Women in STEM: Moving Up or Falling Off the Academic Career Ladder?

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Abstract

Using evidence from the National Science Foundation (NSF) Survey of Earned Doctorates, this paper compares the gender promotion gaps in four different STEM fields and finds that Economics has the largest gap, though it is not the most math-intensive subject. Moreover, although evolving literature has been studying the gender gap in STEM fields, few scholars break down the employment sectors and investigate where women choose to work outside of academia. I find that roughly two-thirds of the "missing female economists" in academia shift to the government sector, with the remainder moving to industry. I find females are more likely to leave the workforce across all STEM fields.

Key Words: Gender Bias; Promotion Gap; Economics of Gender; Non-labor Discrimination

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1 Introduction

Despite gains in recent decades, women are still underrepresented in the math-intensive Science, Technology, Engineering, and Mathematics (STEM) branches of academia (Ceci 2014). Moreover, this under-representation widens with the stage of career. According to the 2017 National Science Foundation (NSF) Survey of Doctorate Recipients, women hold 46% of tenure track positions in science, engineering, and health fields; but only 35% of tenured positions and 30% of full professorships. Within the broad set of STEM fields, women comprise a larger share in some fields – like biology – and a smaller share in others – like engineering, computer science, and physics. Among the fields with the lowest overall female share is economics, which at UC Berkeley, for example, falls below even stereotypically "male" fields like mechanical engineering (UC Berkeley Faculty Salary Equity Study, 2020).

Understanding the causes and correlates of the gender gaps in career advancement in different STEM fields is important because it could help lead to insights into policies to address the gap. Although women in STEM fields have been the subject of numerous studies (e.g., Card, DellaVigna, Funk, & Iriberri 2019; Wang & Degol 2017; Ceci 2014; Ginther & Shulamit 2004), few papers have tried to compare the evolution of the gender gap among different STEM fields and explain why they differ. In addition, little attention has been paid to where those women go who appear to have "fallen off" the academic ladder, and how their destinations differ by field.

This paper aims to study the gender promotion gaps in five STEM fields and women's alternatives if/when they fall off the academic ladder, using the 1993-2013 waves of the National Science Foundation (NSF) Survey of Doctorate Recipients (SDR). This longitudinal data tracks nationally representative doctorate recipients in science, engineering, and health fields during the survey years and documents changes in individual career advancement, providing a more comprehensive depiction of females in STEM fields than has been offered by previous studies.

As shown by Table 1, although economics has the largest gender gap in academia, tenure rate, and associate professorship among all STEM fields, the share of females who work in the government is much higher in economics than other STEM fields. This suggests that government seems to be a popular alternative to academia only for females in economics. Moreover, even though engineering has a small gender gap in academia and tenure rate, the share of women working in the industry is 20% lower than that of men.

Table 1: Distribution of Females and Males by STEM Field

	Economics		Engineering		Biological Sciences		Physics & Math	
	Males	Females	Males	Females	Males	Females	Males	Females
% in academia	0.58	0.43	0.27	0.33	0.53	0.52	0.46	0.55
% in government	0.13	0.27	0.08	0.11	0.09	0.08	0.08	0.08
% in industry	0.29	0.21	0.64	0.47	0.36	0.31	0.45	0.29
% Unemployed	0.004	0.088	0.020	0.087	0.017	0.084	0.013	0.079
% Tenured	0.86	0.68	0.72	0.71	0.36	0.30	0.70	0.79
% Assistant Prof.	0.05	0.12	0.04	0.06	0.22	0.22	0.08	0.09
% Associate Prof.	0.36	0.20	0.15	0.14	0.18	0.14	0.23	0.30
% Professorship	0.12	0.05	0.04	0.04	0.03	0.01	0.06	0.07
Sample size	285	122	1,781	295	1,455	1,060	905	172

Notes: All variables are measured 10 years post-Ph.D. Academia includes people working in 4-year colleges and 2-year colleges. Tenure rate and faculty rank distribution are specifically for people who work in the academia. Faculty rank does not add up to 1 because there are other positions such as adjunct professorship and lecturers. More detailed distribution and its changes across years are in Appendix Figure 1. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

With these data, I use a linear regression model to estimate the probability of receiving tenure, leaving the workforce, and staying in academia. Furthermore, I break down the probability estimates of receiving tenure by five STEM fields — computer science, biological science, chemistry, physics, and economics – to understand the variation in gender gaps among different STEM fields. Lastly, I run linear probability models on four different employment sectors to investigate where women choose to work instead of academia.

