The Economics of the Postdoctoral Position

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Future of Research, Boston

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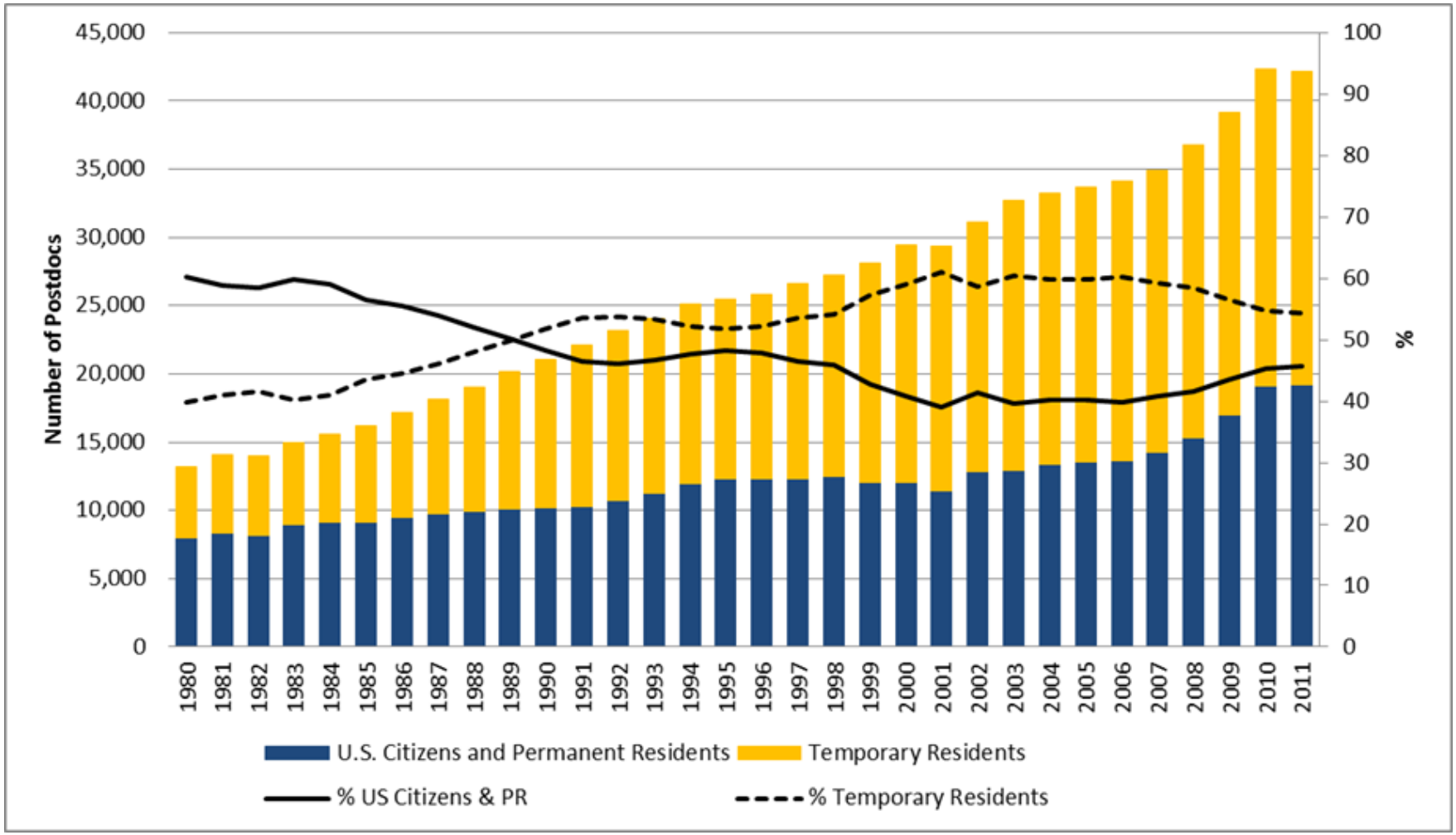
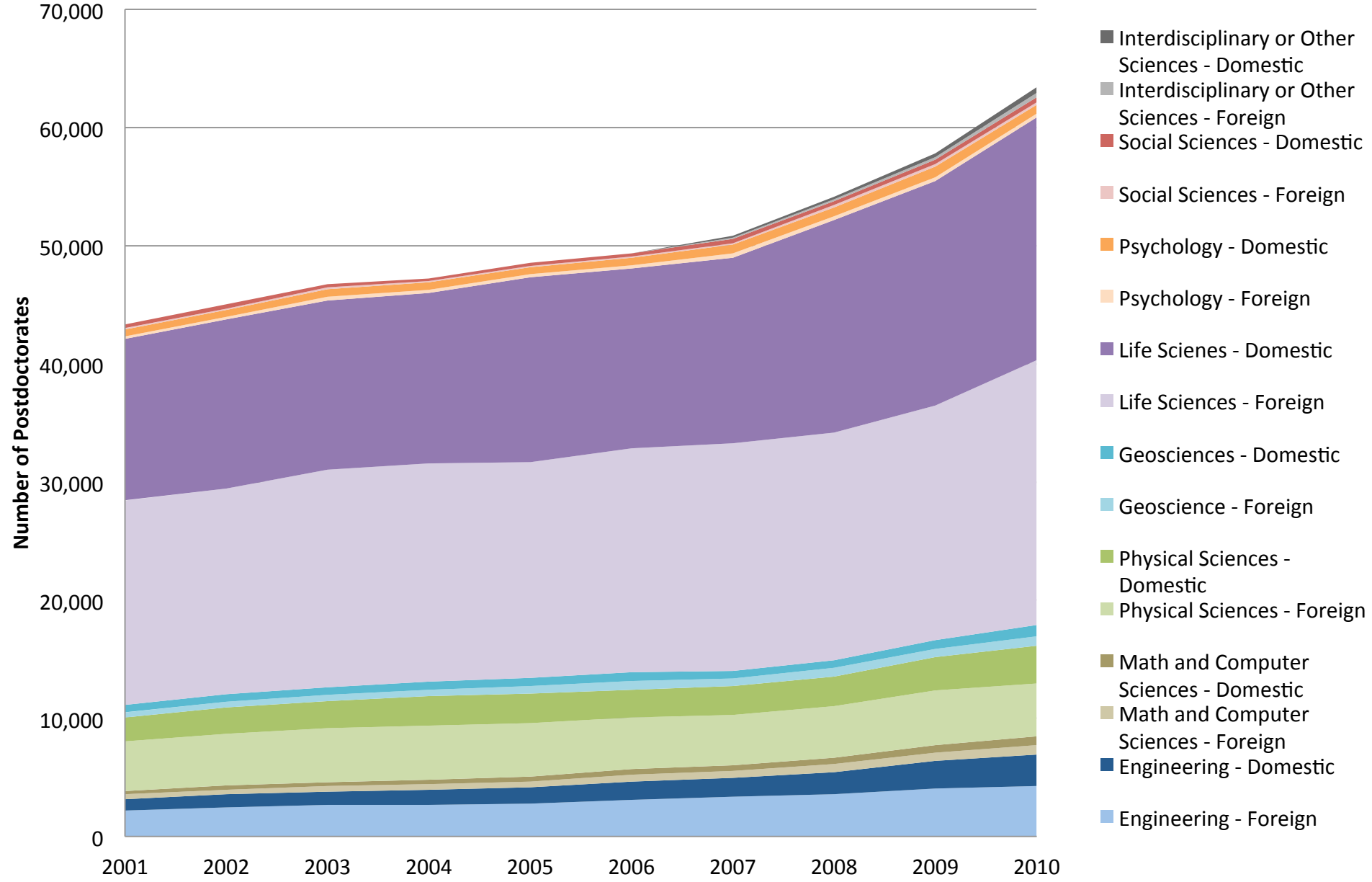
Prologue

- Before looking at underlying economic forces
- Summarize postdoctoral trends over time
- Focus will be on biomedical sciences, although for purposes of comparison, will note situation in other fields as well
- Differentiate between
  - long term trends and
  - trends related to business cycle—especially recent events occurring in 2008

Postdoctorates by Citizenship US, Science and Engineering, excluding Health Fields

