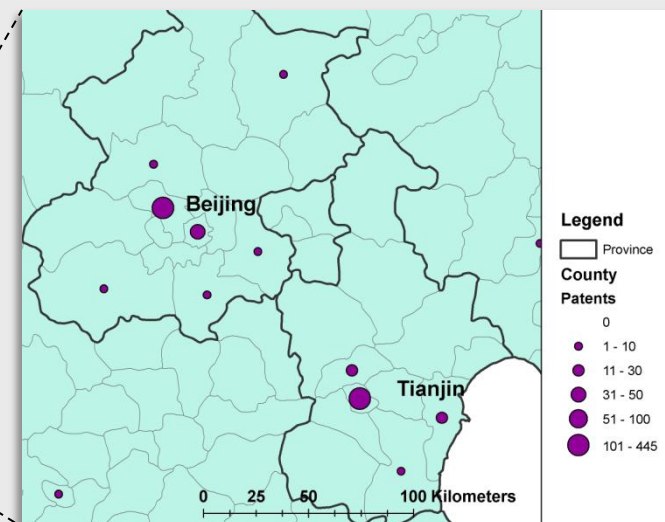
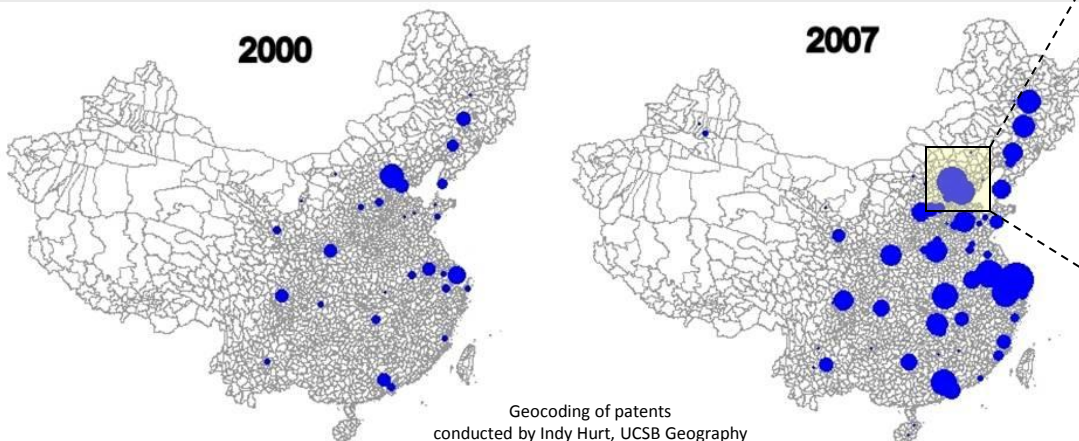
Productive Chinese nanotech centers have been heavily concentrated in the Beijing and Shanghai areas over the past decade due to substantial public funding directed to a few key institutions.

- As predicted by regional divergence theory, geographic concentration is persistent over time.
- A closer observation in the Beijing area and spatial analysis suggest that the clustering is most captured at the scale of 20-25km (13-17mi).

These findings suggest that **geographic spillovers of nanotechnology take place at a small scale** (substantially smaller than U.S. states). If diffusion of nanotech innovation is desired, policymakers should develop strategies to promote inter-regional transfer, possibly including refinement of the research grant distribution.

methods

- Extracted data from Chinese State Intellectual Property Office using 15 nanotechnology-related keywords
- Geocoded postal codes and joined with province and county boundaries
- Employed Gini coefficient & Moran's I to test spatial clustering and changes over time (2000-07, each year)



Motoyama, Yasuyuki and Richard Appelbaum. "Observing Regional Divergence of Chinese Nanotechnology Centers." In preparation for *Regional Science Policy and Practice*