I find that females usually take longer to receive doctorate degrees and to be awarded tenure. In addition, women are much more likely to leave the tenure-track or even quit their job after having a kid than their male counterparts. This effect of children on women's career decisions is similar to what Wolfinger, Mason, and Goulden find in their study in 2008. The data suggest that the presence of children reduces a woman's probability of receiving tenure and increases the probability that she leaves the workforce, whereas for men the effects of children are small.

Moreover, I break down tenure reception and employment sectors by five different STEM fields — computer science, biological science, chemistry, physics, and economics — to closely examine how drop-out rates are different for different subfields. Importantly, economics has the largest gender gap among all five STEM fields in the probability of tenure. This is consistent with UC Berkeley Faculty Salary Equity Study that economics has the least equal gender representation in faculty than other STEM departments: only 10% of the faculty is female in 2020, compared to 20% in chemistry and biology. In addition, females studying economics are far less likely to stay in academia than females in other STEM fields. This is striking, since studies have shown that mathematical intensity has an effect on gender inequality in STEM (Kahn & Ginther, 2017). Nevertheless, the requirement of mathematical skills is not as intensive in economics than computer science or physics, yet the gender promotion gap in academia is wider in economics than in those relatively more math-intensive STEM fields.

Finally, since the gender promotion gap is the widest in economics, I investigate where female economists work instead when they fail to stay in academia. I find female economists are 18 percentage points more likely to work for government and almost 30 percentage points less likely to work at a 4-year college (i.e., stay in regular academic positions). Nevertheless, the rationale behind the shift of female economists from academia to government. This could be due to greater barriers to promotion for women in economics, or it could be driven at least in part by the availability of government sector jobs that are relatively attractive for female economists. Moreover, the shift of female economist to the government sector does not necessarily mean that their progress up the career ladder is faster or easier in the government sector – the available data do not allow me to classify career stage for people outside academia.

The fundamental contribution of this paper is mainly two-fold. First, this paper compares the gender promotion gaps in five different STEM fields and finds that economics has the largest gap, though it is not the most math-intensive subject. Second, although evolving literature has been studying the gender gap in STEM fields, few scholars break down the employment sectors and investigate where women choose to work outside of academia. I find that roughly two-thirds of the "missing female economists" in academia shift to the government sector, with the remainder moving to industry. I find relatively small differences between male and female economist in the probability of leaving the workforce altogether.

2 Current Literature Themes

Unlike other industries, academia has its unique career pipeline: not only it requires more advanced educational training, but its promotion procedure is also often enduring and heavily depends on chances. First, almost all academic jobs at a typical research university require a doctorate, which usually takes five to six years after undergraduate education. Although the percentage of doctorates granted to females is gradually increasing for all subjects from 1970 to 2000, the progress varies significantly by fields. For example, the share of women in life sciences has increased significantly from 20% to almost 50%, whereas that percentage in economics has a much slower growth from 10% to merely above 20% (Ginther & Kahn, 2004). This result is consistent with my data where economics has the lowest share of women among all STEM fields, including math-intensive fields like physics and computer science.

From 2000 and onwards, however, growth in the share of females in economics doctorates has slowed or stopped. The Committee on the Status of Women in the Economics Profession (CSWEP) of the American Economic Association reports that the share of female doctorates in economics remains roughly 30% at the top 10 institutions from 2000 to the present (UC Berkeley CSWEP Report). In my data, the percent of female economics doctorates in general institutions has been fluctuating between 20% and 30% from 2001 to 2013, whereas all other STEM fields have experienced significant progress. Why does the share of females in economics remain stable over the past 20 years, and what hinders its progress?

As Ph.D. candidates receive their doctorate degrees, they make decisions about seeking a career in academia, government, or industry. On average, men are more likely than women to pursue a career in academia. On the contrary, women are more likely to work in public administration than the two alternatives of academia or industry (Conti & Visentin, 2015). This is consistent with my data: after completing doctorate degree, almost 70% of men receive a tenure-track position, whereas only 58% of women do. The corresponding academic position for newly graduated doctorate students is assistant professor, and people who receive such job are said to be on a tenure track. Far fewer people would receive tenure-track jobs than doctorates (Wolfinger, Nicholas, Mason, & Goulden, 2008), because universities usually hire new faculty only when current faculty retire. This step is the first stage where women appear to have "fallen off" the academic ladder. An emerging body of literature has investigated the gender gap in tenure-track jobs and assistant professorships. Ginther and Kahn reveal that marriage and young children can partly explain the gender gap in tenure-track positions in STEM fields. Marriage increases males' likelihood of getting a tenure-track position by 22%, while its positive effect for females is only 5%. Furthermore, having pre-kindergarten-aged children lowers females' probability of getting a tenure-track position by 8.1%, yet it has little effect on males (Ginther & Kahn, 2009). Wolfinger, Mason, and Goulden validate and generalize Ginther and Kahn's research to different academic fields like humanities and social sciences. Similarly, they show that both marriage and children contribute to lower rate at which females receive tenure-track positions in humanities and social sciences. Unmarried women without children have a better chance of receiving assistant professorships than their male counterparts. (Wolfinger, Mason, & Marc Goulden, 2008).