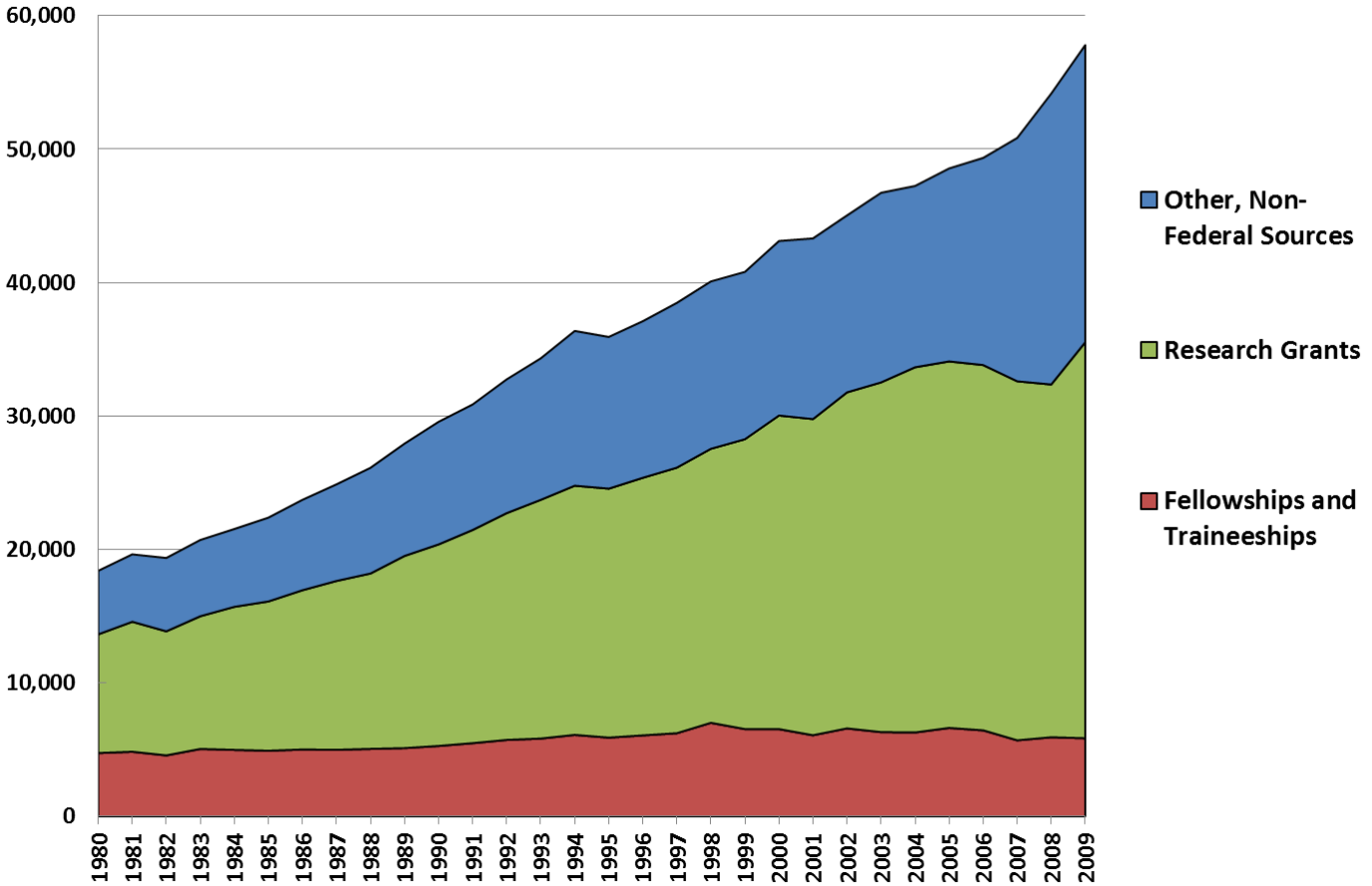


Number of Foreign and Domestic Postdoctorates by Broad Field



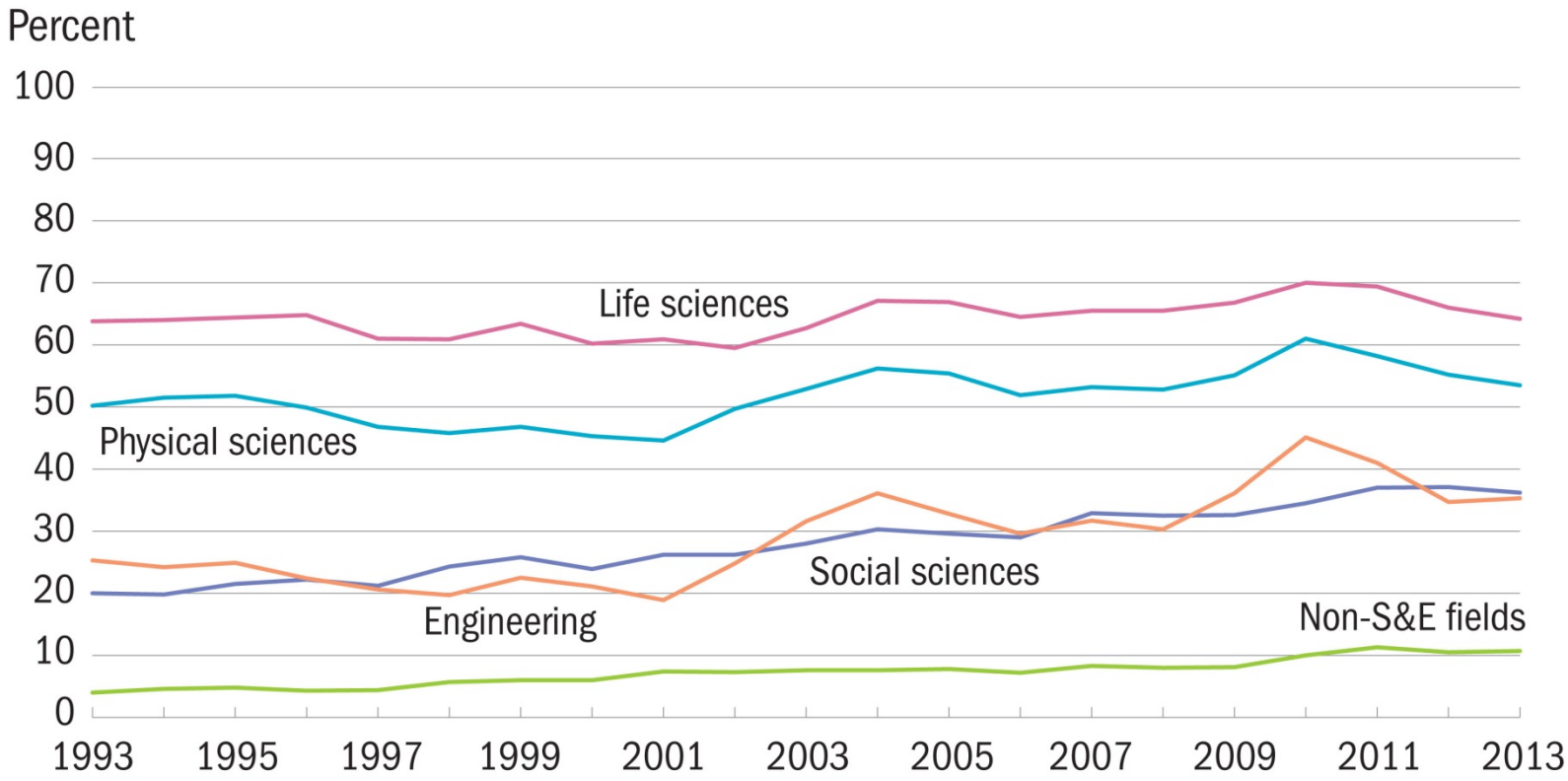
The Life sciences are the largest contributor to the number of postdocs, foreign or domestic

Postdoctoral Researchers in Academe by Type of Support



From NRC Postdoctoral Experience Revisited. NOTE: Includes science, engineering, health postdocs

