The Postdoc and Women’s Academic Careers—More Questions than Answers

for presentation at:
National Summit on Gender and the Postdoctorate
March 11, 2010

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Research Funded by NSF Grant SES-0353703
Disclaimer

- The use of NSF data does not imply NSF endorsement of the research, research methods or conclusions contained in this report.
Gender and Science

- Research is based on:

Economist’s Perspective

- Gender Differences in employment outcomes result from
  - Differences in productivity
  - Differences in choices
  - Imperfect Competition—Monopsony
  - Job Matching
  - Discrimination
Research Questions

- Does Science Promote Women?
  - We examine gender differences in:
    - Tenure Track jobs
    - Promotion to Tenure
    - Promotion to Tenured, Full Professor
Research Questions

- How does the Postdoc affect careers?
  - What factors are associated with transitioning from the postdoc to an academic job?
  - What is it about the postdoc that affects women differently than men?
Preview of Results

- No gender difference in obtaining tenure-track job. However,
  - Married women with children significantly less likely to get a tenure track job within 9 years of PhD.
- We find negligible gender differences in promotion.
- Postdoc is critical point in women’s academic careers.
Organizing Principles

- Based on previous research:
- There is no single scientific labor market
  - Must disaggregate the data
- Gender differences need a context
  - Make comparisons across fields
Data

- Use 1973 - 2006 Survey of Doctorate Recipients (SDR)
  - Biennial, Longitudinal Survey of U.S. Doctorates
  - Used by NSF to analyze scientific labor force

- **Longitudinal Sample**: Individuals who received their Ph.D. between 1972 and 1996 observed between 1973 and 2006.
Data

Academics in the Sciences:

- Life Sciences
  - Agriculture and Food Science
  - Biology and Life Sciences

- Physical Sciences
  - Chemistry
  - Earth Science
  - Physics
  - Computer Science / Mathematics

- Engineering
Data

- Dependent variables:
  - Probability of Tenure Track job within 9 years of PhD
  - Probability of Promotion to tenure and full professor
  - Duration between PhD and promotion to tenure and full professor
Data

Independent variables:

- Gender
- Age PhD
- Year PhD
- Race
- Academic field
- Degree institution characteristics
Data

- Time-varying Independent variables:
  - University/College employer characteristics
  - Rank and Tenure status
  - Primary / Secondary work activities
  - Government Support of Research
  - Publications****
Data Difficulties

- Biennial Survey
- Changes in the sampling frame
- Numerous missing observations, required a lot of imputation
- Imputed productivity from three years of observed publications
Empirical Methods

- Probit models (dependent variable):
  - Tenure track within 9 years of PhD
  - Tenured at 11 years after PhD
  - Tenured, Full Professor at 15 years after PhD
Stylized Facts

- Women’s representation in science depends upon the field
  - Life Science—Progress
  - Physical Science, Engineering,—Anemic representation
Figure 1: Percentage of Doctorates Granted to Females, 1974-2000 Survey of Earned Doctorates

Source: 1974-2000 Survey of Earned Doctorates
Figure 1: Percentage Female by Rank, Biomedical Science Disciplines 1973 - 2006

Sources: 1973-2006 Survey of Doctorate Recipients
1975 - 2006 Survey of Earned Doctorates
Postdocs in Biomedicine

- Part of the decrease in women in academic biomedicine is likely explained by not having a postdoc.
  - Why do women opt out of biomedical careers early in the process?
## Female Probability of Tenure-Track Job 1973 - 2001

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>-0.038</td>
<td>-0.033</td>
<td>0.156</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.010)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>Life Science</td>
<td>-0.041</td>
<td>-0.077</td>
<td>0.108</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.013)</td>
<td>(0.025)</td>
</tr>
<tr>
<td>Physical Science</td>
<td>-0.002</td>
<td>-0.015</td>
<td>0.206</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.017)</td>
<td>(0.029)</td>
</tr>
<tr>
<td>Engineering</td>
<td>0.000</td>
<td>0.013</td>
<td>0.072</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
<td>(0.035)</td>
<td>(0.064)</td>
</tr>
<tr>
<td>Demographics</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Degree Characteristics</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Fields</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Female Interactions</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Effect of Marriage

4.7  7.1  -1.4  2.3

Science  Life Science  Physical Science  Engineering

Men  Women
Effect of Children

![Bar chart showing the effect of children on science, life science, physical science, and engineering, with percentages for men and women.](chart.png)
Effect of Young Children

