Measuring Flows of Human Capital to Firms; Understanding Mobility

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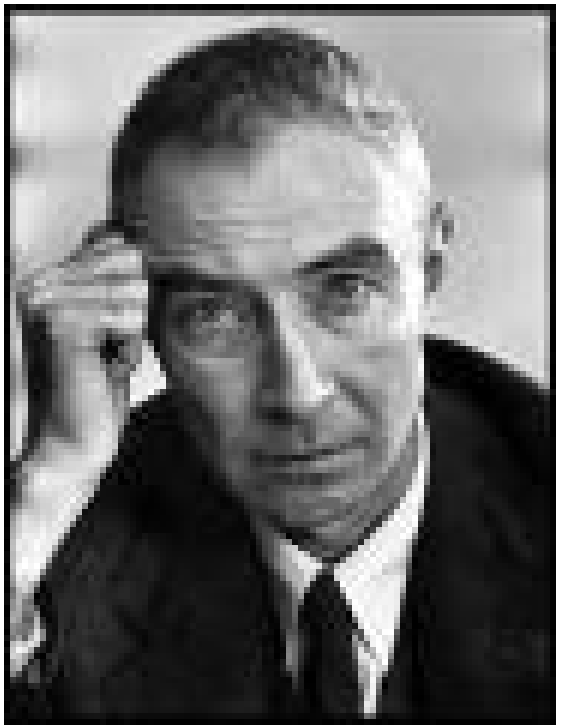
Quantifying flows of highly trained to firms and relating these to innovation

Contribution of Universities to Innovation

- Patents
- Licenses
- Startups
- Rarely focus on placement of highly trained individuals with firms
- Despite fact that individuals are powerful way of transmitting information, especially 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

Opportunity

- Challenging to do in the past
- 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

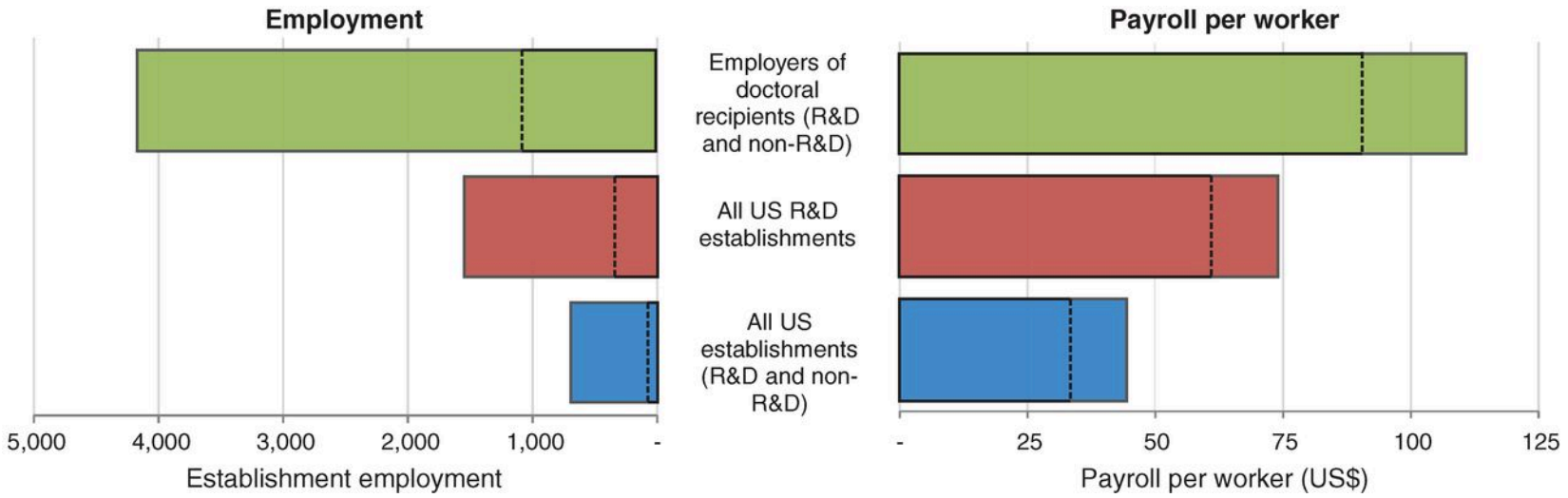
Overall Description

- 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

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
- This match is facilitated by knowing date of birth or approximate date of birth of PhD recipient.
- 1983 doctorate recipients matched in end

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.