Postdoc rate, by field of study: 1993–2013

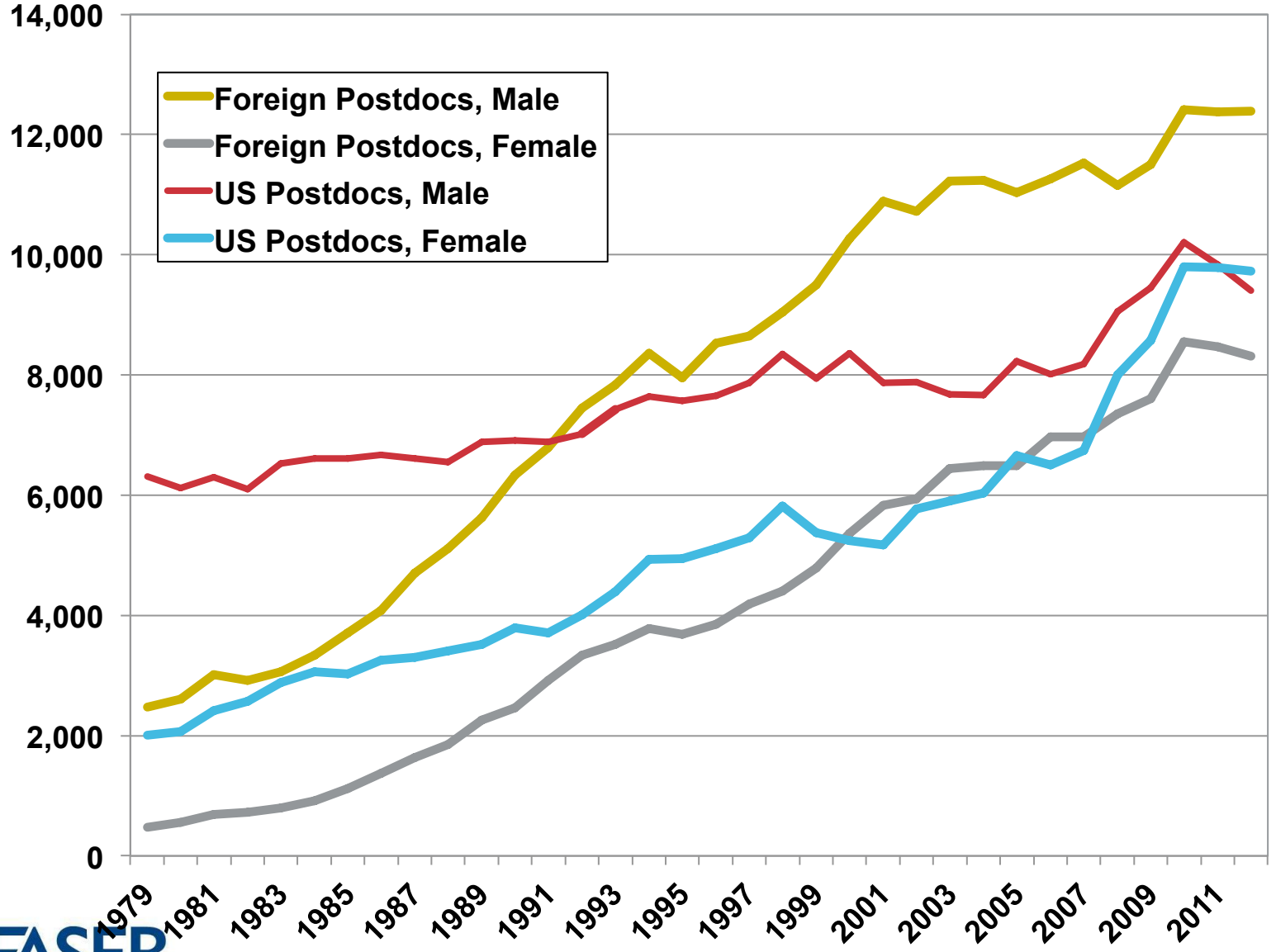


NOTE: Percentages are based on the number of doctorate recipients who reported definite postgraduation commitments for a postdoc position or other employment.
Related detailed data: tables 44, 51, 52.

ARRA (American Recovery and Reinvestment Act)

- ARRA funding appears to have created a temporary surge in number of postdocs
- Distinct fall off after ARRA funds depleted

Figure 1: Biological and Medical Sciences Postdocs by Sex and Citizenship or Visa Status



Source: National Science Foundation, Survey of Graduate Students and Postdocs

FASEB
Federation of American Societies for Experimental Biology

Trends

- Increase in postdoctoral-taking rate over time in all fields through 2010
- Number of postdoctoral scholars on temporary visas grew more quickly than that of citizens and permanent residents until recently
  - Grew especially quickly during doubling of NIH budget

Differentiating Trends

- Some relate to long term problems in the labor market for new PhDs
  - Life sciences—
    - As early as 1977 clear indications that there were problems for new PhDs in this market
    - NRC report evaluating training grants concluded at that time that a "slower rate of growth in labor force in these fields was advisable" [biomedical sciences] (National Research Council, 1994, p. 98).
    - Again in 1998 problems noted *(Trends in the Early Careers)*
- Some reflect structural changes in demand
  - Example: chemistry—demise of large labs; pharma—mergers and acquisitions

Trends Continued

- Percent taking postdoctoral positions also relates to overall state of the economy
  - Empirical work shows negative relationship between the probability that a new PhD takes a postdoc position and a measure of demand for faculty positions
  - Large increase in engineering postdocs after 2008 reflects Crisis of 2008
  - Decline in the biomedical science postdoc rate in late 1990s reflects job market in pharma was strong
  - Increase in number of citizens and permanent residents taking postdoctoral positions after 2008 recession reflects Crisis of 2008 and decline of hiring by industry and academe

Economics of the Postdoctoral Position

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Economics Is about Incentives and Costs

- Incentives and costs have significant impact on number of postdoctoral scholars employed in the United States

Incentives from PI's Perspective

- Increased importance of
  - Specialization in research
  - Funding for research
  - Publications as a necessary condition for funding

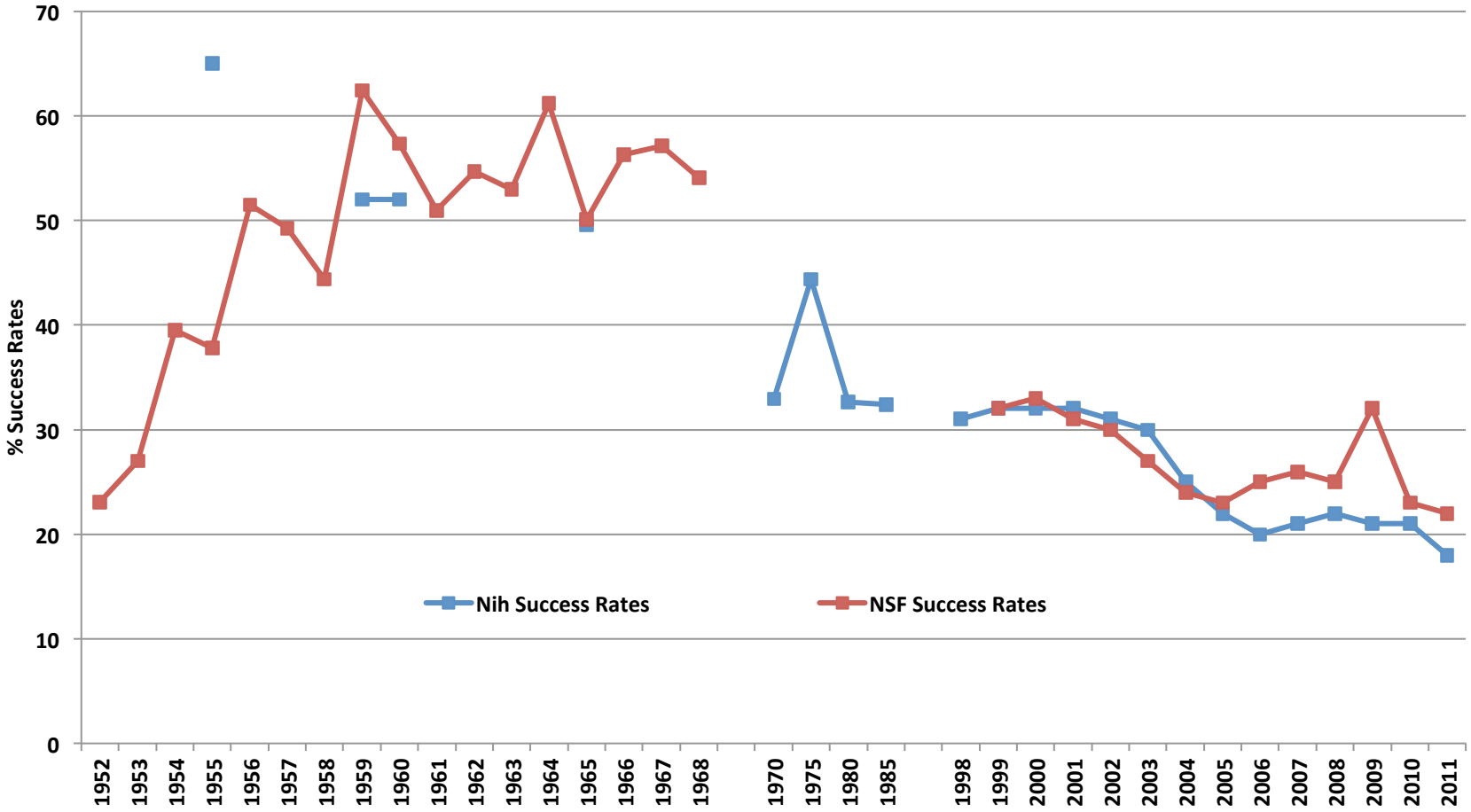
Specialization

- Sole author is dinosaur when it comes to research—fewer than 15% of papers are now sole authored
  - Between 1955 and 2000 average number of authors in science almost doubled from 1.9 to 3.5
- Specialization means faculty increasingly look for individuals to work with them on research and to staff their labs

Increased Importance of Funding

- Faculty increasingly under pressure to bring in funding for research
- Long been model in biomedical and physical sciences; increasingly model in social sciences and even in humanities
- Pressure to bring in funding is particularly acute for faculty in soft money positions— "funding or famine" to quote Stephen Quake
- At same time, funding is in short supply and success rates are declining

NIH and NSF Success Rates Available Years



NSF rates for 1952-1968 are for the Division of Biological and Medical Sciences

Focus on Grant Seeking

- Raises importance of having other people to work in lab—PI's time is diverted to grant preparation
  - Estimate that PIs on Federal grants spend 42% of research time in grant-related administration (Kean)
- Also raises importance of publications given important role publications play in grant review and grant success

Staffing of Labs

- Forces of specialization, funding and publications lead PIs to seek clever individuals to staff labs and help in production of research
- Three groups to choose from:
  - graduate students
  - postdocs
  - staff scientists
- This is where costs begin to play a large role

Costs of a Graduate Student

- Stipend between $16,000 to $28,000
  - Can cost an additional $16,000 or more once tuition is included, depending upon limits set by funding agency and policies of university; one estimate puts total cost at $51,000
- GRAs work approximately 1200 to 1500 hours per year
- Hourly rate as high as $34.00 on some campuses before fringes; low of around $21.00

Cost of Postdoctoral Scholars

- NIH stipulated rate for FY 2015 is $42,840 for NRSA first-year postdoctoral scholar; up from 42,000 in 2014 and $39,264 in 2013.
  - Many institutions follow this rate for other postdocs
- Average postdoc reported working 2650 hours a year in life and physical sciences; 2550 in engineering and 2500 in math and computer sciences
- Hourly rate before fringes is currently about $16.15 in the biomedical sciences

Cost of Staff Scientist

- Start at approximately $60,000
- Fringe benefits are significantly higher than those for a postdoc because they are treated as employees by university
- Hourly rate of approximately $30.00 before fringes

Cost Advantage Lies with Postdoctoral Scholar on Many Campuses

- Low salary and long hours of work mean postdoctoral scholars are about half as expensive as graduate student or staff scientist on many campuses
- Higher level of skill than graduate student
- Possibly more motivated than staff scientist
- Added benefit: some come with fellowships

Funds Available from Grants

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Year

FIGURE 3-16 NIH support of graduate students.
SOURCE: NSF. 2008. *Survey of Graduate Students and Postdoctorates in Science and Engineering*. Washington, DC: NSF.

