Returns to Federal Investment in Graduate Training

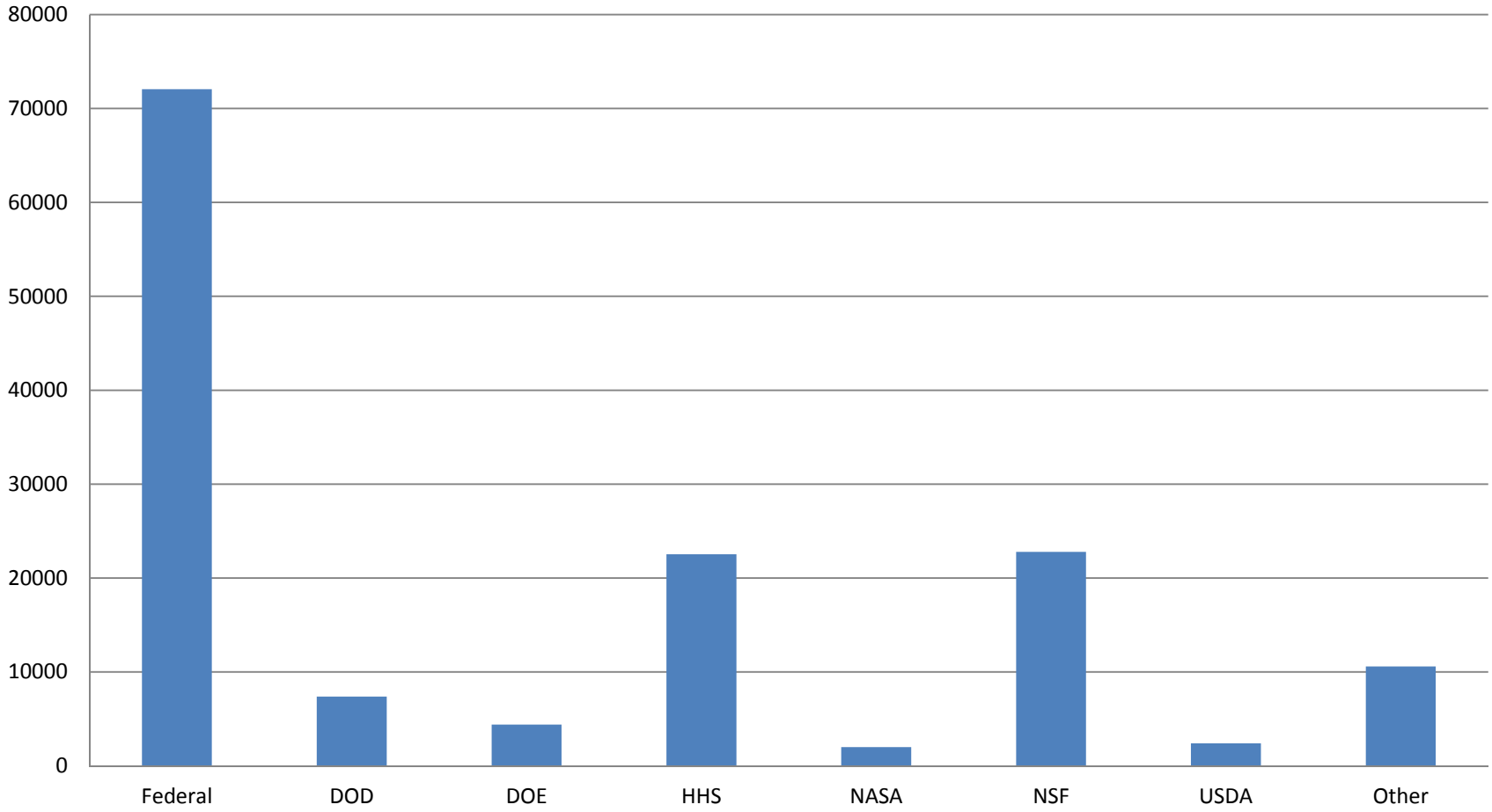
Paula Stephan
Georgia State University & NBER
National Academies December 2016

Facts

- Federal government supports large number of PhD students and postdoctoral fellows either indirectly, as research assistants, through PI grants or directly on fellowships
- Most work in university labs
- Despite substantial investment, know little about return on this investment subsequent to training, especially for those going to work in industry