The traditional next stage in the academic pipeline is to get tenure. Receiving tenure is an essential step in advancing further in the academic ladder, because it grants permanent employment at a college or university. Not all assistant professors or people on the tenure-track get tenure. Tenure grant is often an enduring, arduous, and expensive process with a series of internal procedures. When the possibility of receiving tenure is low in the current university, assistant professors are tempted to seek other academic institutions or careers. One common alternative is to work as adjunct faculty at the current academic institution. Females are disproportionately likely to work as adjunct professors or leave the paid labor force as they fail to receive tenure. Such difference becomes even larger if they have young children (Wolfinger, Mason, & Goulden, 2009). Three popular alternatives other than adjunct professorships are entering the industry, working for the public administration, or exit the work force.

Moving from tenure-track to tenure, women ”leak out of” the academic pipeline more often than men. A few scholars have attempted to explain such gender promotion gap. Ginther and Kahn suggest that the existing gender difference could be partially explained by marriage and publication quality (Ginther & Kahn, 2009). Wolfinger, Mason, and Goulden add that the presence of children, especially children under six, attributes to the gap as well (Wolfinger, Mason, & Goulden, 2009). Furthermore, the stereotypical and unwelcoming culture in academia which perceives men as an in-group and women as an out-group also discourage females to climb up the academic ladder (e.g., Wu 2017; Tonso 1996).

3 Data

3.1 Institutional Background

The data in this paper solely comes from the 1993-2013 waves of the National Science Foundation (NSF) Survey of Doctorate Recipients (SDR). The National Science Foundation (NSF) is an independent agency of the United States government which promotes fundamental education and research in fields of social science and engineering. Starting 1972, NSF sponsored the Survey of

Doctorate Recipients (SDR). The SDR collects individual information on doctorate recipients who received their degrees from American post-secondary institutions. Although it is only limited to STEM fields like economics and engineering, it tracks individual demographics, educational background, work experience, and career development over time. The SDR sample is selected from the Doctorate Records File (DRF), a record of all doctorate recipients graduated from American post-secondary institutions since 1920. The SDR collects data biannually with a trimodal approach — data is collected using a self-administered electronic questionnaire, a self-administered print questionnaire (via mail), and computer assisted telephone interview (CATI).

3.2 Data Description

The SDR is a biennial, longitudinal survey of doctorate recipients from U.S. universities conducted by the NSF. This data gathers comprehensive statistics on doctorate recipients, including demographic characteristics, educational background, tenure status, work productivity, and job motivations and preferences.

I draw upon the SDR to create a data set of individual doctorate who received their Ph.D. between 1993 and 2013 and in fields of economics, biological sciences, computer and mathematical science, physics, and chemistry. I also exclude the individuals who are not observed ten years after Ph.D. receipt, or not participate in the survey every year between 1993 and 2013. The longitudinal sample includes 3050 STEM field doctorates, of whom 2247 are male and 803 are female.

The primary variables of interest are the tenure status indicator and not working indicator. Another dependent variables of interest is the working in academia indicator. Independent variables are gender, number of children, young children indicator, major job responsibility, number of publications, and age receiving doctorate degree. Control variables are racial minority indicator, foreign born indicator, years of experience, and government support.

4 Descriptive Statistics

4.1 Average Characteristics by Gender

Table 2 presents the average characteristics by gender in all fields of study. All the time-variant variables in this table is measured 10^{th} year post-Ph.D. My total sample size is 6,484, consisting of 4,682 males and 1,802 females. Notably, the average proportion married is 10% higher for males than females with 1% significance. In addition, females tend to have less children, especially young children, than males 10 years after receiving doctorate degree. Across STEM fields, women seem less likely to get tenured and more likely to leave the work force 10 years post doctorate. However, females are also more likely to work in academia 10^{th} year post-Ph.D. than their male counterparts.

