CAREER CHOICES AND EARNINGS TRAJECTORIES OF SCIENTISTS

Rajshree Agarwal
University of Maryland
A tale of two studies…

• Industry or Academia, Basic or Applied?: Career Choices and Earnings Trajectories of Scientists
  • Rajshree Agarwal and Atsushi Ohyama
  • Forthcoming in Management Science

• Who has it all?: Gender Gap in Earnings of Scientists and Engineers in Academia and Industry
  • Rajshree Agarwal, Waverly Ding and Atsushi Ohyama
  • Work in progress
Ne’er the twain shall meet…?

- *Satisfactory progress in basic science seldom occurs under conditions prevailing in the normal industrial laboratory.*
  
  Science, The Endless Frontier (Bush, 1945)

- *Applied research is facing a shortage of its principal raw materials*
  
  Charles Stine, Speech to Dupont Executive Committee, 1926 (Hounshell and Smith 1988, p. 366)
What should I do when I grow up?

Academia? Industry?

Basic? Applied?
Empirical context

• Scientists and Engineers Statistical Data System (SESTAT)
  • Survey of Doctoral Recipients 1995-2006
  • Graduates from US universities, working in the US

• Definition of careers
  • Industry—principal employment in private, for profit institution
  • Academia—principal employment in 4 year college or university, medical school, or research affiliates of university
  • Basic research – study directed toward gaining scientific knowledge primarily for its own sake
  • Applied research – study directed toward gaining scientific knowledge to meet a recognized need
Are the careers really orthogonal?

<table>
<thead>
<tr>
<th></th>
<th>Counts</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Basic Science</td>
<td>Applied Science</td>
</tr>
<tr>
<td>Academia</td>
<td>204,542</td>
<td>167,865</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry</td>
<td>104,393</td>
<td>310,596</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: 2003 SESTAT data using sample weights in SESTAT
Career choices and earnings trajectories: In a nutshell…

• Main research questions
  • What factors impact scientist career choices between industry or academia, and basic or applied science?
  • What are the implications of career choice on earnings trajectories?

• Key predictions and findings
  • A taste for non monetary returns
    • sorts scientists to choose careers in academia over industry,
    • but has little impact on the choice between basic and applied science
  • Ability
    • differentiates among academic scientists,
    • but no significant differences among industry scientists
  • Earnings profile
    • In industry, similar trajectories for basic and applied researchers
    • In academia, basic researchers start at lower levels of compensation, but earnings evolve at a higher rate
    • Basic researchers in academia ultimately make the same as industry scientists
Model Setup: Scientific Labor Markets

- Incorporates matching theory into traditional lifecycle models of human capital investment
- Supply side heterogeneity in ability and preferences of scientists
- Demand side heterogeneity in complementary physical and human capital
  - Basic scientists have greater access to physical capital than applied in academia, reverse is true in industry
  - Basic and applied scientists are complements in scientific production function in industry, but not in academia
Positive Assortative Sorting: Basic vs. Applied and Academia vs. Industry

- Strong complementarity
- Symmetric roles

A taste for non-monetary returns
Proposition 1: Ability sorting in academia, but not in industry

- Strong complementarity
- Symmetric roles

A taste for non-monetary returns
Proposition 2: Taste sorting between academia and industry, but not in basic and applied science.

• Strong complementarity
• Symmetric roles
Proposition 3: Earnings in academia are lower than in industry.
Proposition 4: Initial earnings of basic scientists lower than applied scientists in academia
Proposition 5: Similar slopes in industry, but steeper slope for basic than applied in academia
Policy implications

• Are we really doing all that we can in the universities to equip PhD students for the career options other than basic academic research?
  • There is *no* evidence of ability sorting between academia and industry
  • Need to develop programs
    • that systematically complement “science skills” with “business savvy”
    • that provide “career counseling” for PhD students to match them to career options

• Productivity gains (and higher earnings) in industry is due to true synergies between basic and applied science
  • If we want to encourage more university technology transfer, we need to break the “silos” of applied and basic research in academia
A tale of two studies…

• Industry or Academia, Basic or Applied?: Career Choices and Earnings Trajectories of Scientists
  • Rajshree Agarwal and Atsushi Ohyama
  • Forthcoming in Management Science

• Who has it all?: Gender Gap in Earnings of Scientists and Engineers in Academia and Industry
  • Rajshree Agarwal, Waverly Ding and Atsushi Ohyama
  • Work in progress
Chart 1. Women’s earnings as a percent of men’s, full-time wage and salary workers, 1979–2010 annual averages

NOTE: Data relate to median usual weekly earnings of full-time wage and salary workers.
What about highly skilled labor markets?

- Our explicit focus:
- Individuals with a PhD in Science and Engineering

<table>
<thead>
<tr>
<th></th>
<th>Industry (private, for profit)</th>
<th>Academia (4 year educational institutions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>155,560 (80.6%)</td>
<td>182,920 (67.4%)</td>
</tr>
<tr>
<td>Female</td>
<td>37,340 (19.4%)</td>
<td>88,620 (32.6%)</td>
</tr>
</tbody>
</table>

Source: NSF SESTAT data, 2006
Gender issues salient in both sectors

“Having it all…depended almost entirely on what type of job I had”
Anne-Marie Slaughter, Princeton University

“The moment a woman starts thinking about having a child, she doesn’t raise her hand anymore”
Sheryl Sandberg, Facebook
Gender gap in academia vs. industry

- Main research questions
  - Is the gender gap higher in industry or academia?
  - What are the potential explanatory factors, particularly as it relates to family status?

- Quick poll…
  - Where do *you* think that the gender gap is higher?
  - Why?

- Methodology to estimate gender gap
  - Parametric (OLS) regression with controls for ability, demographics, family status…
  - Non parametric Coarsened Exact Matching by creating “twins” based on ability, demographics, family status…
OLS Estimation of Earnings Gap
(LogSalary ~ marriage, children, spousal working, school ranking, parental edu, exp, exp^2, white, citizenship, occupation)
OLS vs. CEM estimation

Estimated earnings differentials

Years of Experience

Academia (OLS)  Academia (CEM)  Industry (OLS)  Industry (CEM)
Possible Explanations?

- “Work-life” balance issues
  - Dual Careers
    - Women in academia may be more restricted in options of universities in major metropolitan areas
  - The “Baby Penalty”
    - Child rearing responsibilities disproportionately affect women in academia given coincidence of having babies and getting tenure
- “Good Ol’ Boys” effect
  - Market forces may be stronger in industry vs. academia
- The Pink Ghetto argument
  - Women are more segregated into lower paying sectors in academia than in industry
- Cohort effects
  - Widening gap over experience maybe due to compositional differences in cohorts
Your help…

- Tried to do sub-samples to get at “pink ghetto effects”
  - Not enough observations to get CEM matches
- Cohort differences?
  - Will be getting 2008 SESTAT data, but still have issues related to number of distinct points across cohorts
- Other human capital investment considerations?
- How to attribute residual to “Good Ol Boys Club”?
- Other??