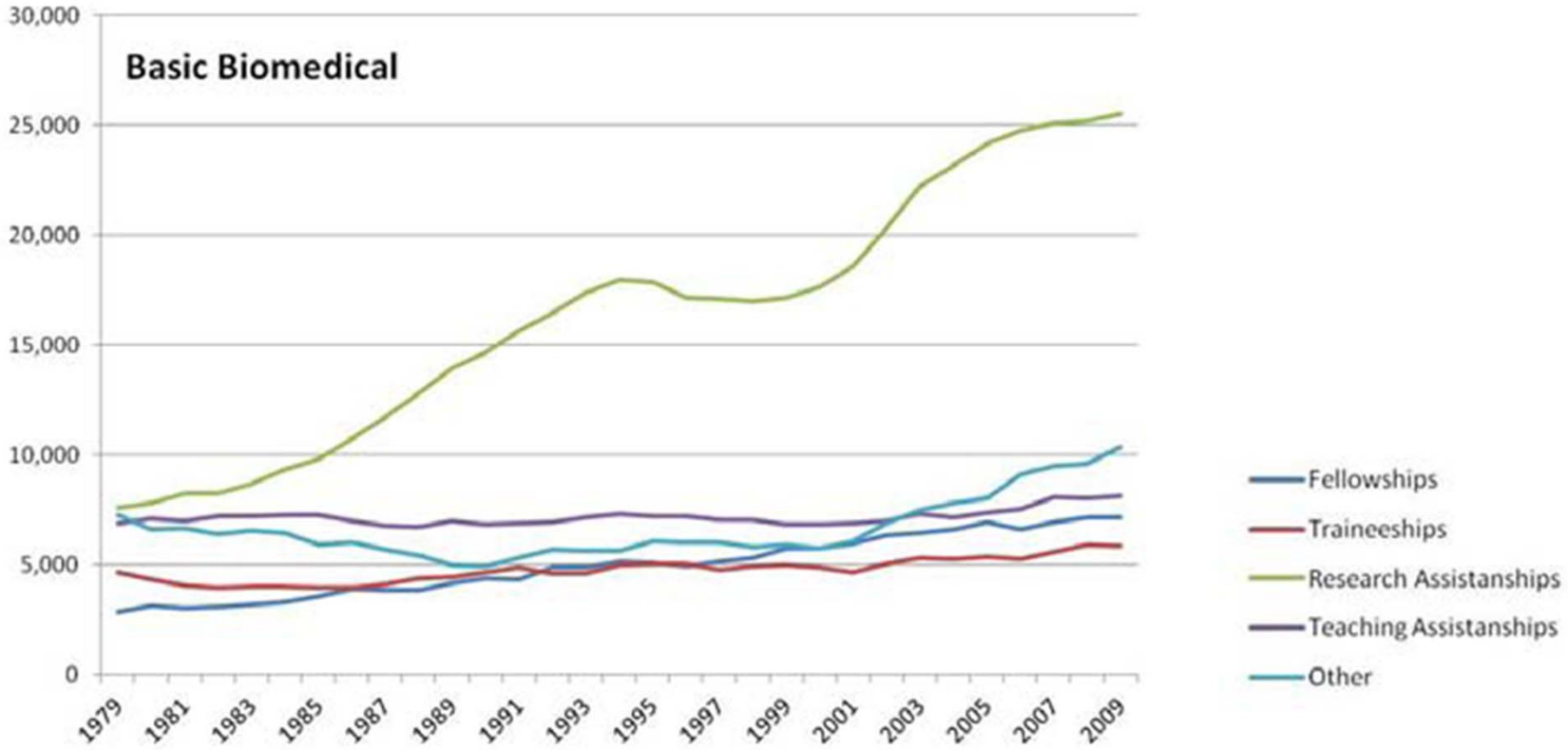
Alex Pines Lab, Berkeley

Federal Support for Full-time Graduate Students at PhD Granting Institutions

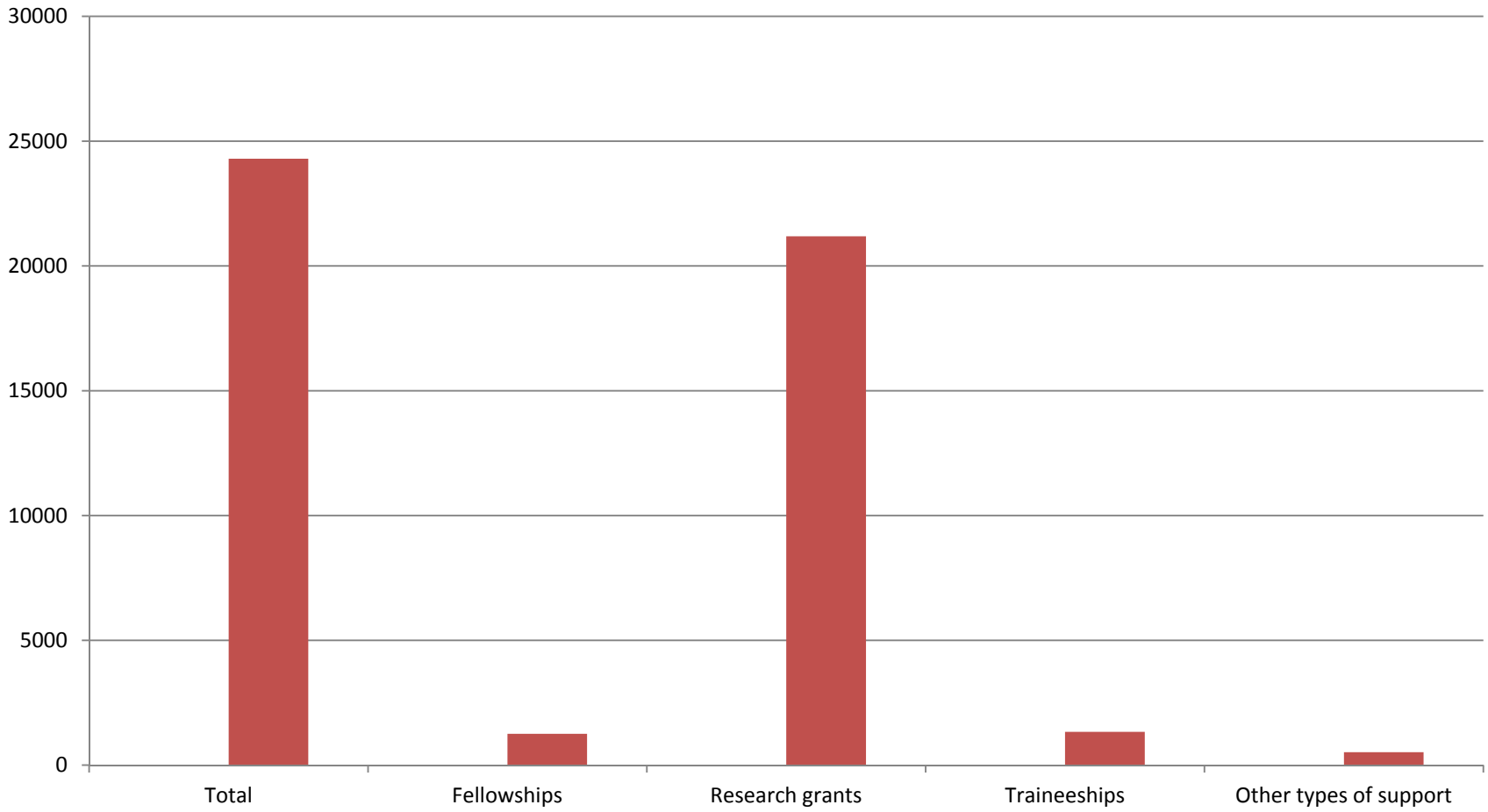


https://ncsesdata.nsf.gov/gradpostdoc/2014/html/GSS2014_DST_19.html

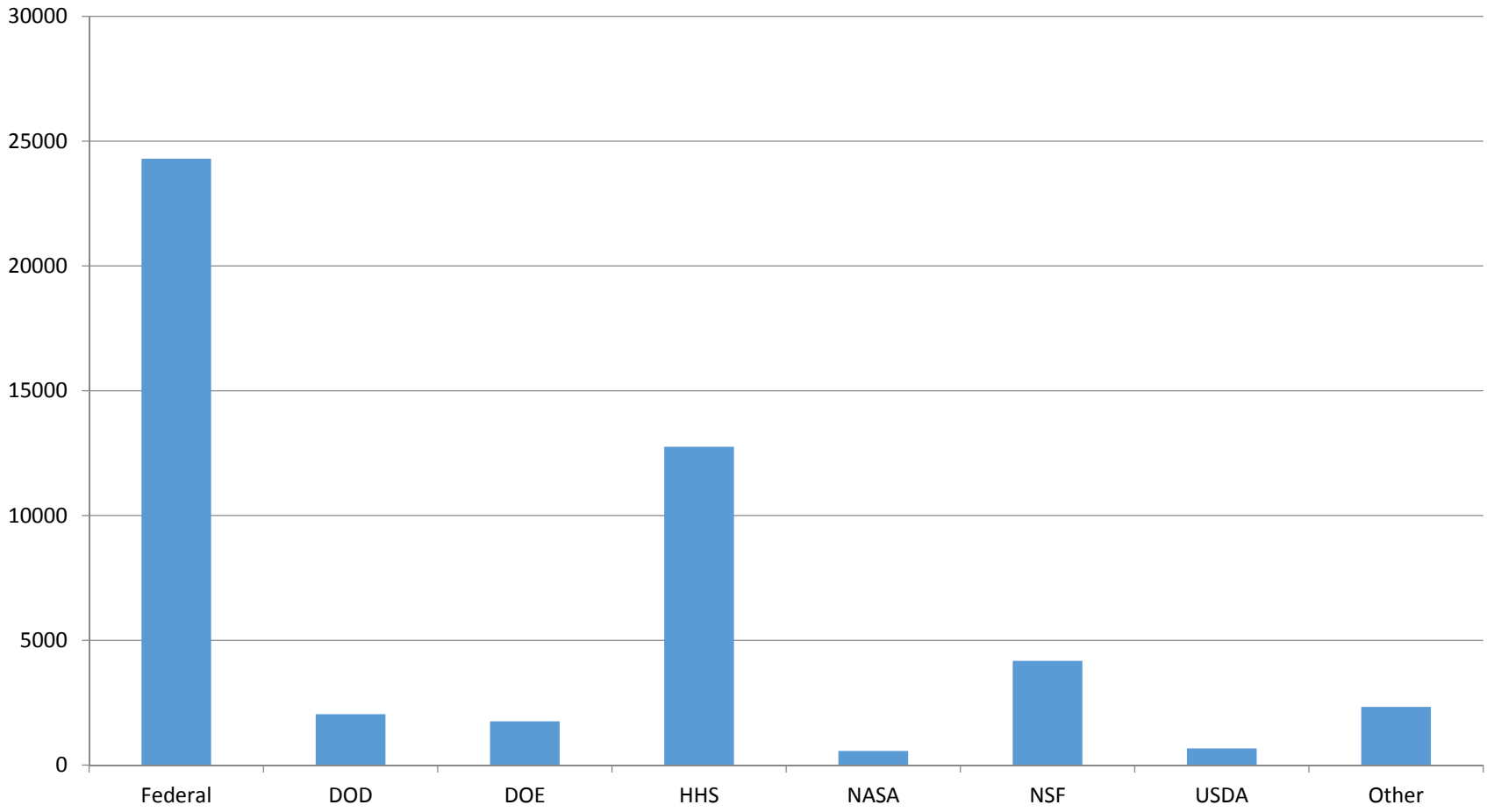
Doctoral Students by Type of Support



