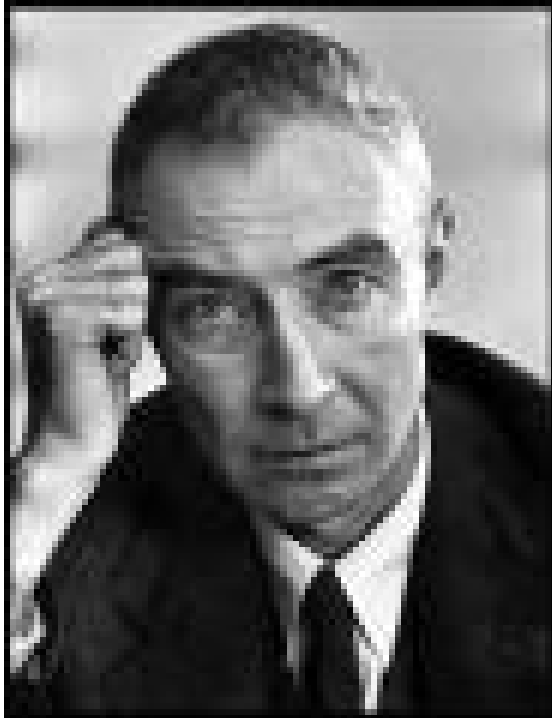


Wrapping It Up in a Person: The Mobility Patterns of New Ph.D.s

Paula Stephan
Andrew Young School
Georgia State University
June 2006

[Motivation]

- Knowledge flows from universities to firms play important role in fostering innovation
- Flows follow a variety of paths
- Face-to-face transmission important when tacit knowledge is involved.
- Placement of new PhDs with industry provides one mechanism for transmitting tacit knowledge.



“The best way to send information is to wrap it up in a person”*

J. Robert Oppenheimer

“The eternal apprentice,” Time Magazine, vol. 52, p. 81

But Little Known About These Knowledge Flows

- Where do the new PhDs train?
- Do they go to work with firms in close proximity?
- Or “fly the coop”?
- Lack of knowledge relates to absence of data concerning placement of new PhDs going to work in industry

[HR data also Illuminates Patterns of Innovation Missed by R&D Data]

- R&D data not available at the city level
- R&D data collected at corporate level, not at the plant where innovation occurs
- R&D data often miss innovative activities that occur in the service sector, as well as in “non-lab” sector of manufacturing firms

[Objective]

- Analyze new data source concerning placements of new PhDs with firms
- Examine what data say about sources of new knowledge production and location of hiring firms
- Explore insights that data bring to study of innovation
- Examine implications for public policy

[Data Source]

- Survey of Earned Doctorates administered to all new PhDs since 1958 (NSF)
- 92% response rate
- Asks those with definite plans (63%) where they will work after graduation:
 - Name the organization and geographic location where you will work or study.