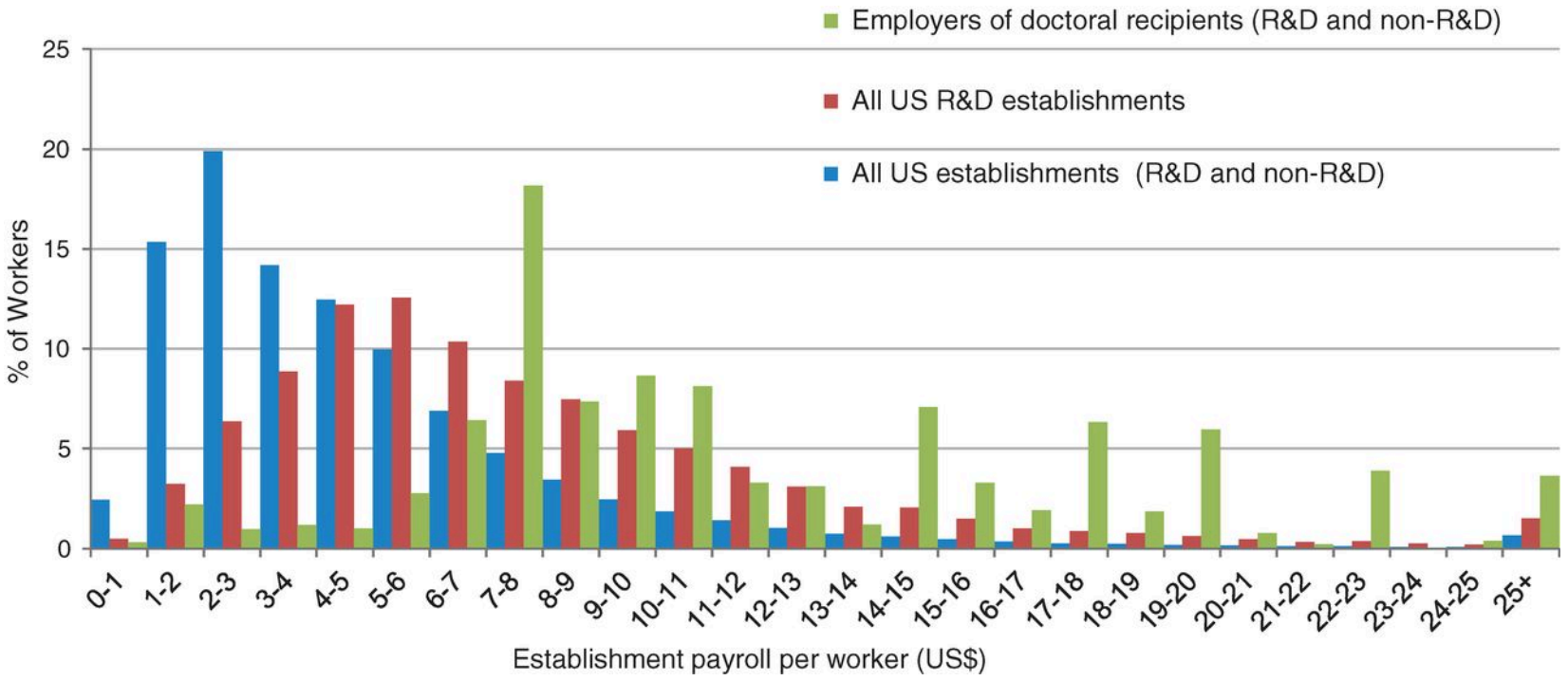


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Fig. 3 The annual earnings and placement of doctoral recipients supported by grants vary by field.