-8.1  -8.0  -5.6  -9.7

Science  Life Science  Physical Science  Engineering

Men  Women
Tenure Track Jobs in Biomedicine

- Updated the analysis for biomedicine using 1973-2006 SDR

- Very similar results:
  - Single women are 3 percentage points more likely to have tenure track jobs than men
  - Women with young children are 6.7 percentage points less likely to have tenure track jobs than men
# Promotion to Tenure

<table>
<thead>
<tr>
<th></th>
<th>Full Sample</th>
<th>Life Science</th>
<th>Physical Science</th>
<th>Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Female Probit Coefficient</strong></td>
<td>0.00</td>
<td>-0.03</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>Promoted 11 Yrs Ph.D.</td>
<td>(0.88)</td>
<td>(0.19)</td>
<td>(0.73)</td>
<td>(0.75)</td>
</tr>
<tr>
<td><strong>Female Risk Ratio</strong></td>
<td>0.97</td>
<td>1.02</td>
<td>1.00</td>
<td>1.06</td>
</tr>
<tr>
<td>(No Covariates)</td>
<td>(0.33)</td>
<td>(0.60)</td>
<td>(0.96)</td>
<td>(0.56)</td>
</tr>
<tr>
<td><strong>Model 1 Female Risk Ratio</strong></td>
<td>0.95</td>
<td><strong>0.89</strong></td>
<td>0.93</td>
<td>1.00</td>
</tr>
<tr>
<td>(Excluding Productivity)</td>
<td>(0.14)</td>
<td>(0.02)</td>
<td>(0.22)</td>
<td>(0.97)</td>
</tr>
<tr>
<td><strong>Model 2 Female Risk Ratio</strong></td>
<td>0.97</td>
<td><strong>0.92</strong></td>
<td>0.94</td>
<td>1.03</td>
</tr>
<tr>
<td>(Including Productivity)</td>
<td>(0.29)</td>
<td>(0.07)</td>
<td>(0.28)</td>
<td>(0.82)</td>
</tr>
</tbody>
</table>
### Promotion to Full Professor

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<th>Physical Science</th>
<th>Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Female Probit Coefficient</strong></td>
<td>-0.05</td>
<td>-0.09</td>
<td>-0.02</td>
<td>0.09</td>
</tr>
<tr>
<td>Promoted 15 Yrs Past Ph.D.</td>
<td>(0.02)</td>
<td>(0.00)</td>
<td>(0.51)</td>
<td>(0.37)</td>
</tr>
<tr>
<td><strong>Female Risk Ratio</strong></td>
<td>0.90</td>
<td>0.96</td>
<td>0.79</td>
<td>0.95</td>
</tr>
<tr>
<td>(No Covariates)</td>
<td>(0.01)</td>
<td>(0.48)</td>
<td>(0.00)</td>
<td>(0.74)</td>
</tr>
<tr>
<td><strong>Model 1 Female Risk Ratio</strong></td>
<td>0.95</td>
<td>0.93</td>
<td>0.87</td>
<td>1.09</td>
</tr>
<tr>
<td>(Excluding Productivity)</td>
<td>(0.34)</td>
<td>(0.37)</td>
<td>(0.11)</td>
<td>(0.89)</td>
</tr>
<tr>
<td><strong>Model 2 Female Risk Ratio</strong></td>
<td>0.97</td>
<td>0.96</td>
<td>0.89</td>
<td>1.04</td>
</tr>
<tr>
<td>(Including Productivity Covariates)</td>
<td>(0.54)</td>
<td>(0.61)</td>
<td>(0.19)</td>
<td>(0.82)</td>
</tr>
</tbody>
</table>
Conclusions

- Does Science Promote Women?
  - YES—once they’re on the tenure track
- Gender differences in tenure track
  - Explained by differences in family at the time of the postdoc.
Future Research Questions

- We show that family considerations at the time of the postdoc affect the probability of taking a tenure track job.

- WHY?
  - Job matching
  - Differences in productivity
  - Choices
  - Institutions
Philosophical Question

What is the nature of the postdoc?

- Is it an investment in training and human capital?
  - If so why do women choose to forgo this investment?
- Or is it an unproductive queuing mechanism for research jobs?
- Or a bit of both?