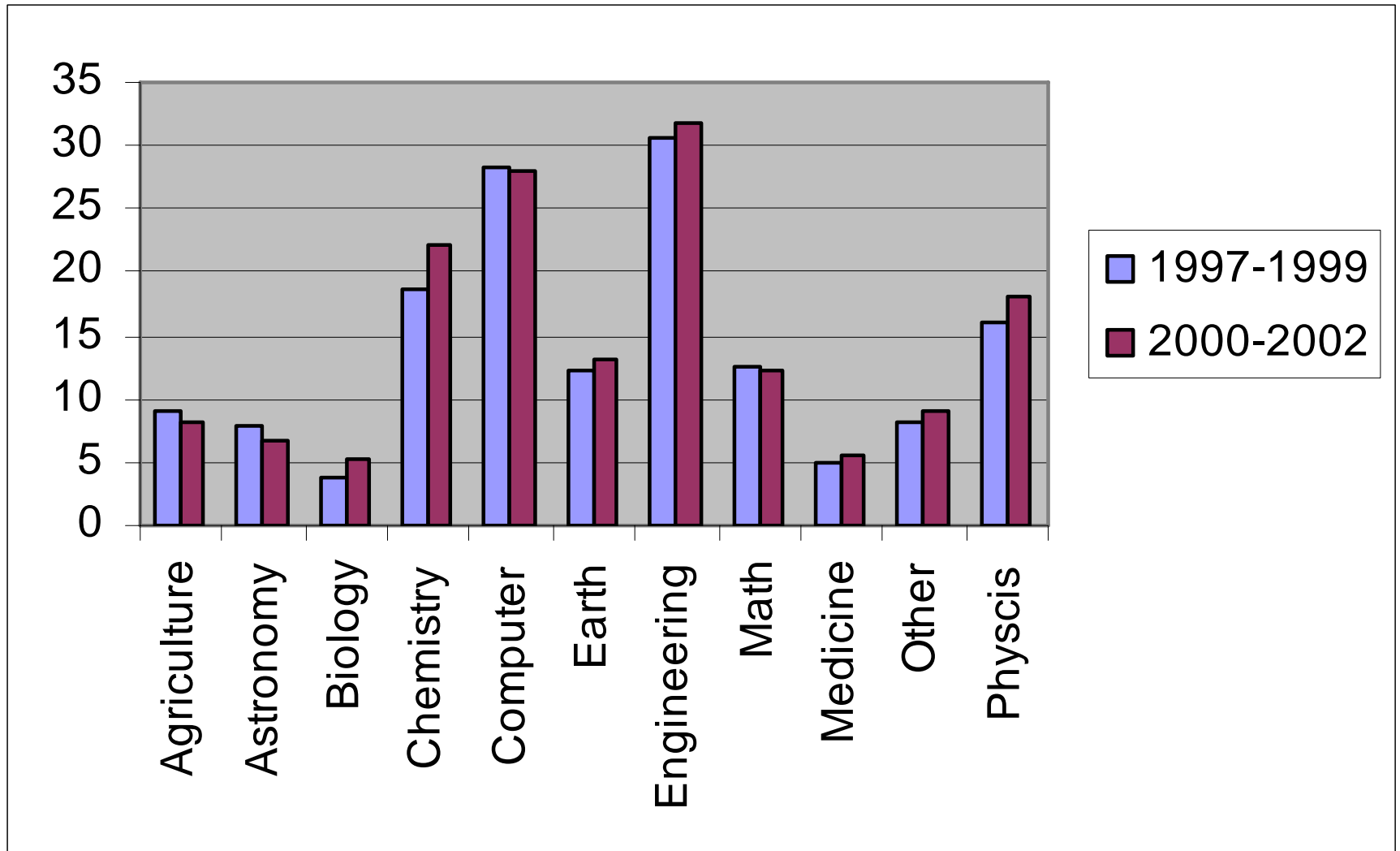
So What Makes It a New Data Source?

- Industrial placement information has never been coded
- But, since 1997 verbatim files have been kept of answers to “where are you going to work” question
- We coded verbatim for 1997-2002 placements for those trained in S&E

[Summary of Data]

- 21,765 identified a firm where they were going to work
- Represents 15% of those receiving PhDs in S&E during the period
- Undercounts in two serious ways:
 - No information for 37% who said they had plans to work in industry but had yet to be offered or accept a job in industry.
 - Many scientists and engineers who go to work in industry initially take a postdoctorate position.

Percent of PhDs Going to Industry



[Large or Small Firms?]

- About 39% go to a top 200 R&D firm
 - Computer scientists, engineers and chemists most likely—around 45%; astronomers close behind.
 - Biology, medicine, agriculture and “other” least likely.

[Role of Small Firms]

- Finding suggests that small firms play a larger role in innovation than R&D data would suggest
 - Top 200 R&D firms expend more than 70% of all R&D in U.S.
 - Hire only 39% of new PhDs

[Where Do They Train?]

- New England and Middle Atlantic: 25%
- Pacific States: 17%
- **Mid West: 27%**
- South Atlantic: 15%
- Other: 16%

[University R&D]

- University R&D expenditures often used as a measure of knowledge available to spillover
- Compare placements to R&D expenditures
- Greater than 1 infer R&D understates knowledge spillovers; Smaller than 1 overstates.

[Training Relative to R&D]

- New England and Middle Atlantic: 1.1
- Pacific States: 1.0
- Midwest: 1.26
- South Atlantic: .81
- Other: .79
- Suggests that R&D data understate knowledge spillovers coming out of some universities; overstate that coming out of other universities.