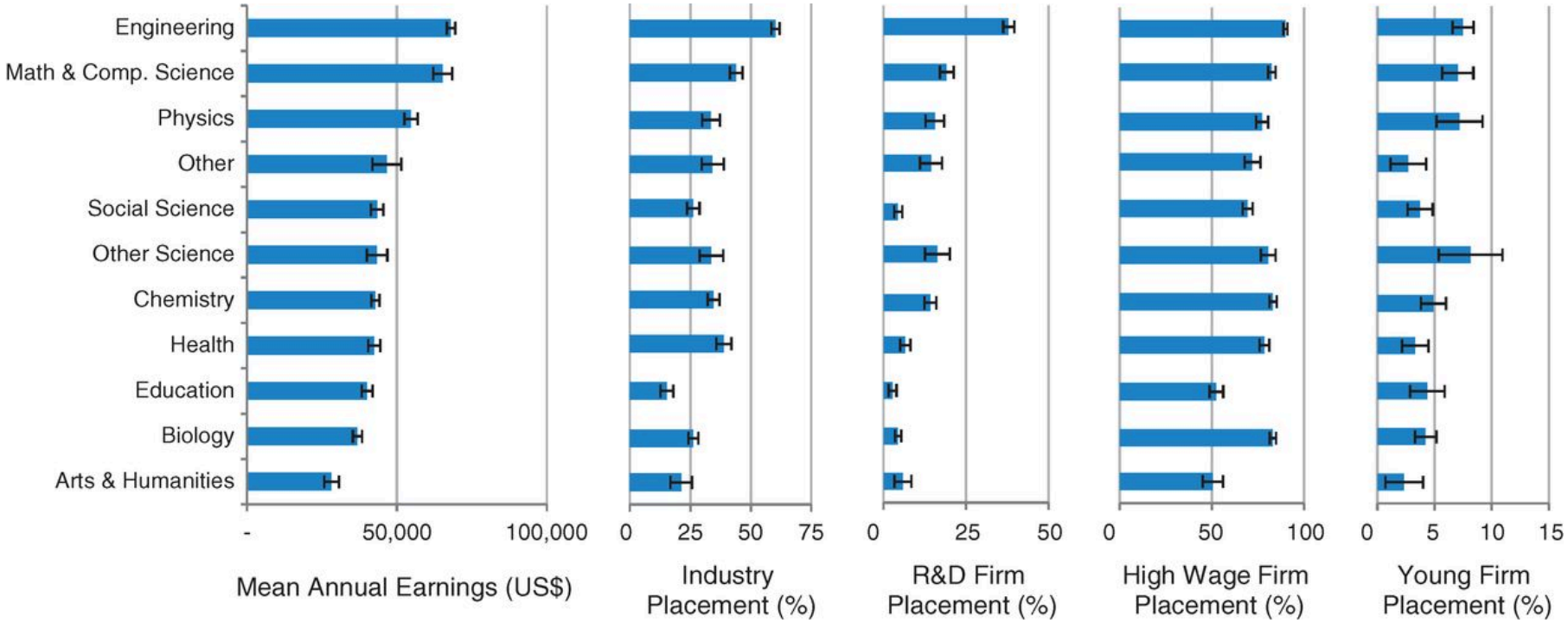

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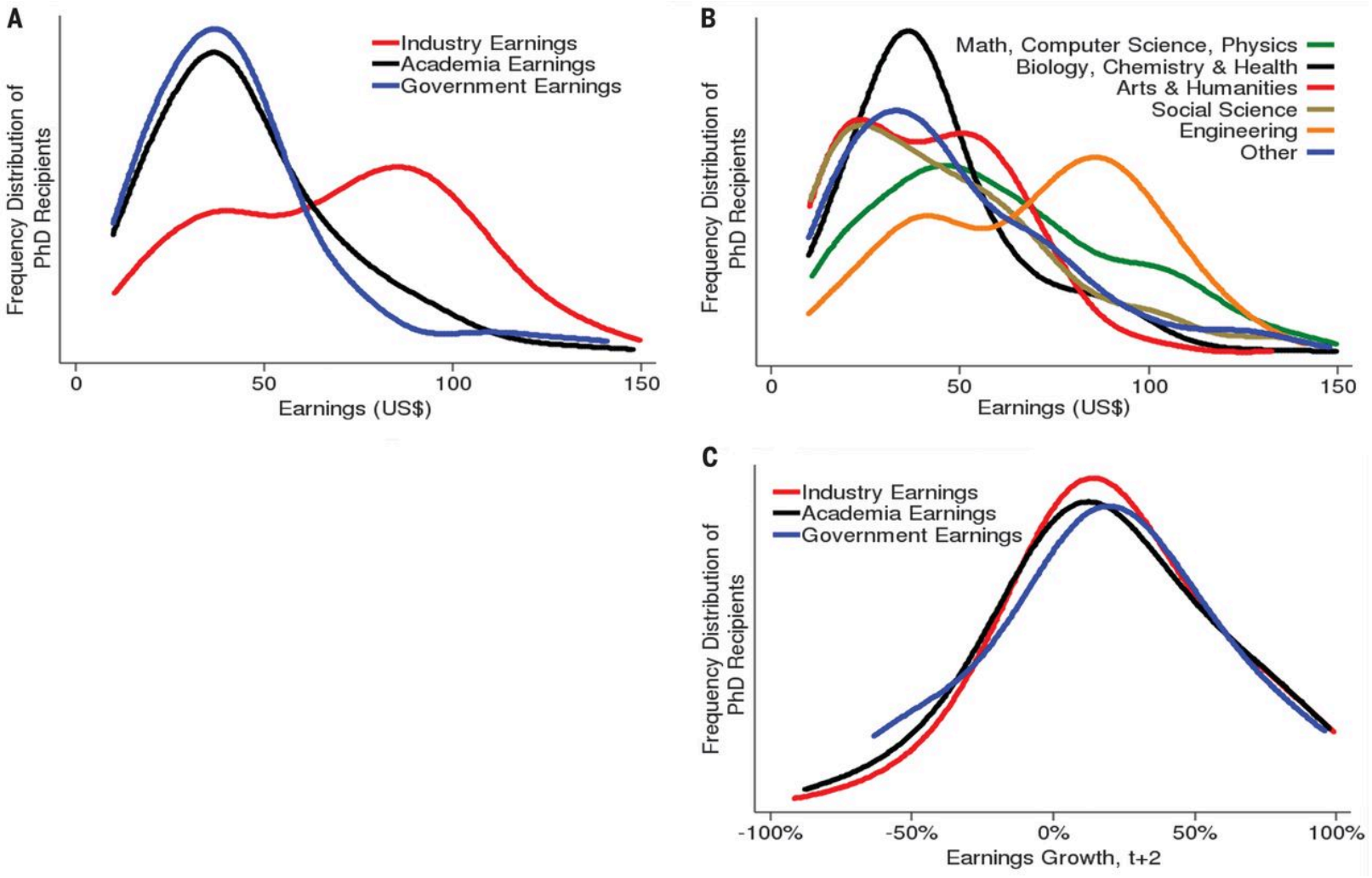
Fig. 4 Annual earnings (U.S.$1 × 1000) and earnings growth of UMETRICS doctoral recipients by sector and discipline.