Federal Support for Postdoctoral Fellows



Postdoctoral Fellows By Agency



https://ncsesdata.nsf.gov/gradpostdoc/2014/html/GSS2014_DST_41.html

Conceptualizing Returns

Benefits to Training

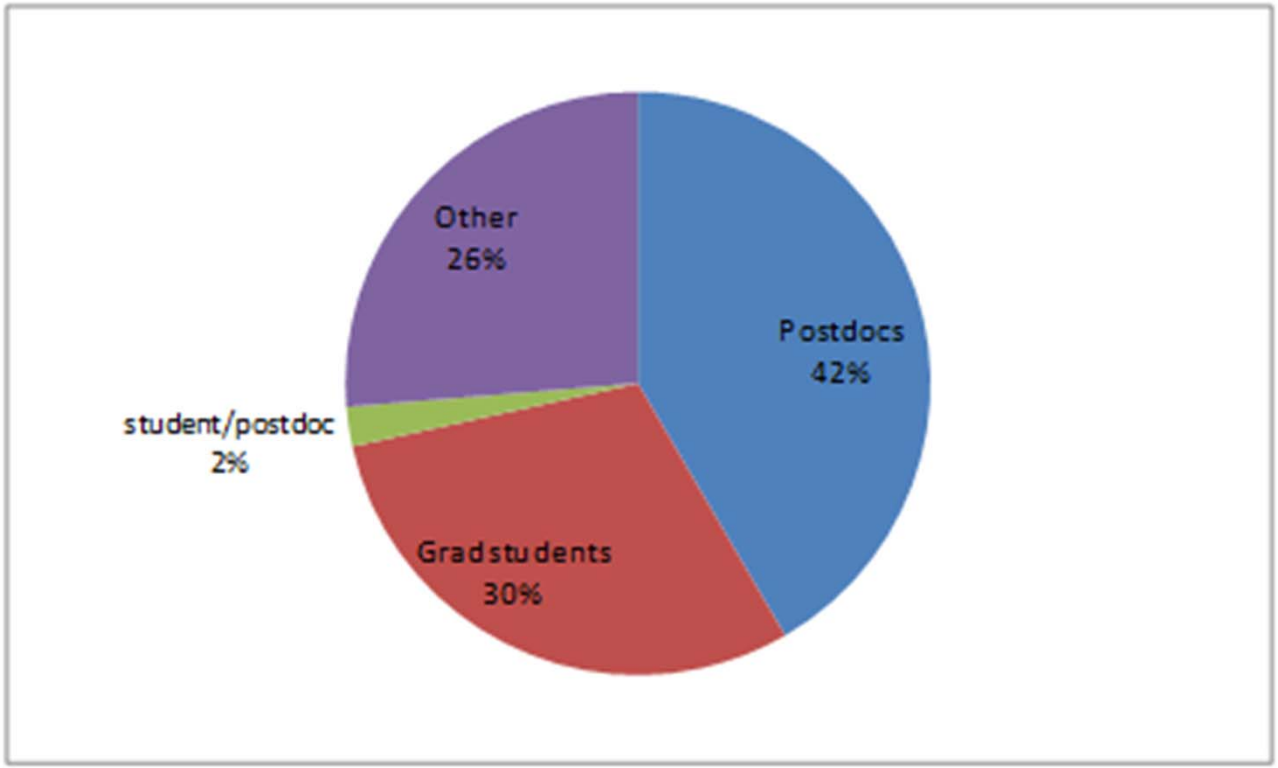
- Accrue while working in lab
- Benefits accrue when trainees leave and take a position