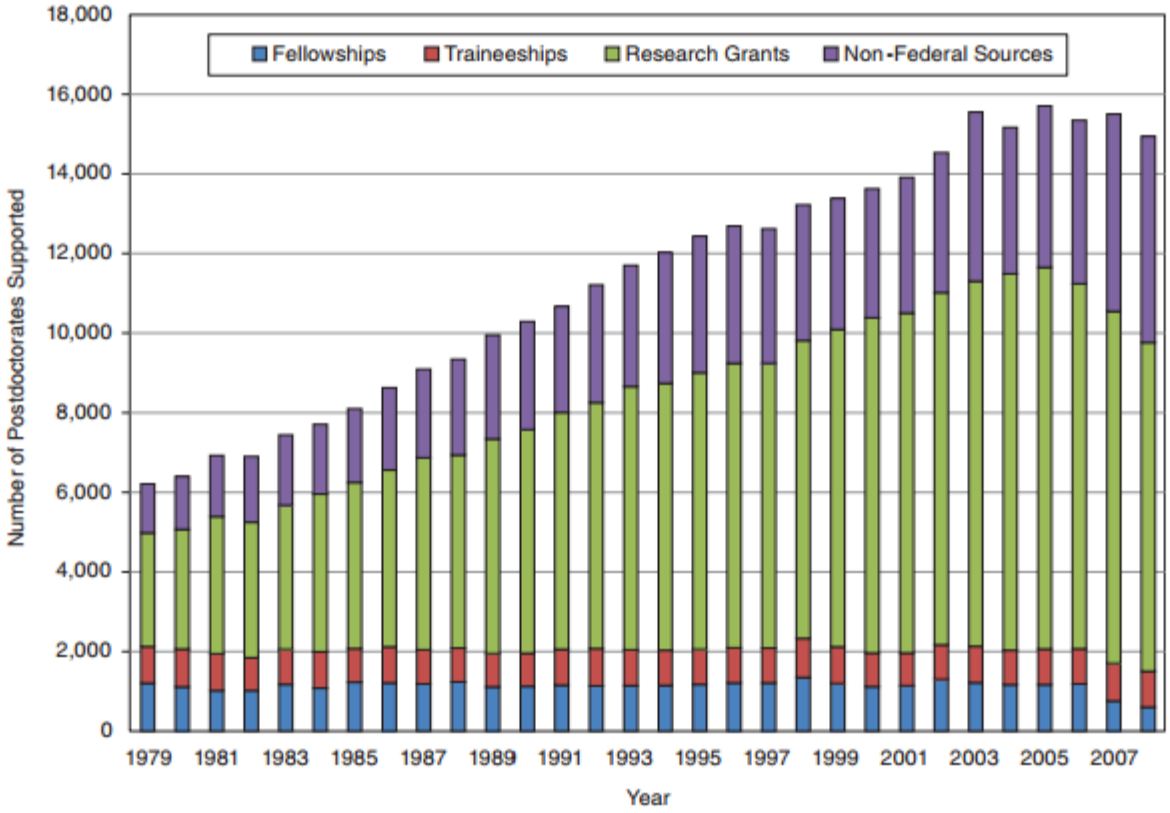
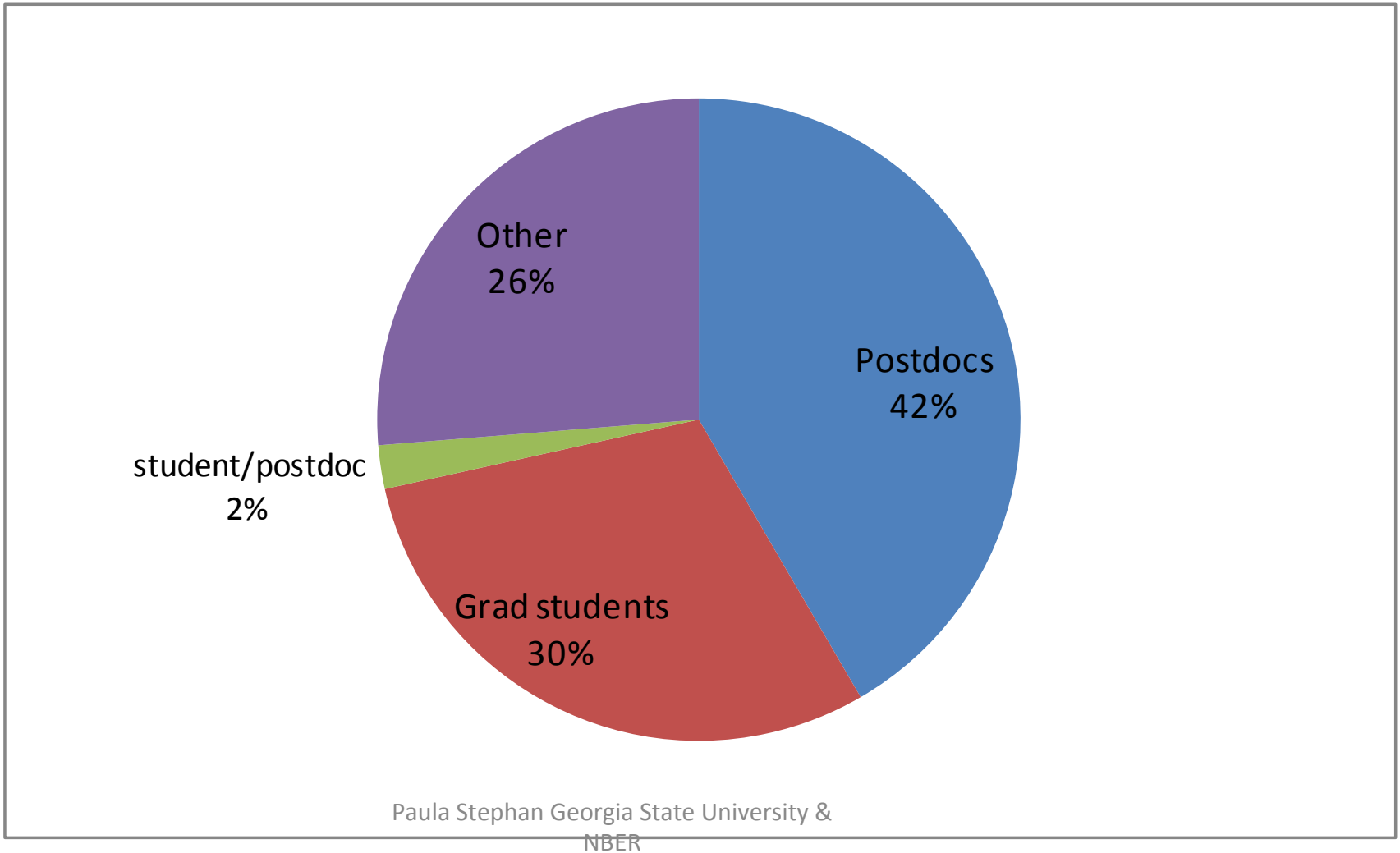


FIGURE 3-17 Postdoctoral support in the biomedical sciences.
SOURCE: NSF. 2008. *Survey of Graduate Students and Postdoctorates in Science and Engineering*. Washington, DC: NSF.