Table 2: Average Characteristics by Gender, All Fields

	Males	Females
Age completing Ph.D. degree	31.168**	31.492**
Racial minority = 1	0.098***	0.124***
Foreign born = 1	0.312***	0.271***
Variables measured 10 years post-Ph.D.		
Proportion married	0.840***	0.748***
Young children	0.615***	0.546***
No. children = 0	0.299***	0.391***
No. children >= 2	0.515***	0.417***
No. children	1.414***	1.138***
Proportion research	0.559***	0.497***
Proportion teaching	0.189***	0.234***
Proportion management	0.114	0.098
Government support	0.363	0.381
Tenure and related variables		
Tenured 10^{th} year post-Ph.D.	0.588***	0.483***
Tenured as of 2001	0.820***	0.689***
Assistant Professorship 10^{th} year post-Ph.D.	0.110***	0.167***
Associate Professorship 10^{th} year post-Ph.D.	0.190*	0.172*
Professorship 10^{th} year post-Ph.D.	0.046***	0.030***
In academia 10^{th} year post-Ph.D.	0.413***	0.480***
Not working 10^{th} year post-Ph.D.	0.016***	0.084***
Years experience since Ph.D. as of 2013	21.884***	21.047***
Cumulative publications as of 2003	5.199***	4.563***
Cumulative publications as of 2008	5.717***	4.860***
Sample size	4,682	1,802

Notes: Young children means children below 12. Some of the tenure related variables have a specific year attached to it, because they are included in the survey only for that specific year. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.2 Average Characteristics by Gender, Field of Study

Table 3 presents the average characteristics by both gender and fields of study during doctorate education. I include five distinct STEM fields, which are Economics, Biological Sciences, Engineering, Physics, and Math. I put Physics and Math together because both fields are relatively similar and the sample size of women is relative small separately.

Across all fields, women on average take longer to receive doctorate degree and thus have less professional experience. Women are also less likely to be married than their male counterparts. On average, women are less likely to have young children or children in general in the household than men. The difference of children presence is statistically significant at 1% across all fields except for Economics.

As for tenure and related variables, interestingly, the field of Economics is significantly distinct from other academic fields: Economics has the widest tenure status gap and the largest associate professorship difference than other fields in the sample. Moreover, Economics and Engineering has the widest employment gap: women are much more likely to leave the workforce than their male counterparts. Different from the overall average characteristics, males are more likely to stay in academia than females in Economics. On the contrary, women are significantly more likely to stay in academia in Physics and Math. In general, Table 3 shows very similar trends compared to Table 2, but some variation across different fields.

Table 3: Average Characteristics by Gender and Field

	Economics		Biological Sciences		Engineering		Physics and Math	
Control variables	Males	Females	Males	Females	Males	Females	Males	Females
Age completing Ph.D. degree	31.53	31.94	31.27	31.42	31.27**	30.55**	30.80***	32.42***
Racial minority = 1	0.14	0.11	0.10	0.12	0.09	0.12	0.09**	0.14**
Foreign born = 1	0.28	0.34	0.18	0.19	0.41	0.38	0.33***	0.42***
<u>Variables measured 10 years post-Ph.D.</u>								
Proportion married	0.83**	0.73**	0.85***	0.74***	0.85**	0.79**	0.81***	0.74***
Young children	0.57	0.59	0.62***	0.55***	0.64	0.63	0.59***	0.44***
No. children = 0	0.34	0.36	0.30***	0.39***	0.27*	0.32*	0.33***	0.46***
No. children >= 2	0.51	0.42	0.51***	0.42***	0.55*	0.49*	0.46***	0.36***
No. children	1.36	1.20	1.39***	1.15***	1.51***	1.28***	1.30***	0.95***
Proportion research	0.43	0.46	0.64***	0.54***	0.55**	0.47**	0.48***	0.37***
Proportion teaching	0.35	0.34	0.14**	0.18**	0.16	0.21	0.25***	0.40***
Proportion management	0.13*	0.07*	0.10	0.10	0.15	0.14	0.08	0.07
Government support	0.17	0.27	0.42	0.42	0.33	0.30	0.39	0.36
<u>Tenure and related variables</u>								
Tenured 10^{th} year post-Ph.D.	0.86**	0.68**	0.36*	0.30*	0.72	0.71	0.70**	0.79**
Tenured as of 2010	0.96	0.86	0.71***	0.58***	0.87	0.79	0.88	0.87
Assistant professorship 10^{th} year post-Ph.D.	0.05**	0.12**	0.22	0.22	0.04	0.06	0.08	0.09
Associate professorship 10^{th} year post-Ph.D.	0.36***	0.20***	0.18***	0.14***	0.15	0.14	0.23**	0.30**
Professorship 10^{th} year post-Ph.D.	0.12**	0.05**	0.03***	0.01***	0.04	0.04	0.06	0.07
In academia 10^{th} year post-Ph.D.	0.58***	0.42***	0.53	0.51	0.27*	0.32*	0.46***	0.54***
Not working 10^{th} year post-Ph.D.	0.004***	0.088***	0.017***	0.084***	0.020***	0.087***	0.013***	0.079***
Years experience since Ph.D. as of 2013	22.36	22.07	22.24***	21.32***	21.55***	19.93***	21.84***	20.77***
Cumulative publications as of 2003	4.50**	3.10**	7.23***	5.21***	3.49	3.20	5.45**	4.25**
Cumulative publications as of 2008	4.90*	3.41*	8.20***	5.67***	4.06	3.55	5.38**	4.08**
Sample size	285	122	1,455	1,060	1,781	295	1,161	325