Measuring Benefits

- Benefits accruing while in university lab
  - Technology transfer through production of patents
  - Creation of knowledge embedded in articles

Authorship Patterns U.S. Articles with 10 or fewer authors in *Science*

First Authors: N=137



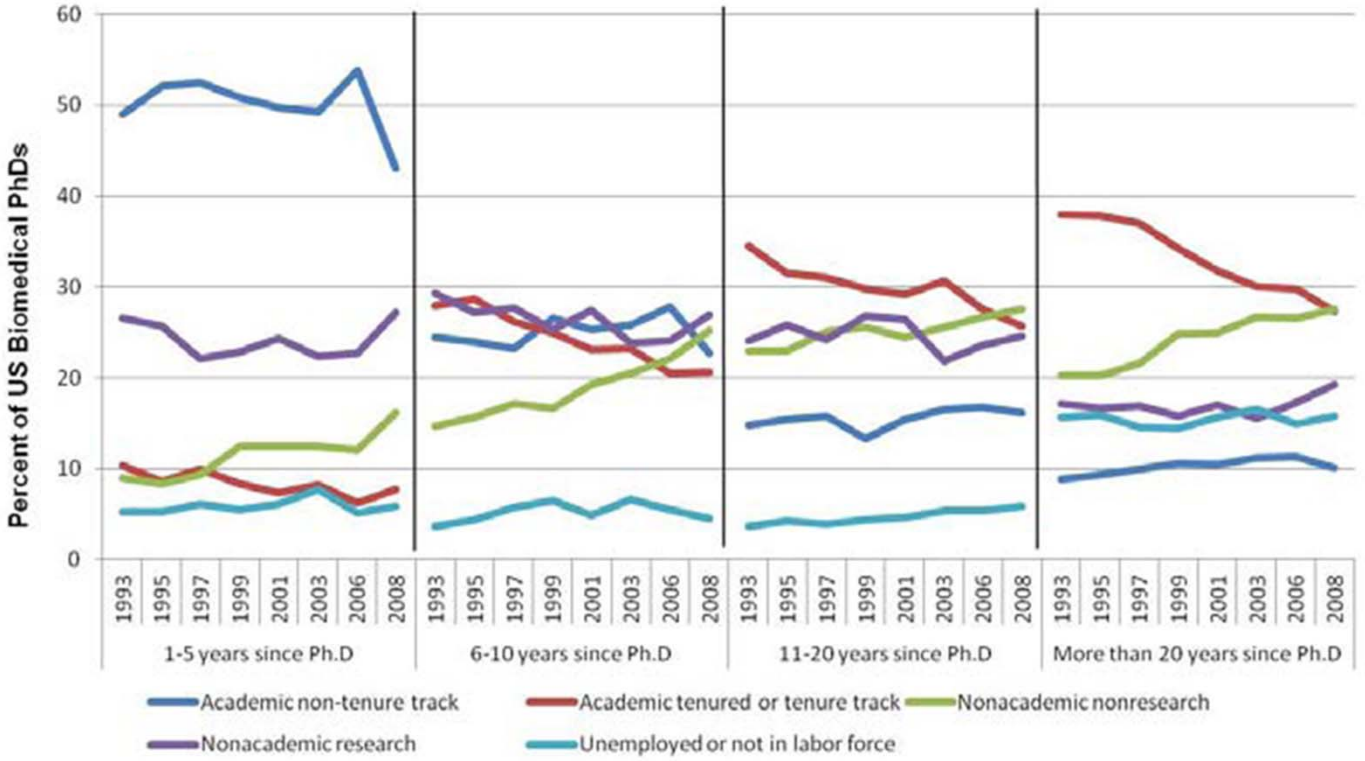
Benefits Accruing Post Training

- Academic positions
  - Technology transfer
  - Creation of knowledge embedded in articles
  - Training of new students
- Non academic positions
  - R&D firms
  - Non-R&D firms