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

First Authors: N=137



“Cost Advantage” Suggests a Closer Look at Why Postdoctoral Wages Are Low

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Postdoctoral Salaries (Median) Reported by New PhDs in 2013 (SED)

- Life Sciences: $40,000
- Physical Sciences: $50,000
- Social Sciences: $42,120
- Engineering: $45,000
- Non science and engineering: $50,000

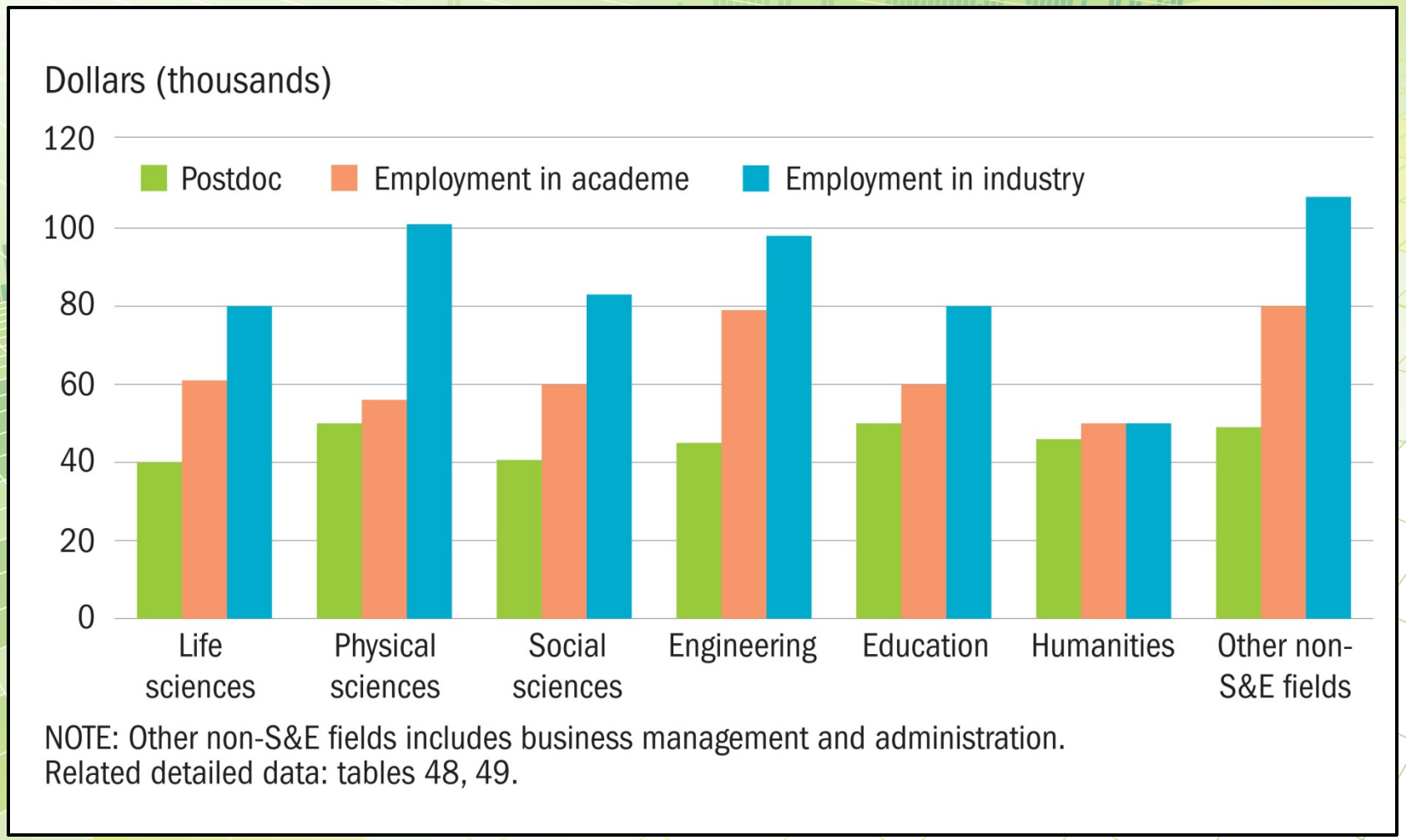
Survey of Earned Doctorates

Salary Relative to Alternative is Low

Salary Relative to Alternatives Is Low

- PhD in S&E (2013 SED data)
  - Median salary starting in academe: $55,000-$75,000 depending on field
  - Median salary starting in industry: $87,000 to $100,000, depending on field

Median basic salary of doctorate recipients with definite commitments in the United States, by position type and field of study: 2013



NOTE: Other non-S&E fields includes business management and administration.
Related detailed data: tables 48, 49.

Starting Faculty Salaries Assistant Professors, Research Public Universities 2013-2014

- Engineering: $84,011
- Biological and Biomedical: $74,176
- Math and Statistics: $67,382

Why So Low?

Training Argument

- Low pay to postdoctoral scholars is due to large training component of position
- Argument is that training received is portable to another position and thus should be paid for by the postdoctoral scholar in the form of reduced wages;
  - low wages are a down payment on a research career

Validity of Training Argument

- Definitely strong training component in many postdoctoral positions
  - But in some labs training component is minimal and postdoctoral scholars are relied on for routine procedures
  - Over postdoc career, training component diminishes
- High cost of training
  - Classmates who did not get training beyond a BA are earning about $49,911 in 2012, seven years after graduating; (Table 28 http://www.census.gov/hhes/www/income/data/historical/people/)
  - Approximately $28.00 per hour
  - Compare this to $16.00. A high cost of training!
  - Especially when many of the skills learned may not be transferable into a non-research position—a likely outcome for many—most recent data for PhDs in biomedical sciences in US finds approximately 25% working in non-academic, non-research positions; 5% out of labor force or unemployed six to ten years after receiving PhD

Alternative Explanation
Low Wages

- Not a real market
- Ample supply of domestically produced PhDs and large supply of PhDs educated abroad keep salaries low
- Postdoc pay set by NIH in biomedical sciences; many campuses follow this for other fields

Why Do Postdoctoral Scholars Take the Position?

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Incentives from Their Point of View

- Interest in science
- Aspirations
- Career building
- Information (lack of)
- Lack of alternatives
- Hard to know when to leave

Interest/Aspirations

- Postdoctoral scholars get satisfaction from engaging in research
- They perceive their chances/ability as being better than that of others in their field
  - (Sauermann and Roach find majority of students rate themselves as being more able than peers in the program)
- Postdoctoral position is logical step for those who want to get a research position—acquire skills and build resumé

Career Building

- Publications
  - Academic market place highly competitive; need publications to be considered for an academic appointment
  - Essential to have more publications in pipeline before starting an academic career
- Funding
  - Must have preliminary data before beginning to apply for grants
  - Postdoctoral position used to set the stage for future research

Information

- Information is in short supply.
- Many students receive minimal information about career options when they decide to go to graduate school or start their graduate training; PhDs are stressed over MA degrees
- Many doctoral programs offer few seminars or workshops that provide students with information on careers other than those in academia
- Postdoctoral position often first time information concerning jobs becomes available and is talked about
- PhD programs rarely post job outcomes on their Web pages
- Many faculty resist students seeking information regarding alternative careers; faculty are misinformed

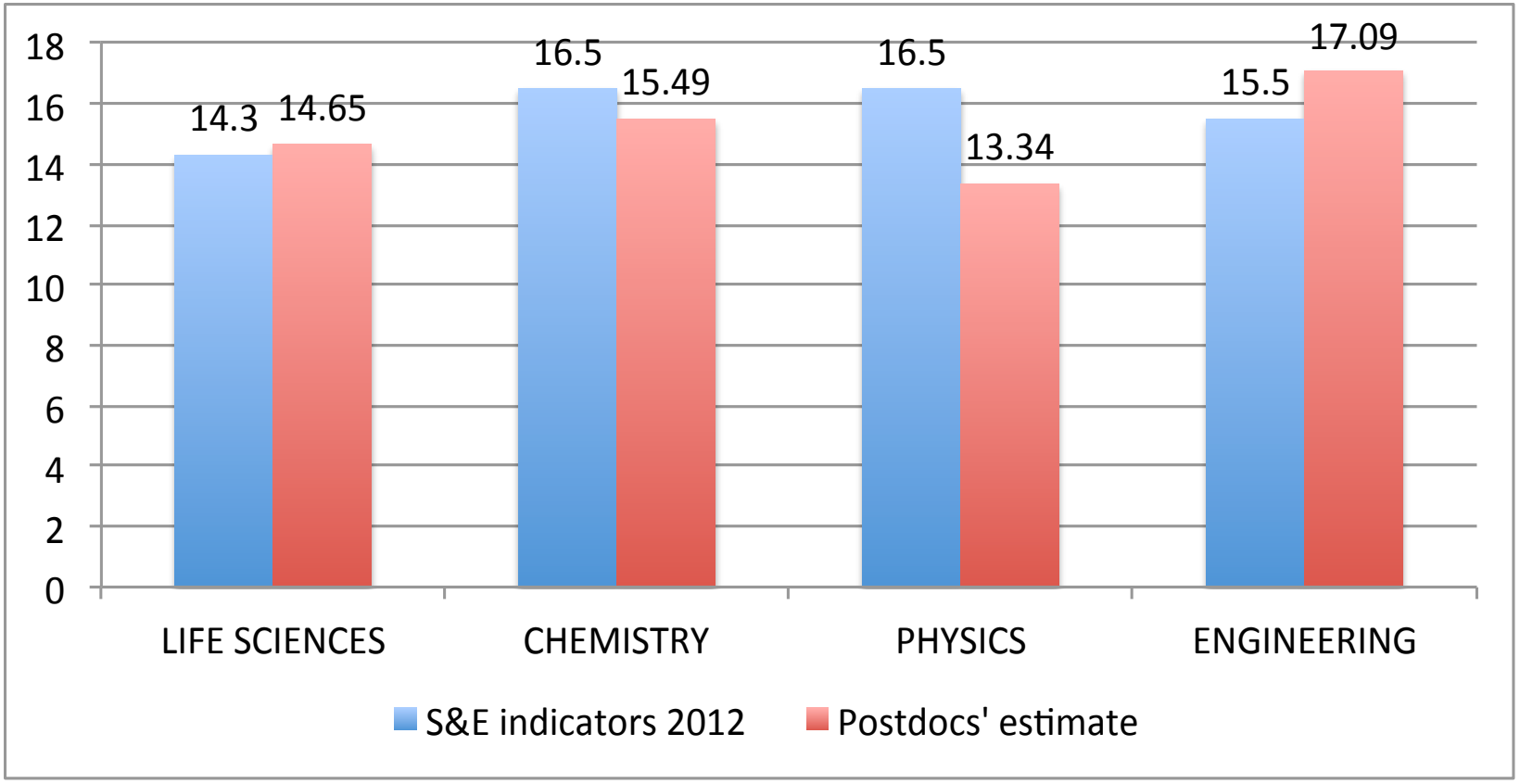
“Lack local” Information

- Important
- Students may know overall outcomes
- But perceive the outcomes of individuals from their programs as being better
- Supported by work of Sauermann and Roach

Are they aware of labor market conditions?