Notes: This sample excluded all missing variables. Young children is children below 12. Some of the variables have a specific year attached to it, because they are included in the survey for that specific year. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5 Methodology

I use linear probability models to estimate the probability of working in academia, and working in academia with and without tenured. The dependent variables of interests are working in academia indicator, working in academia and tenured indicator, and working in academia and not tenured indicator. The independent variables are gender, field indicators, gender and field interactions, marriage indicators, gender and marriage indicators. I also control for age receiving doctorate degree, racial minority indicator, foreign birth indicator, years of experience, children living in households, governmental support, and job responsibilities.

For my linear probability model, all time variant variables are measured the 10^{th} year post Ph.D. For example, working in academia indicator is the working status at the 10^{th} year post Ph.D. of individual i. Thus, my equation for the linear probability model is:

$$Academia_i = Female_i + Field_i + Female_i \times Field_i + Marriage_i + Female_i \times Marriage_i + Controls_i + \varepsilon_i \quad (1)$$

$Academia_i$ is a dummy variable indicating if an individual is working in academia (1 = work in academia, 0 = not work in academia) 10^{th} year post Ph.D.. $Female_i$ is 1 when the individual is female, 0 when the individual is male. $Field_i$ represents the specific STEM field in which the individual has received doctoral degree. $Female_i \times Field_i$ is the interaction between gender and field, which can be used to see the gender gap in each specific STEM field. For colinarity, I omitted the field of Biological Sciences. $Marriage_i$ is a dummy variable represents the marriage status of the individual 10^{th} year post Ph.D.. $Female_i \times Marriage_i$ is the interaction between gender and marriage status.

5.1 Robustness Check

For robustness check, I break down the sample by field of study and run linear probability models with the same dependent variables. The independent variables are the same except for the field-dependent variables.

With such analysis, I can see if the effects of gender and presence of children are different for individuals from different fields.

6 Results and Discussion

6.1 Tenure Status, Unemployment, and Working in Academia

Table 4 shows the probability estimates of working in academia, with a tenure, and without a tenure with a linear probability regressions. Notably, being in the field of Economics can increase the likelihood of working in academia and receiving a tenure by almost 30%, yet this effect is negative for women: being a female decreases the probability of receiving tenure by almost 14% – quite a large effect since probability estimates range from 0 to 1. In addition, the effect of being a female is the opposite in the other fields: being a women would increase the probability of staying in academia and getting a tenure for Engineering and Physics and Math. Specifically, women in Physics and Math are almost 10% more likely to staying in academia and 14% more likely to receive tenure. This gender premium is smaller yet still statistically significant for women in Engineering. Thus, the tenure gap is much larger in the field of Economics than the other STEM fields.

Although not statistically significant, Table 4 column (3) suggests that being married would increase the probability of working in academia by around 2%, but this effect will be negative if the individual is a female. Similarly, column (6) suggests that being a female and married would decrease the probability of receiving tenure by about 3%, while the effect is positive for males. Since the signs and magnitude are similar across the regressions, we can safely conclude that being a female would decrease the chance of getting tenured, but increase the chance of working in academia. What's worse, women are more likely to leave the workforce than their male counterparts: women are almost 8% more likely to leave the workforce. Interestingly, if an individual receives doctoral degree in Economics, he or she is 2% more likely to stay in the work force than other STEM fields, and this effect is statistically significant. However, this effect become negative for women in Economics. The effect of being a female is similar for getting tenure or staying in academia.