Patterns

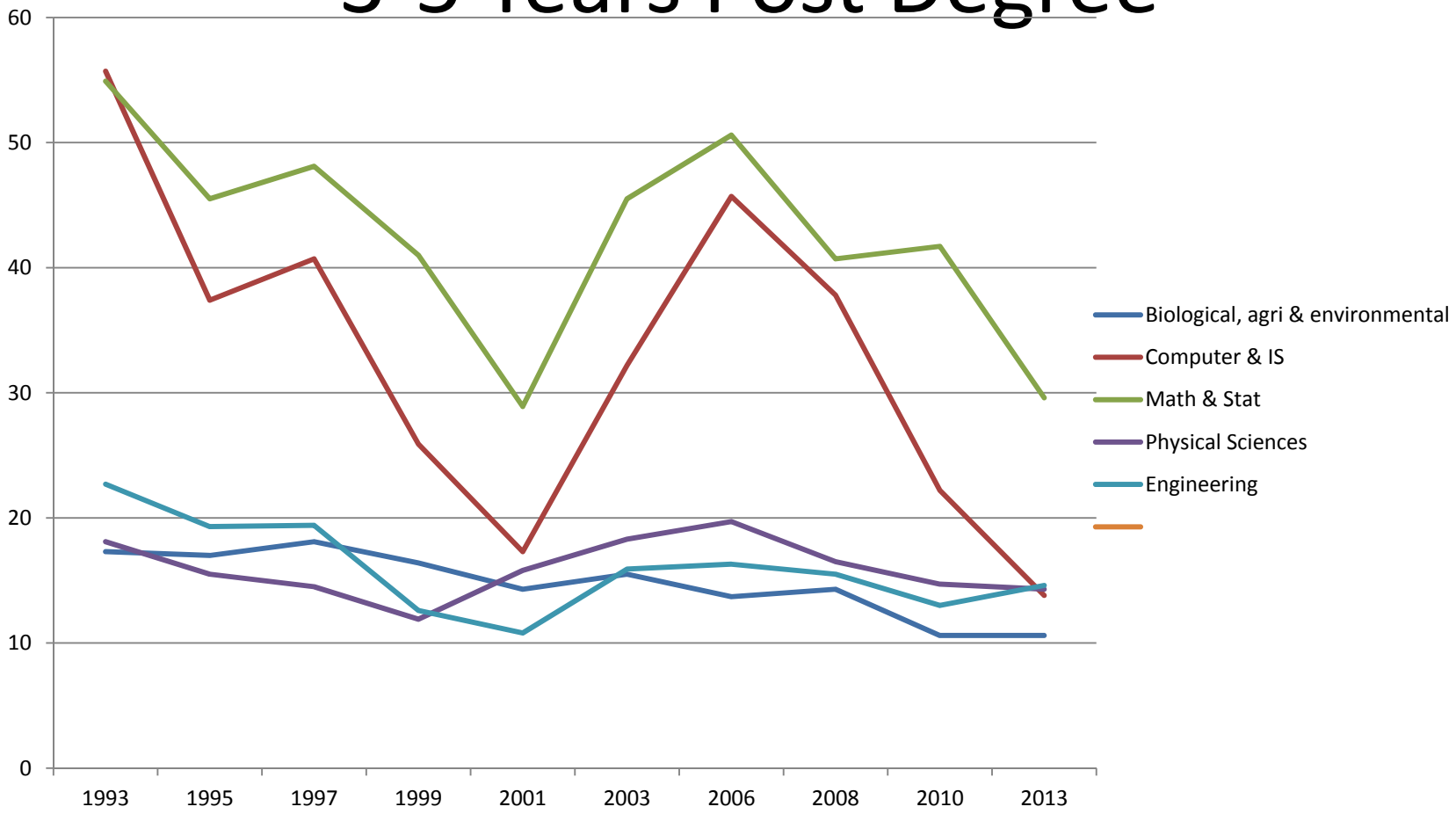
- Increasingly trainees take positions in industry, many in non-R&D firms
- Academic appointment is now the "alternative" track

Employment Outcomes by Cohort Biomedical Sciences



Doctorates Holding Tenured or Tenure Track Positions in Academe 1993-2013

3-5 Years Post Degree



S&E Indicators Table 3-16 Chapter 3

Quantifying flows of highly trained to firms and relating these to productivity

Trainees

- Provide skills and knowledge to firms
- “Best way to send information is to wrap it up in a person.” J. Robert Oppenheimer
- To date, handicapped in understanding relationship between placement & firm performance—
  - Do not have a ready way for tracking graduates who go to industry, most of whom neither publish nor patent—traditional way for measuring contributions post-graduation

But Making Progress

UMETRICS DATA

Opportunity

- Challenge in past to know placement of students in industry
- Now able to do so routinely by matching PhD records at US Census Bureau
- Recently demonstrated this with a “proof of concept paper” that was published in *Science*

Approach

- Match UMETRICS data for 8 universities to Census Data to examine placements under strict confidentiality protocols
- Focus: Recent PhD graduates supported on grants while in graduate school
- Findings published in *Science* in December 2015
- Team effort: Nikolas Zolas, Nathan Goldschlag, Ron Jarmin—all at Census, Paula Stephan, Jason Owen-Smith, Rebecca Rosen, Barbara McFadden Allen, Bruce Weinberg and Julia Lane

Overall Description

- UMETRICS project collects administrative data from universities regarding research funding
  - Federal funding for all
  - Includes private funding on some campuses
- Data are being deposited at a research institute at the University of Michigan—IRIS
- Jason Owen-Smith is director

UMETRICS Participation

- 56 campuses "verbally committed" to join IRIS.
  - They do over $25 billion in R&D (about 36% of the total).
  - Mix of public and private
  - located in 21 states.
- 25 have executed the MOU; rest are in various stages of negotiation

Summary of Study

- Uses data for 8 universities
  - Indiana, Iowa, Michigan, Minnesota, Ohio State, Purdue, Penn State, and Wisconsin.
- Scrapes off names of graduate students supported on grants
- Determines if they have received a PhD by matching their names with ProQuest Data (2009-2011)
- Matches individual records of those who receive a PhD at US Census for years 2010-2012
- Match is facilitated by knowing date of birth or approximate date of birth of PhD recipient.
- 1983 doctorate recipients successfully matched