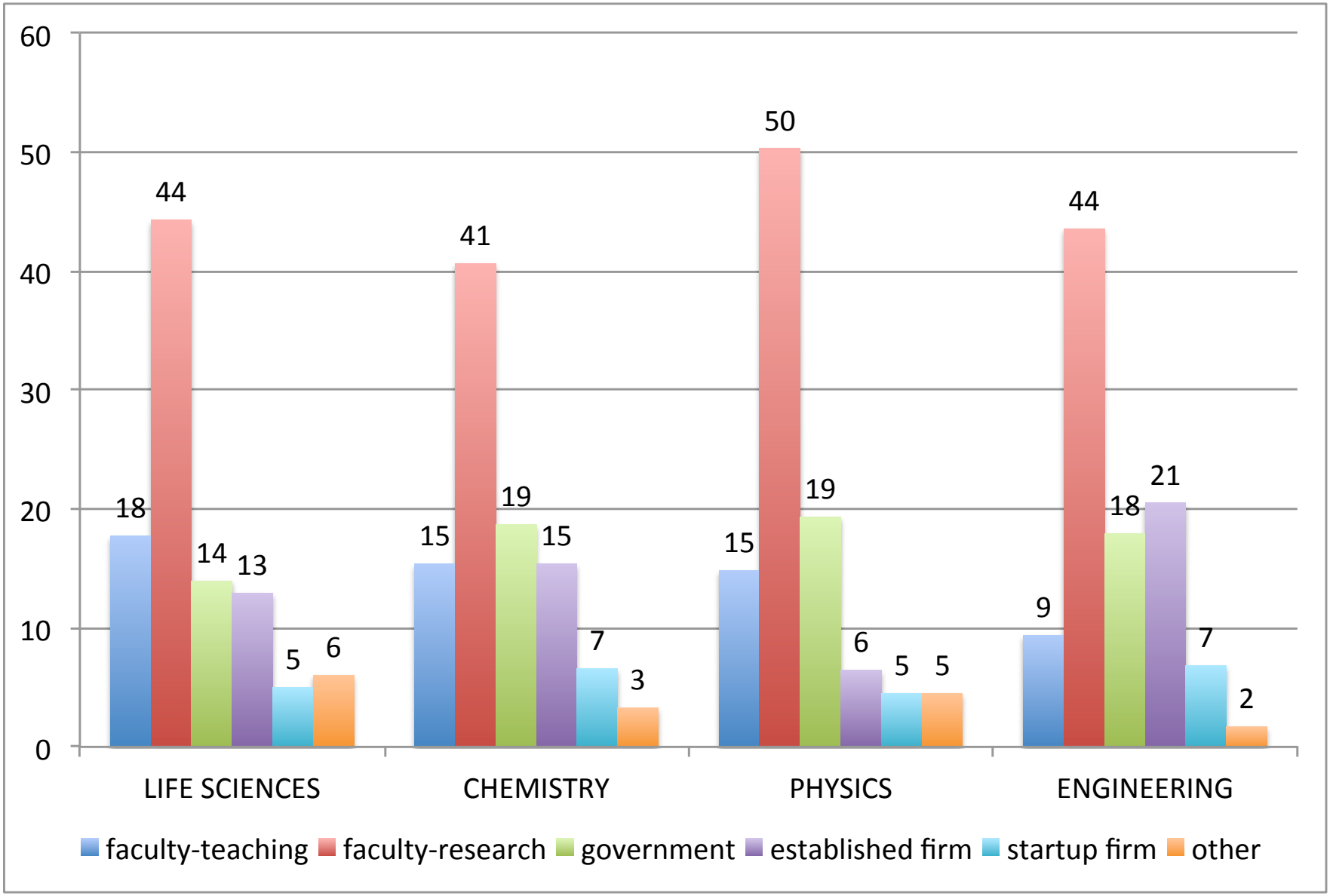
"What do you think is the percentage of PhDs in your field holding a tenure-track faculty position five years after graduation?"

- Compare their estimates with actual numbers from S&E indicators (Table 3-20)



Sauermann presentation, National Academies 2013

Most preferred career – current Postdocs, in percent



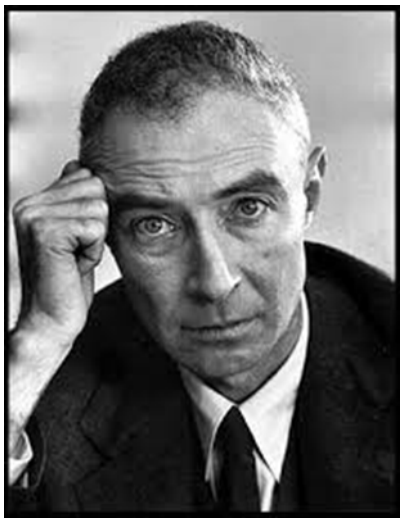
Sauermann, NAS presentation 2013

Survey of 45 Departments, Three Fields

- Only two reported on web page where students were placed
- By contrast, common in business schools and economics programs to report placements on web
- Note that NRC Committee "Trends in the Early Careers of Life Scientists" made recommendation that departments disseminate information regarding career outcomes—1998!

Not a Metric Universities Report

- Universities routinely report
  - Publications
  - Patents
  - Startup companies
  - Funding
- Do not report placements—
  - An important metric of how knowledge is produced and diffused from a university



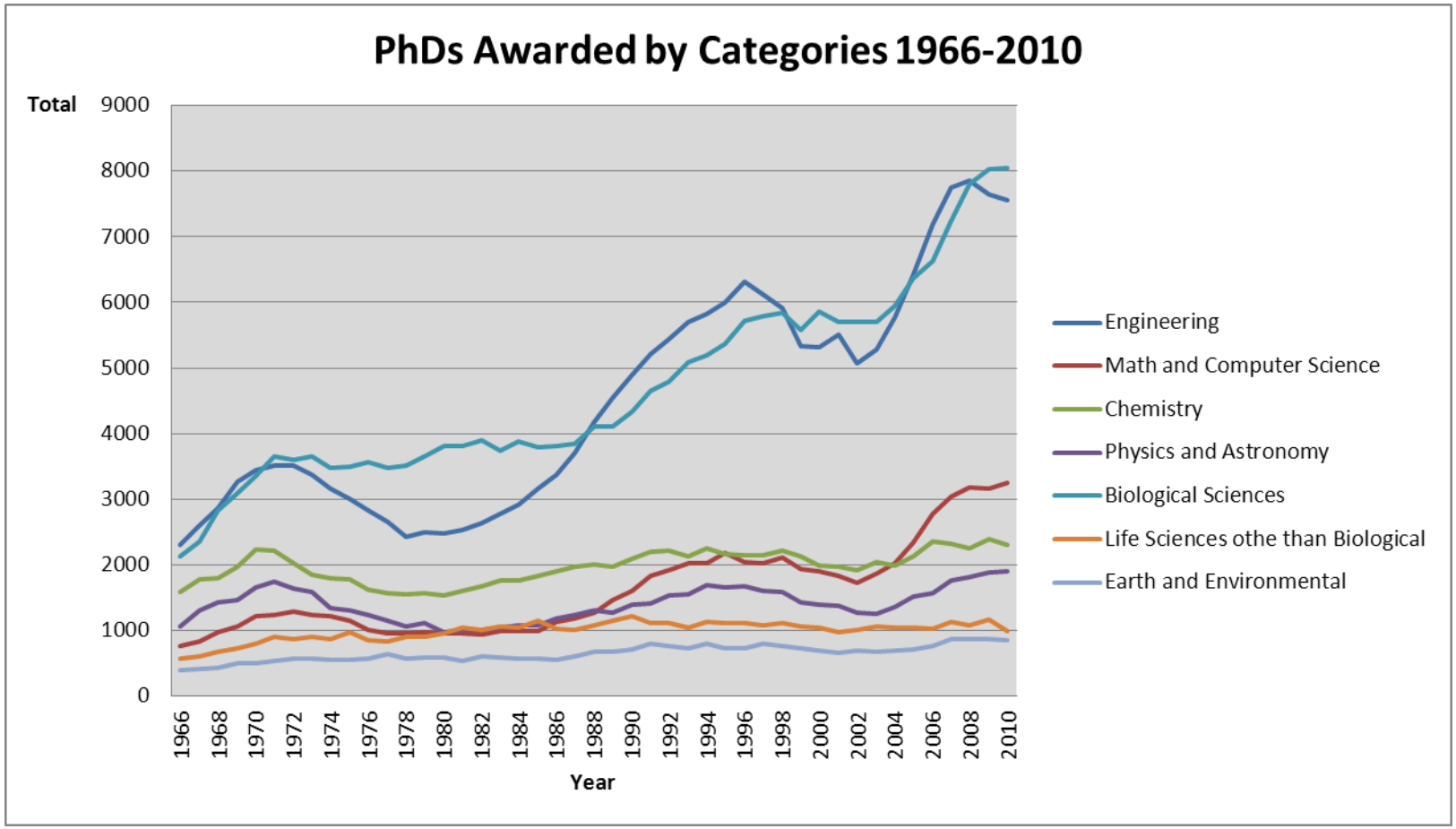
"The best way to send information is to wrap it up in a person"*
J. Robert Oppenheimer