Nanotechnology Doctoral Production 1999-2009

Introduction

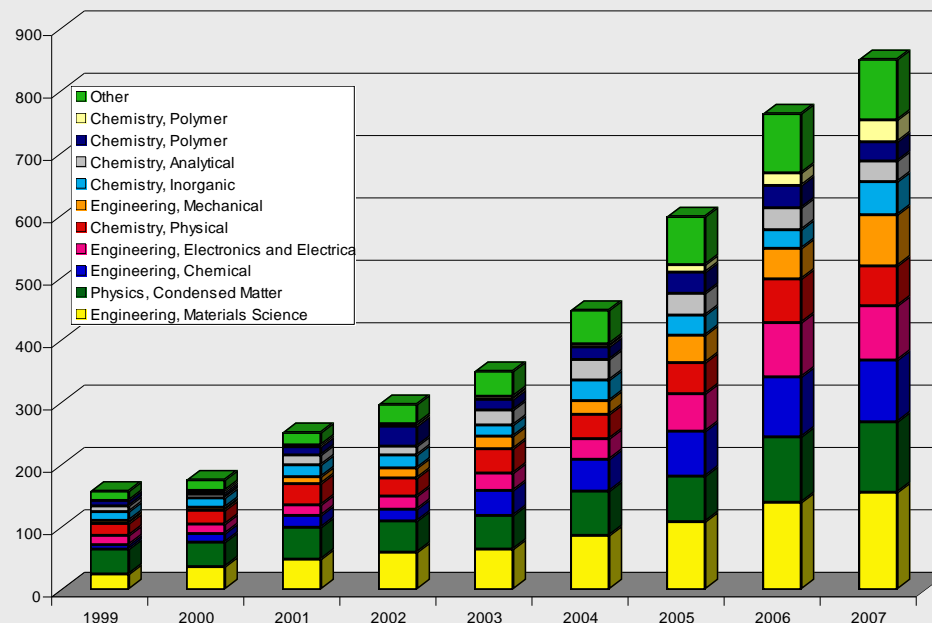
- By providing a link between the established research community and future scholarly work, the profile of recent graduates and junior researchers intimately structures the trajectory of research and innovation and is central in the intergenerational transmission of knowledge.
- Despite its potential for mapping quantitative and qualitative shifts in the emerging scientific community, studies of nanotechnology have neglected PhD production in favor of patents, publications and other data.

Data

- All dissertations published on nanotechnology between 1999-2009 retrieved from the Proquest/UMI dissertation database.
- Dissertations identified using bibliometric methods.
- Data was coded by year, department, university and geographic location to study trends in the disciplinary, institutional and spatial distribution of recent doctorate production. Our initial findings related to field of study are provided to the right.

Walsh, James, Claron Ridge, and Richard Appelbaum. 2011. "Innovators in the Pipeline: Nanotechnology Doctoral Production 1999-2009." *Manuscript in preparation.*

Nano PhD Growth by Subdiscipline



Implications

When completed, our study promises to enhance the monitoring and evaluation of research capacities by academics and policymakers. Specifically our data can be utilized by governments, firms and universities to augment strategies for future research planning and capacity building- both of which are increasingly instrumental in remaining globally competitive in cutting-edge sectors.

The Contributions of Foreign-Born Scientists to U.S. Nanotechnology Innovation

What is the role of foreign-born scientists and engineers in U.S. nanoscience innovation?

While scholarship has documented the role of non-citizens in innovation concerning information technology and biotechnology, comparable studies on nanotechnology are conspicuously absent.

This study examines the authors of the top-1% most highly-cited articles on nanotechnology by U.S. scientists and engineers between 1999-2009.

Methods

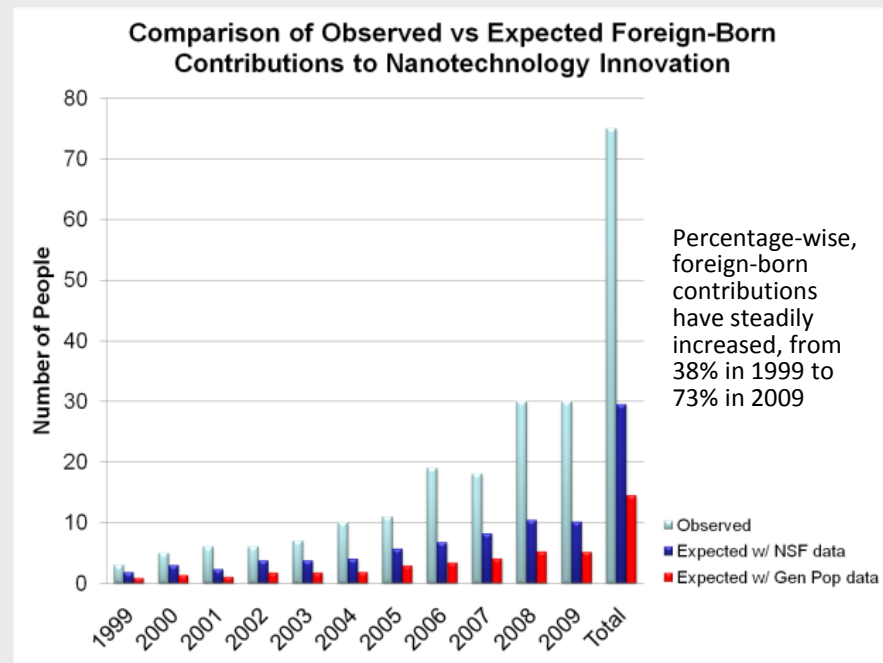
- Most highly-cited articles identified using bibliometric methods.
- Nationality of authors (both corresponding and non-corresponding) gathered through biographic resources (*American Men and Women of Science*). At present, only data on corresponding authors has been analyzed. Nationality of remaining authors will be determined through survey conducted in spring 2011.
- Data benchmarked against the prevalence of the foreign born in the American scientific labor force and general population (statistical significance determined using Chi-square and two-tailed binomial test) to determine significance.

Results

- Prevalence of the foreign-born significantly exceeds that of the general population ($p < .05$ for all years, $p < .01$ for 2005-2009) and of the U.S. scientific community as a whole.
- China, India and Germany all made significant contributions.