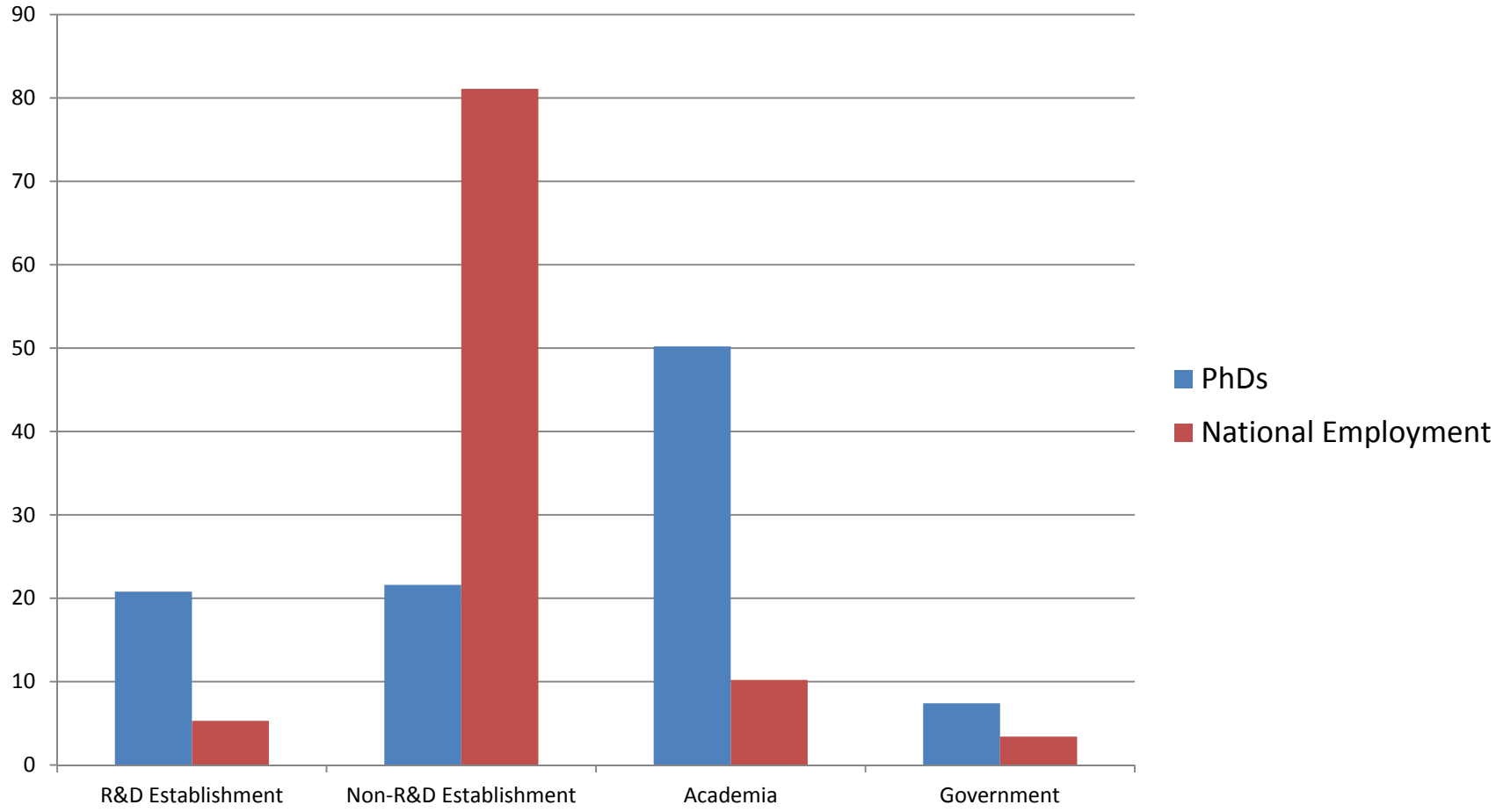
Placement Data

- Placement data obtained from links to

(i) Business Register (BR), which is universe of U.S. nonagricultural firms and associated establishments, and

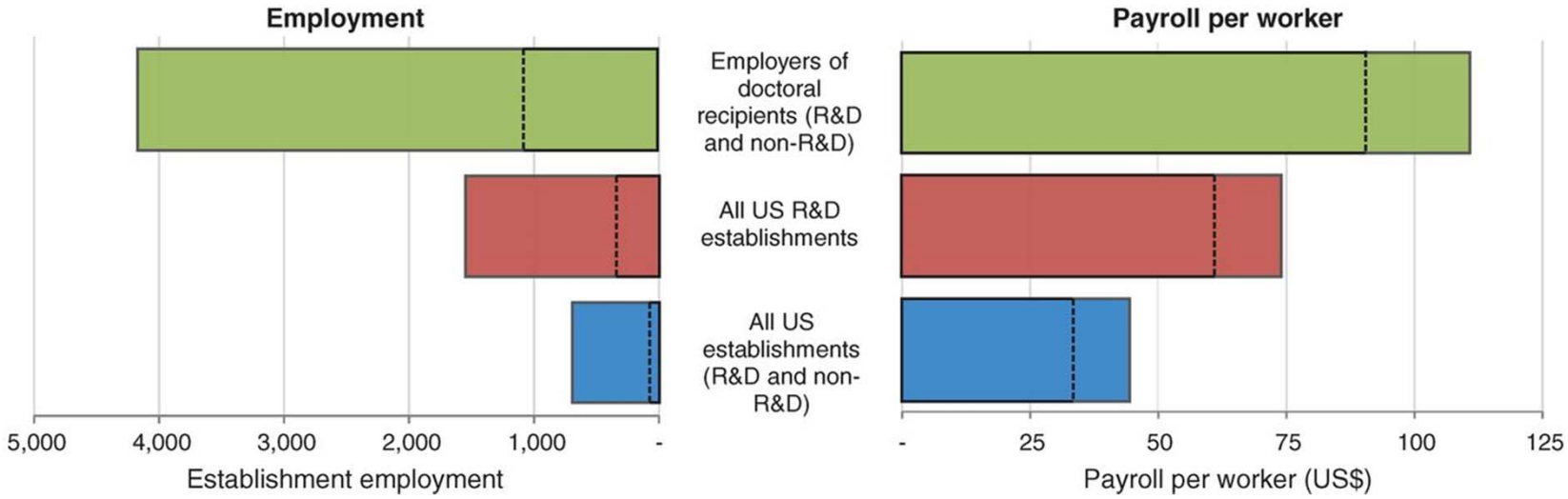
(ii) Longitudinal Business Database (LBD), contains longitudinally linked data for all firms and associated establishments with paid employees in the United States