"The eternal apprentice," Time Magazine, vol. 52, p. 81

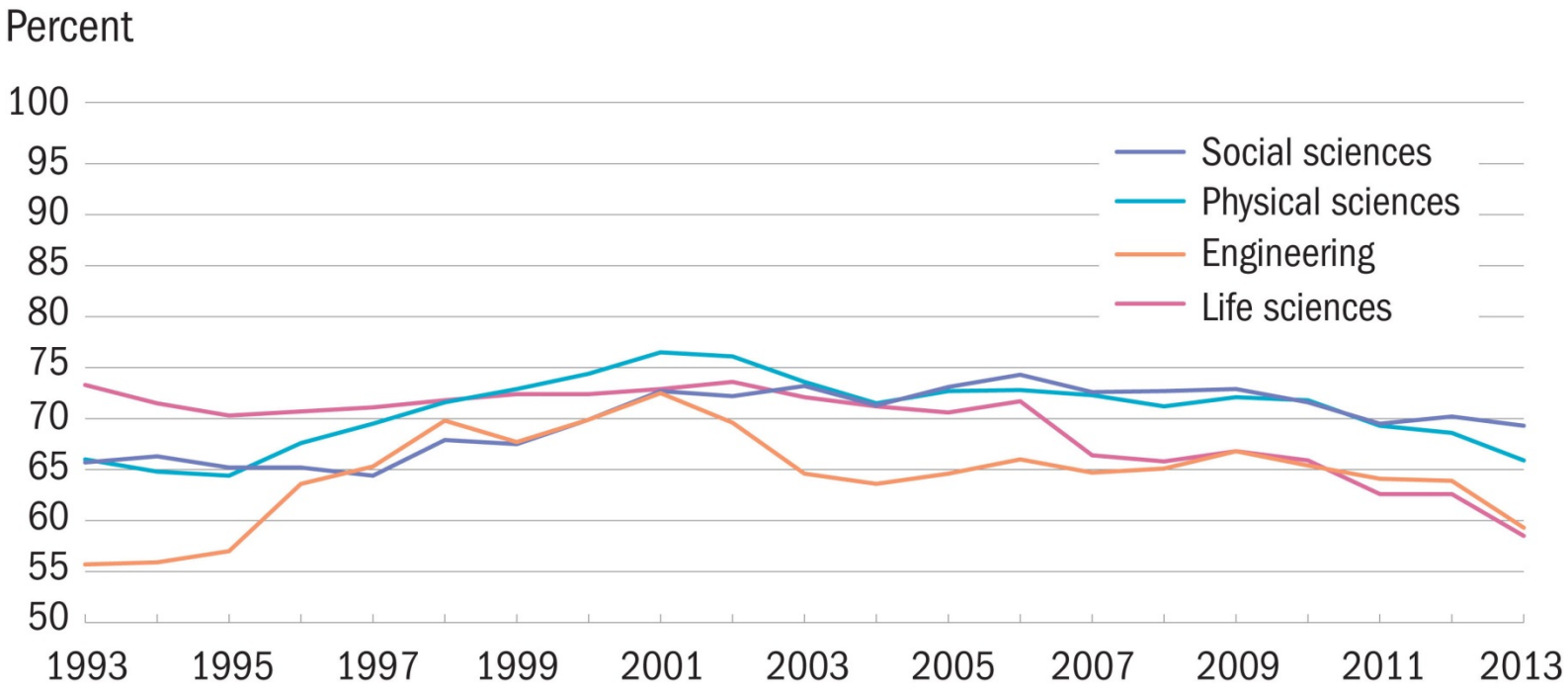
Alternative Jobs Are in Short Supply

- Number of PhDs has increased
- Demand has slowed
  - Funding for research flat
  - State support declining
  - Restructuring of research in industry—example of pharma and large chemical research labs
- Probability of finding position has declined
- Probability of finding research position has declined

Production of PhDs



Definite commitments at doctorate award, by science and engineering fields of study: 1993–2013



NOTE: Definite commitment refers to a doctorate recipient who is either returning to predoctoral employment or has signed a contract (or otherwise made a definite commitment) for employment or a postdoc position in the coming year.
Related detailed data: tables 42, 43.

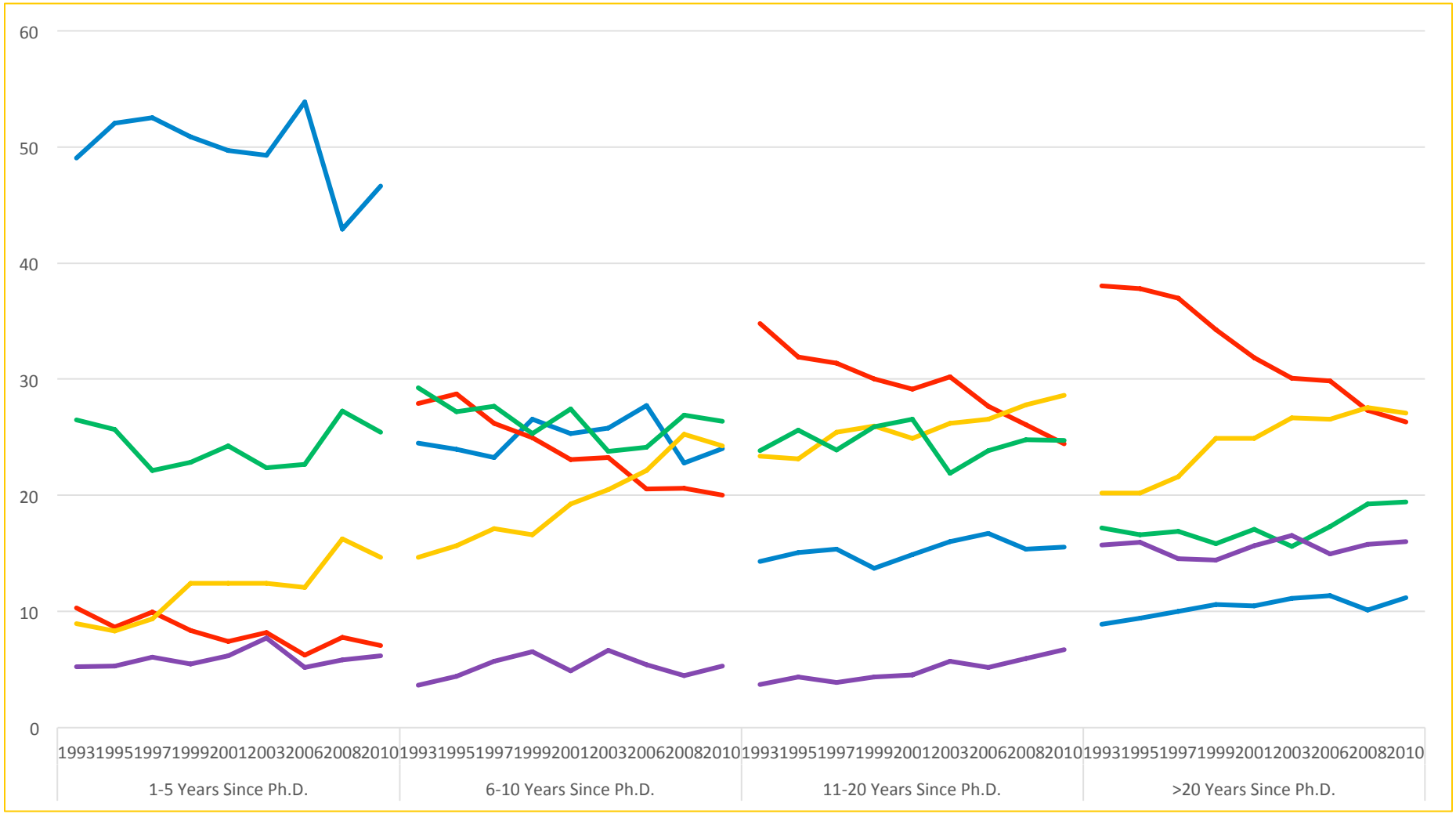
Summarize

- Percent of new PhDs with definite commitments
  - Declined in the physical sciences by about 14% since 2001 peak;
  - Declined in engineering by about 17%
  - Declined in life sciences by about 17%

Salary changes 2011-2013

- Postdoctoral position
  - Life sciences: 2.5%
  - Physical sciences: 6.3%
- Academe
  - Life sciences: 1.6%
  - Physical sciences: 3.7%
- Industry
  - Life sciences: -5.9%
  - Physical sciences: 1.0%

Career Outcomes, US trained Biomedical Workforce by Cohort



Red—academic tenure track; blue—academic non-tenure track; yellow—non-academic, non-research; green - non-academic, research; purple-out of the labor force or unemployed. Thanks to Donna Ginther, SDR data

Key Points

- For each cohort, percent in tenure-track positions declining
- Percent in nonacademic, non-research positions has been increasing

Hard to Know When to Leave

"You invested so much you can't stop, just like the War in Viet Nam."