732

Top Five Producing Universities



670



579



576



528

Next Five



527



451



521



489



430

Observations

- Heavily concentrated: Top 10 educate 25% of those going to industry
- Midwest plays an important role: five of top-ten are in the Midwest
 - Illinois
 - Purdue
 - Minnesota
 - Michigan
 - Wisconsin

[Retention by Region]

- 48% stay in the region of training
 - Pacific Region retains 70%
 - Mid Atlantic retains 51%
 - New England 46%
 - Midwest 37%

[State Retention]

- 37% stay in state of training
 - Midwest states retention is low
 - Iowa retains 14%
 - Indiana retains 12%
 - Wisconsin retains 18%
 - Pacific states is high
 - California retains 70%

[Stay Rate Low Compared to]

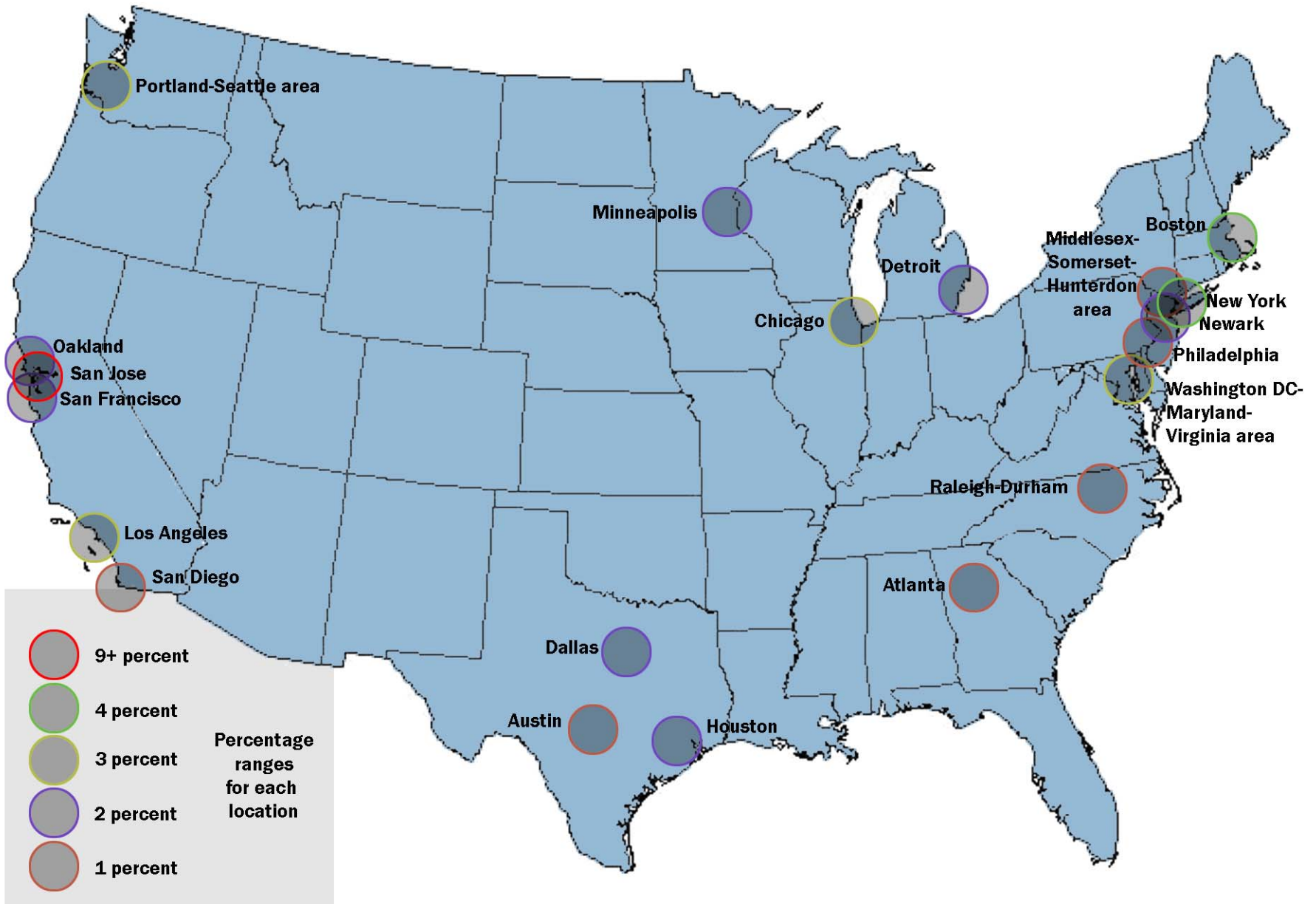
- Law school graduates: 57% stay in state
- Bachelors and Masters in science: 64%
- Bachelors and Masters in engineering 62%

Destination Cities of Interest

- Information on location provides a different measure of innovation than do patent counts or SBIR counts
- Useful in that U.S. does not collect R&D data by city. HR data provide a different lens for examining innovation at the city level.