Placement Outcomes of New PhDs by Sector



For 1983 PhDs from 8 Universities; graduated between 2010-2012

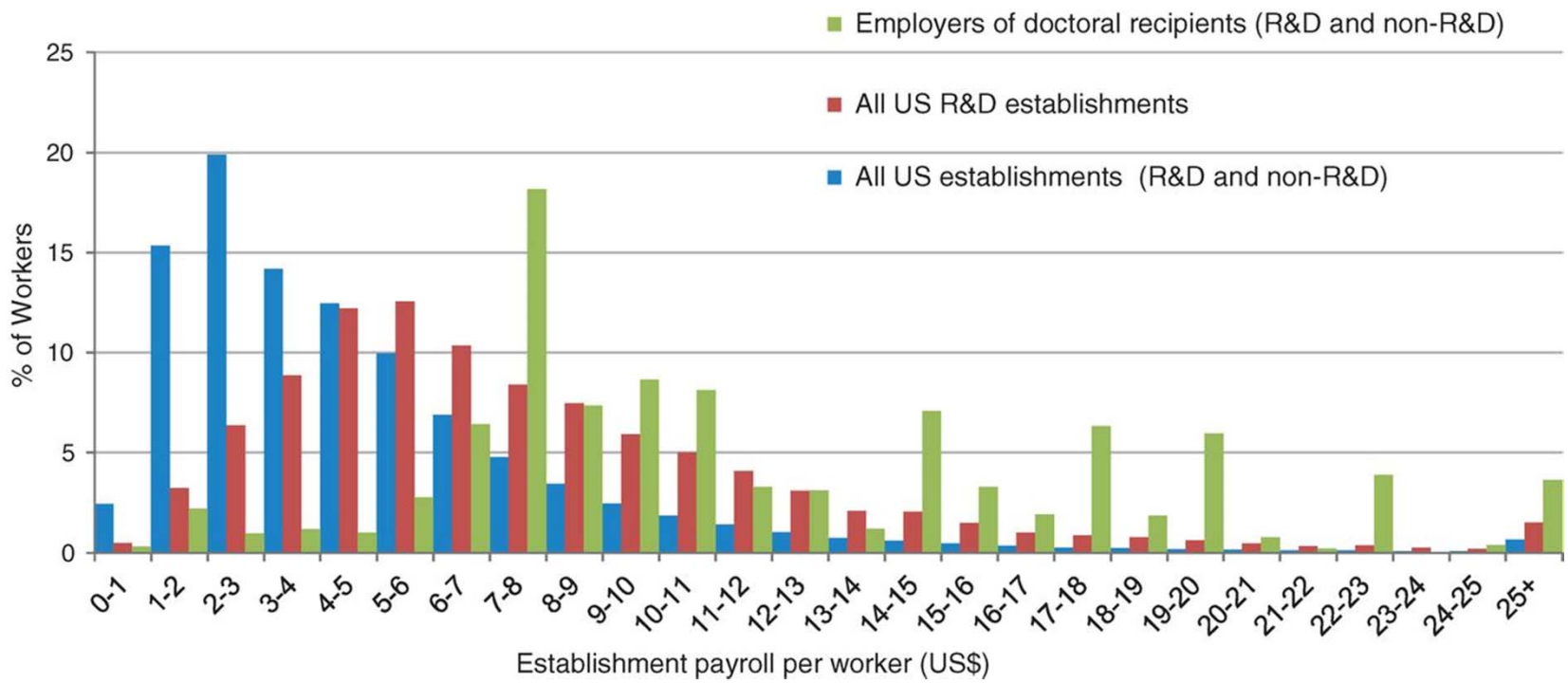
Fig. 1 UMETRICS doctoral recipients are placed at establishments that are larger and have higher payrolls per worker.



Medians—dashed lines; means—solid lines

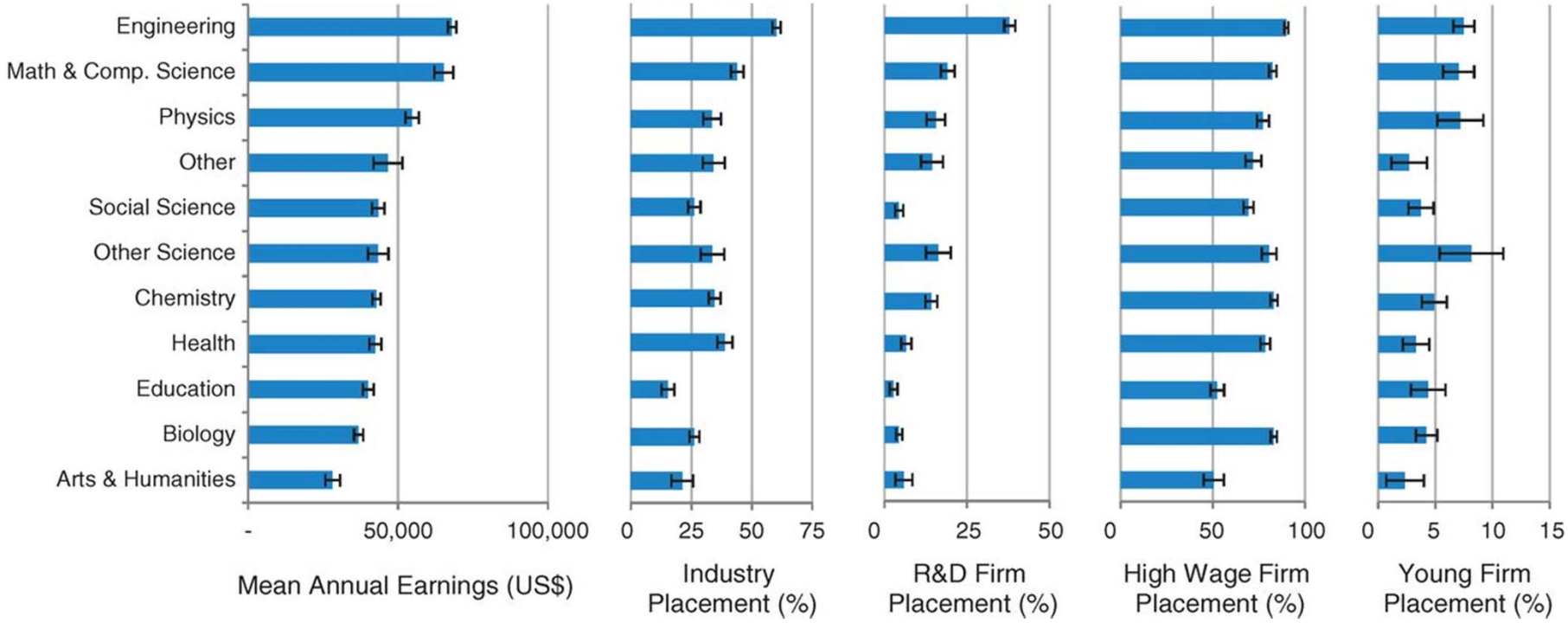
Nikolas Zolas et al. Science 2015;350:1367-1371

Fig. 2 Annual payroll per worker at establishments that employed UMETRICS doctoral recipients, establishments owned by firms that perform R&D, and all U.S. establishments.