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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
- One way to begin is to carefully match SED with UMETRICS data at IRIS—using this as a pilot—recognizing confidentiality issues, etc.

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

Stay Rates of Foreign Doctorate Recipients

- Address a serious gap in knowledge going forward concerning stay rates
- For years, Mike Finn estimated stay rates of US PhDs by assembling batches of SED records and matching Social Security numbers to tax records
- No longer possible, given that SED no longer collects full Social Security number
- Matching SED with Census data would accomplish this

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

International Mobility

Measuring Flows of Highly Trained

- Research suggests that internationally mobile scientists and engineers contribute disproportionately to innovation
- Part of this is due to selection
- But some research suggests that it is not all due to selection and that mobile individuals contribute above and beyond to innovation

But Little Known about Mobility

- SDR used to only follow PhDs who stayed in US
- Now making effort to follow individuals who get PhD in US and then move outside US
- More difficult to follow individuals who come for postdoctoral training with PhD in hand
- Extremely difficult to compare mobility of scientists and engineers in US with patterns outside the US

Problems/Challenges

- There are ways of measuring movements of those already productive, through changes of address on publications
- But to understand movements prior to "coming of age scientifically" requires use of other techniques
- Moreover, not all scientists who "come of age" publish. Many work in firms but are not observable through paper trail

Data Issues Studying Foreign Born

- Lack of consistent data across countries
- Virtually no country has data on emigrant scientists
- Little empirical evidence concerning degree to which foreign born scientists outperform native born scientists;
  - yet many countries implicitly assume they do;
  - many countries also promote international experience for residents, assuming it promotes productivity

Difficult to Study Cross Country Patterns

- Extremely difficult to make comparisons between mobility in US and other countries
- OECD data that exist are generally for tertiary educated—do not focus exclusively on PhDs
- Virtually no output variables available in the data
- Virtually nothing known about postdocs

Surveys One Possible Means

GlobSci Survey Designed to Circumvent these Kinds of Issues

Joint with

- Chiara Franzoni
  - Politecnico Milano

- Giuseppe Scellato
  - Politecnico Torino

Supported in part by IPE, NBER

The GlobSci Project
Data on scientists' migration

4 fields:

Biology
Chemistry
Earth & Environment
Materials science

16 countries:

Australia, Belgium, Brazil, Canada, Denmark, France, Germany, Japan, India, Italy, Netherlands, Spain, Sweden, Switzerland, UK, USA

Panel construction

Divide journals by quartiles of IF in each subfields of 4 disciplines

Randomly pick in each quartile

Retrieve all articles published in 2009 in each subfield

Retrieve email ad from correspond authors (more th had one)

Keep correspondent authors with email in any one of 16 countries

U.S. sample restr ".edu")

Keep only 1 recor for duplicate auth

FINAL PANEL

47,304 unique corresponding authors

Sample continued

- Journals contain approximately 30% of all outlets in four fields.
- Probability that authors would be chosen in one or another quartile of Impact Factor is random
- Choose 4 fields because common practice in these fields to include email address in address information of corresponding author
- Qualtrics® platform used http://qualtrics.com/