[Top Twenty Destination Cities]

- San Jose: 1878
- Boston: 1015
- New York: 937
- Washington DC: 758
- Portland-Seattle: 694
- Chicago: 669
- Los Angeles-Long Beach: 622
- Houston: 586
- Newark: 547
- San Francisco: 534
- Dallas: 505
- Minneapolis: 439
- Detroit: 429
- Oakland, CA: 424
- Philadelphia: 377
- San Diego: 345
- Austin: 341
- Raleigh-Durham: 320
- Atlanta: 309
- Middlesex-Somerset-Hunterdon: 299



[Observations]

- High geographic concentration: top 20 cities attract 60% of new PhDs
- San Jose hires twice as many as any other city.
 - More San Jose placements in 2000-2002 than in 1997-1999.
- California heavily represented with five cities
- But...not as geographically concentrated as patent or SBIR counts

[Top hiring firms]

- Confidentiality restricts our ability to “name names”
- Instead examine top 32 hiring firms by NAIC classification
 - Greatest number of hires were in firms working in computer and electrical
 - Followed by hires in publishing industries and professional scientific and technical services

[Mix of Expertise]

- SED data provide insight into mix of expertise that firms hire
- Pharmaceuticals provide an illustrative case:
 - Hire 1047 new PhDs during period. Dominant field is chemistry (402), but 100 or more were hired from four other fields: 193 biology; 147 engineering, 140 medicine, 132 from math.
 - And this is a major undercount in the sense that it misses new PhDs who go to pharma after holding a postdoc.

International Destinations

- Five percent have plans to work for industry outside U.S.
 - Korea--250
 - Germany--96
 - Japan--93
 - Canada--66
 - Taiwan--55
- Approximately 60 are headed to China, India and Thailand

[Data Issues]

- HR data clearly informs our understanding of innovation patterns and knowledge flows
- If data were enhanced, we would know even more
 - Follow-up those without definite plans
 - Learn about placements of postdocs with industry
 - Obtain salary information for new placements
 - Extend data to pick up additional post dot.com years
 - Link data with productivity measures

Recent SRS Data Initiatives

- SRS is in the process of adding a “salary offer” question to the SED for those with definite plans.
- SRS has established guidelines for how SRS data can be matched to other data, such as patent databases; publication counts.
- SRS is in the process of reviewing and studying the possibility of fielding a postdoc survey.

[Major headlines]

- Midwest universities play a major role in educating new PhDs going to industry
- PhDs working in industry are not that likely to remain in state
- Stay patterns particularly low among certain Midwestern states

[Policy Issue]

- Certain states and regions are “underwriting” the high quality of the S&E workforce
- Many Midwest PhD programs were developed to support local industries
- The industrial prowess of Midwest has declined in recent years
- Will the Midwest persist in training individuals destined to other states?

[The Kindness of Strangers]

- One can make the case that a highly trained S&E workforce will only be maintained if the Federal government increasingly provides financial support for graduate education as state legislatures become increasingly aware of these migration flows.
- It's risky as a nation to continue to rely on the "kindness" of Midwestern states to educate the high-quality S&E work force that heads out of state.

Of course, not “kindness” that drives such an outcome

- Universities benefit from doctoral students, especially to the extent that they provide cheap labor in the classroom and the laboratory.
- Fact remains that while all public institutions, and indirectly the states that support these institutions, garner these benefits, *some states garner the added spillover benefits which occur when new PhDs remain in state. Others do not.*

Regional Growth and Development

- New PhDs not only contribute to innovation;
- Also contribute to local economic development.
- Newly trained PhD in computer science earns \$87,000; engineers earn \$79,000.
- More than 300 new PhDs a year go to work in industry in San Jose alone.
- They spend much of their income locally—through multiplier effect their spending contributes to regional economic growth.

[Role of Small Firms]

- Data suggest that small firms play a larger role in innovation than R&D data would suggest.
- Reflects in part degree to which small firms are “knowledge-intensive”
- Degree to which R&D statistics are dominated by development costs associated with large firms.

[Questions? Comments?]

- pstephan@gsu.edu