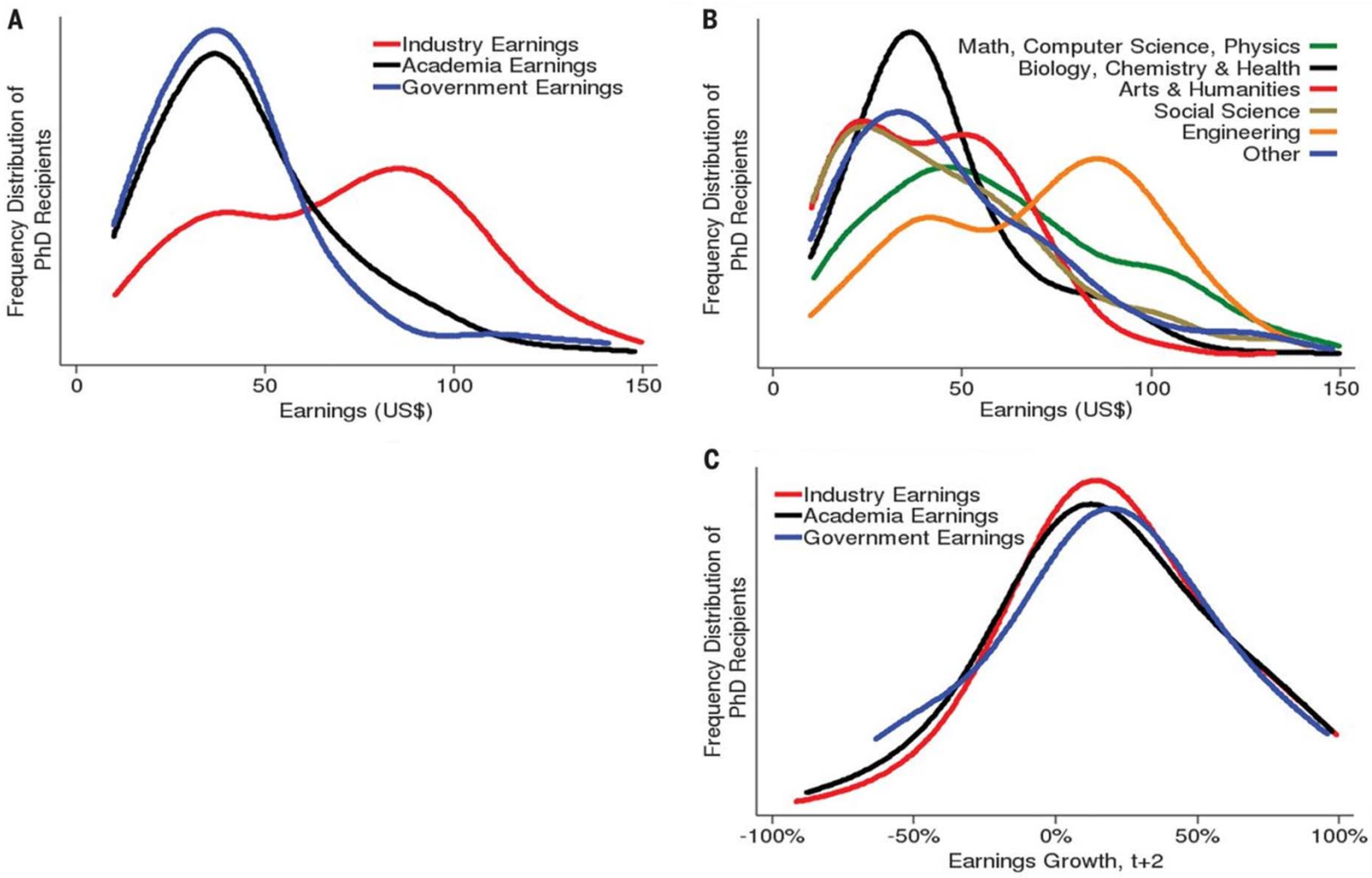
Nikolas Zolas et al. Science 2015;350:1367-1371

Fig. 3 The annual earnings and placement of doctoral recipients supported by grants vary by field.



Nikolas Zolas et al. Science 2015;350:1367-1371

Fig. 4 Annual earnings (U.S.$1 × 1000) and earnings growth of UMETRICS doctoral recipients by sector and discipline.



Nikolas Zolas et al. Science 2015;350:1367-1371

Broaden Scope

- Current goal is to do this for all UMETRICS institutions
- But no reason analysis could not be done for all PhDs in US
- Match SED with data at US Census Bureau; consistent with Ryan Murray Act

Opportunities

- Understand patterns of innovation missed by R&D data
- Start to model how knowledge stocks embedded in human capital contribute to innovation and firm performance
- Examine other research questions such as
  - How type of support relates to employment outcomes of PhDs;
  - Role of social networks in placement; networks between universities and firms; networks across firms

Postdoctoral Fellows

- A bit more challenging to do, but no reason that similar type of approach could not be taken to understanding employment outcomes of postdoctoral fellows and ways in which they contribute to economy

Approach Not Limited to UMETRICS

Data Warehouse for Fellowships

- With Alfred P. Sloan Support Reinhilde Veugelers and I are organizing a workshop to investigate possibility of creating a data warehouse containing information on individuals nominated for fellowships, both in Federal sector and in Non-Profit Sector with goal of linking this data to Census Data as well as other data bases.
- Interested? Send either me or Reinhilde an email

Thank You

- Questions, comments: pstephan@gsu.edu