Loren Williams, Professor of Chemistry and Biochemistry, Georgia Institute of Technology

Moving Forward
Possible Solutions

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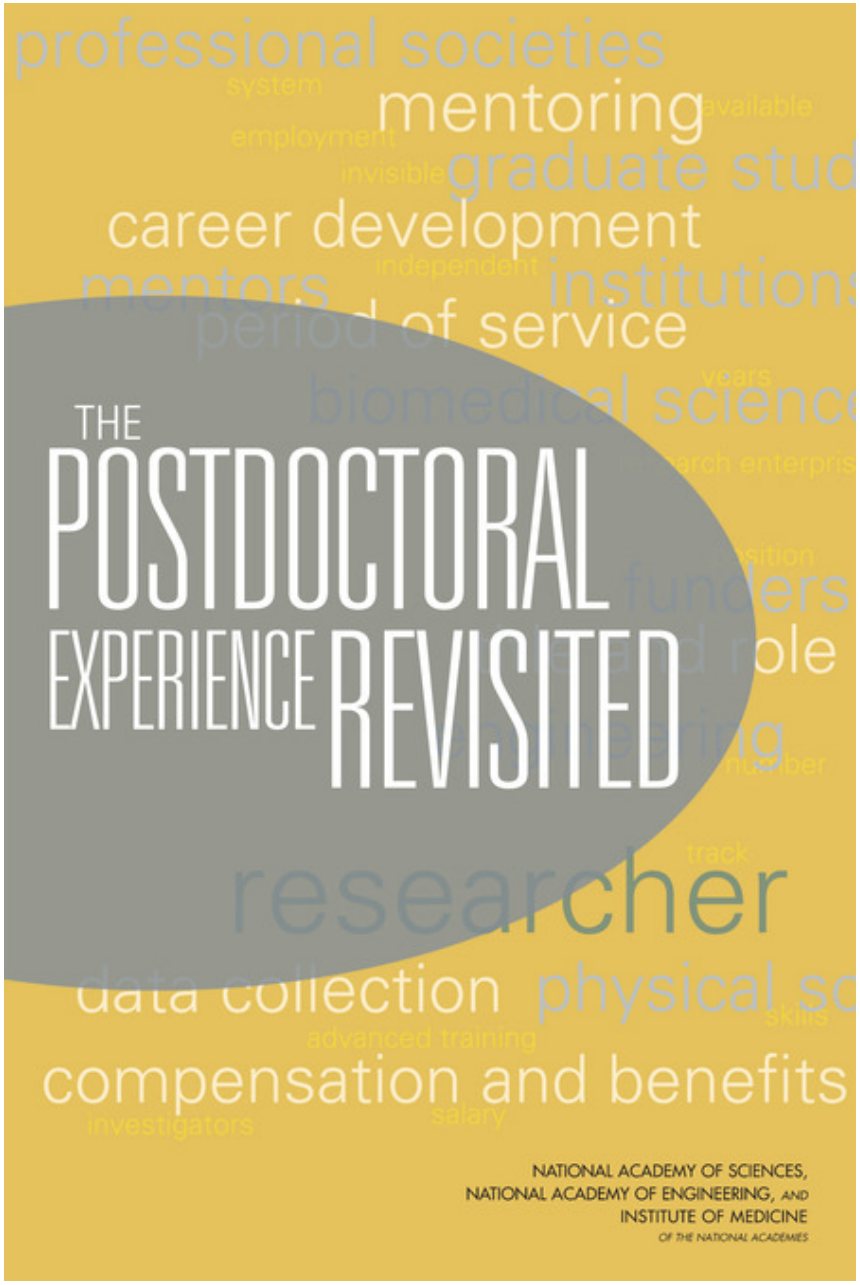
Fix What's Broken
Cut Back Demand for Postdocs

- Discourage overreliance on postdocs—make costs reflect social cost
  - Raise salary and benefits significantly
- Encourage institutions and provide incentives for institutions to create more staff scientists positions; common at NIH but less common in university community
- Limit amount of salary charged off grants, thereby diminishing demand for graduate students and postdocs

Cut Back Supply of Postdocs

- Provide information regarding different career paths early in graduate training experience; don't wait for career counseling until the postdoc!
- Provide information on alternative degrees, such as MA's
- Encourage internships during graduate school experience
- Require departments to post placement information on line: no reporting, no funding
- Require students to pay for part of their tuition as a graduate student
- Lessen coupling between research and training, thereby decreasing supply of PhDs: Effective training requires a research environment but effective research does not require a training environment
  - "Abstinence is, after all, the most effective form of birth control"


professional societies
system
mentoring
available
employment
graduate stud
invisible
career development
independent
institutions
mentors
period of service
years
biomedical science
funders
role
researcher
track
data collection
physical sc
skills
advanced training
compensation and benefits
investigators
salary
THE
POSTDOCTORAL
EXPERIENCE REVISITED
NATIONAL ACADEMY OF SCIENCES,
NATIONAL ACADEMY OF ENGINEERING, AND
INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

Six

- Period of Service
- Title
- Career Development
- Compensation and Benefits
- Data Collection
- Mentoring

Compensation*

- **Compensation and Benefits of Employment:** Current postdoctoral salaries are low. Salaries should be increased to (1) reflect the qualifications of postdoctoral scholars, (2) address the slow progress the community has made towards implementing the salary increases recommended in several National Research Council reports, and (3) adjust the relative wage of postdoctoral researchers to appropriately reflect their value and contribution to research.
- NIH should raise the NRSA postdoctoral starting salary to $50,000 (2014 dollars), and adjust it annually for inflation. Postdoctoral salaries should be appropriately higher where regional cost of living, disciplinary norms, and institutional or sector salary scales dictate higher salaries.

* Two of the committee members do not support the recommendation for a prescriptive "salary standard" based upon one particular field and funding agency.

Rationale

- Focus on NIH is because data on starting postdoctoral salaries reveal that the starting salary prescribed by the National Institutes of Health for the Ruth L. Kirschstein National Research Service Award (NRSA) postdoctoral award has become the de facto standard for many disciplines and on may academic campuses.

Five Approaches Considered for Determining Appropriate Minimum

- Indexing to
  - Contemporaries who have but a college degree
  - Graduate stipends
  - Newly hired assistant professors
- Inflation adjustment of previous recommendations
- Research Grade Evaluation Guide
- All suggest a salary of around $50,000

Result

- Indexing to
  - Contemporaries who have only a college degree: $49,911 in 2012
  - Graduate stipends: Average total cost (including tuition) for graduate students in science and engineering was $51,000 in 2011
  - Newly hired assistant professors in 2013-2014: Two-thirds starting salary of new faculty in biomedical sciences (nine month salary): $49,700
- Inflation adjustment and NIH's response to recommendation made in 2000: $54,800
- Research Grade Evaluation Guide: beginning researcher starts at GS-11 or minimum of $50,800 in 2014

Benefits

- In addition, host institutions should provide benefits to postdoctoral researchers that are appropriate to their level of experience and commensurate with benefits given to equivalent full-time employees.

Implementation Includes

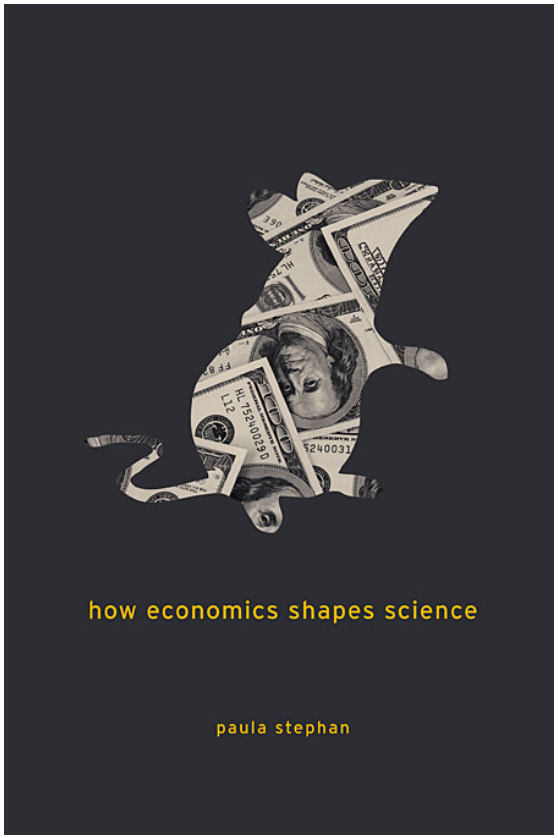
- **Implementation**
  - Federal agencies should require host institutions to provide documentation of the salary a postdoctoral researcher will receive with all grant proposals.
  - Professional societies should collect data on salaries for all positions and make these publicly available

Take Note

- More funding would help but it does not address underlying issue of positive feedback in the system
  - Increased funding is accompanied by increased training which is accompanied by increased demand for funding and postdocs; unstable system
- Need to address incentives that have allowed system to evolve to current situation

Drawn from

Recent now in paper



Comment in *Nature*

Questions/Comments?

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