Response Rate

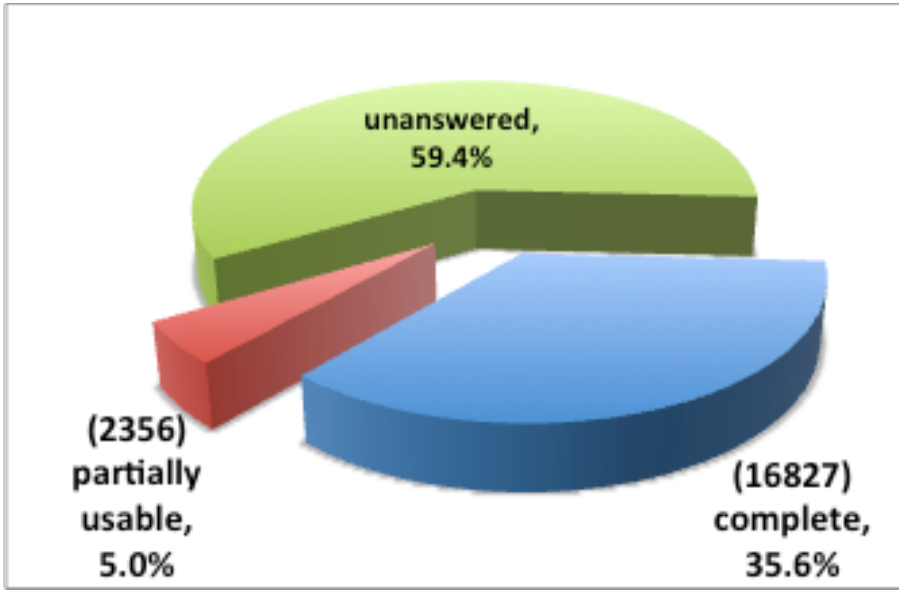
- 47,304 individuals in panel
- 19,183 answers = **40.6**%;

calculation excludes non-deliverables (5% higher estimate)

- High for web-based survey

which often have 10-25% response rates (Sauermann & Roach)

- Response rates by country
  - Italy highest (69.0%)
  - Germany lowest (30.3%)
  - 12 countries (32-41%)
- Academic sample 15,672 observations
- Response rate bias appears minimal, comparing respondents vs. non-respondents; incomplete vs. complete respondents; late vs. early respondents



THE GLOBSCI SURVEY

- Collected four layers of data:
  - Data about respondent **background** (education, job condition, age etc.)
  - Data about **mobility:** country at age 18 (country of origin), current country, international experience in the past, reasons for moving, reason for going back, likelihood to go back in the future)
  - Data on the **specific article** through which the respondent has been admitted in the sample (type of research, characteristics and location of the co-authors).
  - Data on the **research network** of the respondent (e.g. number of collaborating countries, propensity to collaborate).

THE GLOBSCI SURVEY

- Main advantages:
  A. Possible to track mobile researchers who returned to country of origin (if included in 16 core countries) or who emigrated to a core country.
  B. Data on “entry point” of foreign born (e.g. PhD, postdoc, faculty)
  C. Numerous individual level controls
  D. Bibliometric measures of focus article
- Limitations:
  A. No data for China and South Korea
  B. Covers only four fields
  C. Questionnaire provides a snapshot in 2011.
  D. Statistics reflect outbound mobility towards the 16 countries
  E. Do not have information on “quality” of scientist

Results Summarized

- http://www.nature.com/news/global-mobility-science-on-the-move-1.11602

- http://www.nber.org/workinggroups/ipe/ipe_researchproject.html

NBER

National Bureau of Economic Research

Examples of Findings

- Patterns of mobility vary considerably across 16 countries
- Major reason individuals return is for “family and personal;” not because of opportunities
- Mobile scientists more likely to establish international links; have links with larger number of countries; exhibit superior performance on international collaborations
- Mobile scientists are more productive than non-mobile scientists as well as returnees; results persist after instrumenting for mobility
- Graduate students and postdoctoral fellows are drawn to study in US vs. other countries because of reputation of institutions, financial support, perceptions as how study in US affects future career; discouraged studying in US vs. elsewhere because of lifestyle issues

Data Available

- At NBER: http://www.nber.org/gobsci/

Surveys Only Get You So Far…

- Encourage NCSES to continue to work with other countries to develop systematic ways to collect data across countries that can provide consistent longitudinal information regarding internationally mobile scientists and engineers.
- More generally, need to think about how we can benchmark US data with that of other countries when it comes to production of human capital and movement of human capital.

Questions/Comments

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