These findings point to the **significance of non-native researchers in promoting U.S. nanotechnology innovation**. The data indicate **significant internal globalization** of the American scientific and engineering communities.

Figure 1



Top 4 Countries by Number of Corresponding Authors

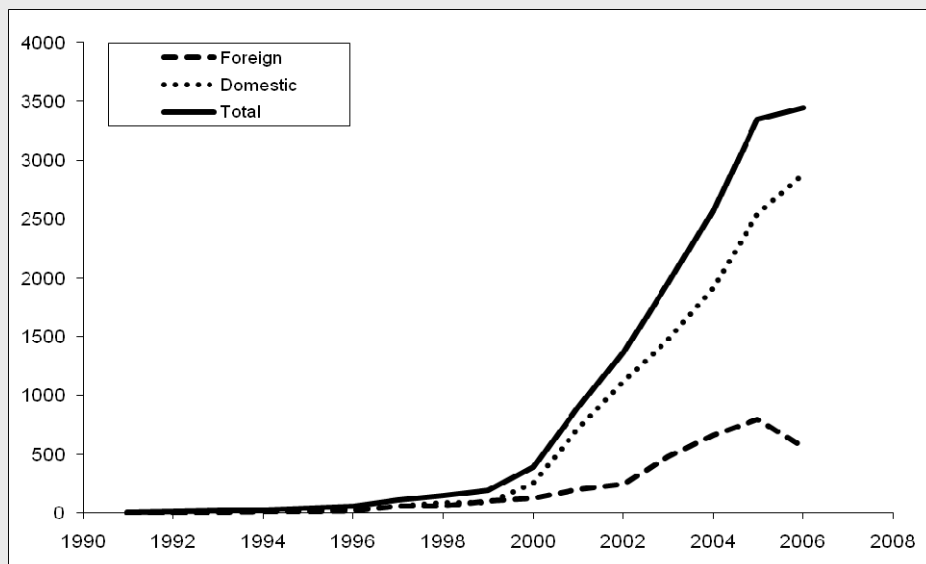
United States of America	→ 47 Scientists
China	→ 21 Scientists
India	→ 8 Scientists
Germany	→ 5 Scientists

Walsh, James, Richard Appelbaum, and Sriyay Rajan. 2011. "The Contributions of Foreign-born Scientists to Nanotechnology Innovation 1999-2009." *Manuscript in Preparation*.

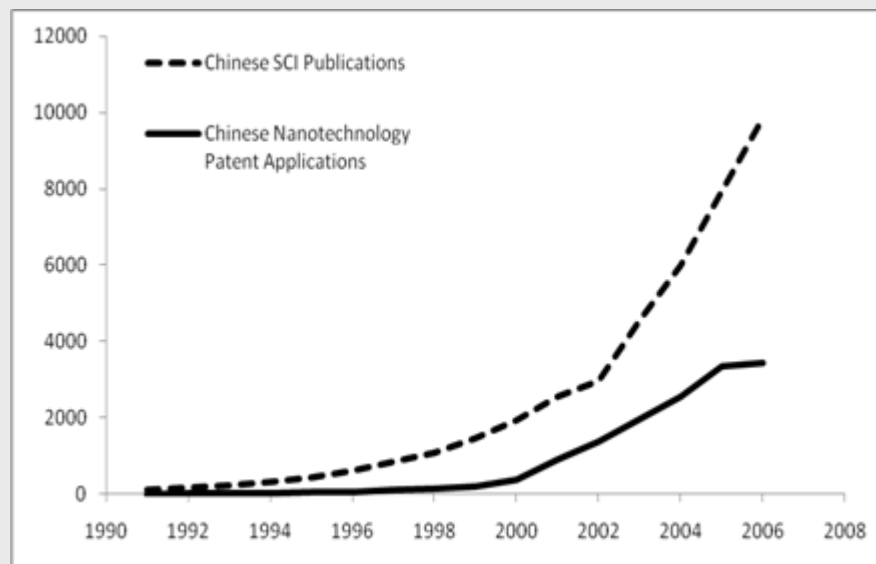


Based on patents and publications, the Chinese Nanotechnology Landscape is Rapidly Changing

SIPO Nanotechnology Patent Applications: 1991–2006



Trends of Domestic Chinese Patent Production and SCI Chinese Publication Production in Nanotechnology



There has been a significant increase in patents since 2000, with domestic applications increasingly surpassing foreign applications since that time. Most domestic patent applications were from Chinese institutions of learning while most foreign patents were from firms. This suggests that even though China is becoming globally important in nanotechnology-related research, its commercial potential has yet to be realized.

Parker, Rachel, Claron Ridge, Cong Cao, and Richard Appelbaum, "China's Nanotechnology Patent Landscape: An Analysis of Invention Patents Filed with the State Intellectual Property Office" *Nanotechnology Law & Business Review* (6) 524-539 (Winter 2009).