In short, being a female would decrease the probability of receiving tenure, but increase the probability of staying in the academia. In addition, being married would further decrease women's chance of receiving tenure and staying in academia. Compared to men, being married would impose significant disadvantages to females, because they traditionally share household chores and responsibilities than their male counterparts.

Table 4: Linear Probability Estimates of Staying in Academia, Tenure Status, and Working Status 10 Years Post-Ph.D.

	Working in Academia			Working in Academia & Tenured			Not Working		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Female	0.066***	-0.014	0.015	-0.023**	-0.040***	-0.033	0.068***	0.067***	0.078***
	(0.014)	(0.021)	(0.042)	(0.011)	(0.014)	(0.033)	(0.007)	(0.009)	(0.019)
Economics		0.050	0.081**		0.285***	0.292***		-0.013**	-0.019***
		(0.033)	(0.032)		(0.032)	(0.032)		(0.005)	(0.006)
Engineering		-0.256***	-0.235***		0.014	0.025*		0.003	0.001
		(0.017)	(0.016)		(0.013)	(0.013)		(0.005)	(0.005)
Physics & Math		-0.068***	-0.084***		0.111***	0.099***		-0.004	-0.003
		(0.020)	(0.019)		(0.016)	(0.016)		(0.005)	(0.005)
Female $\times$ Economics		-0.138**	-0.155***		-0.133**	-0.139***		0.018	0.017
		(0.059)	(0.057)		(0.053)	(0.052)		(0.029)	(0.028)
Female $\times$ Engineering		0.064*	0.072**		0.050*	0.059**		0	-0.003
		(0.036)	(0.034)		(0.028)	(0.027)		(0.019)	(0.019)
Female $\times$ Physics & Math		0.099***	0.098***		0.144***	0.142***		-0.001	0.002
		(0.037)	(0.037)		(0.033)	(0.033)		(0.018)	(0.018)
Marriage			0.016			0.028			-0.004
			(0.023)			(0.019)			(0.007)
Female $\times$ Marriage			-0.015			-0.025			0.021
			(0.038)			(0.030)			(0.016)
Constant	0.413***	0.526***	0.278***	0.203***	0.154***	-0.111**	0.413***	0.017***	-0.107***
	(0.007)	(0.013)	(0.067)	(0.006)	(0.010)	(0.055)	(0.007)	(0.003)	(0.030)
Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
Observations	6,147	6,147	6,147	6,147	6,147	6,147	6,147	6,147	6,147
R-squared	0.004	0.052	0.159	0.001	0.043	0.103	0.016	0.028	0.046

Robust standard errors in parentheses .

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

6.2 Working in Academia by Field

Table 5 conducts linear probability estimates of staying in academia and getting tenured by different field of study. This table reveals that compared to other STEM fields, the gender gap in continuing the academic career is most significant in Economics: being a female with young children living in the households would decrease the probability of receiving tenure by around 20%; such effect is merely less than 6% for other STEM fields. In addition, marriage for females decreases the probability of receiving tenure by 15% in Economics, in compared to a positive effect of 16% for their male counterparts. Interestingly, having a young children have a positive effect of 6% in tenure status for Biological Science, which is the field with the largest gender gap of 4%. As evident from Table 5, young children seems to have far more significant negative effect for females in Economics than other STEM field, so the next section will investigate possible explanations.

Table 5: Linear Probability Estimates of Staying in Academia and Tenured by Field of Study

Field of Study	(1) Economics	(2) Engineering	(3) Physics & Math	(4) Biological Science
Female	0.078	0.086	0.135	-0.036
	(0.115)	(0.059)	(0.061)	(0.103)
Young children	-0.099	0.005	-0.001	0.056*
	(0.112)	(0.052)	(0.049)	(0.030)
Female × Young children	-0.204*	-0.013	-0.058	-0.045
	(0.077)	(0.0417)	(0.069)	(0.031)
Marriage	0.162*	0.008	0.048	-0.014
	(0.090)	(0.031)	(0.069)	(0.031)
Female × Marriage	-0.152	-0.075	-0.001	0.026
	(0.134)	(0.032)	(0.069)	(0.041)
Constant	0.518**	0.119	0.111	-0.003
	(0.244)	(0.085)	(0.221)	(0.081)
Controls	YES	YES	YES	YES
Observations	375	1,968	1,403	2,401
R-squared	0.075	0.060	0.020	0.026

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

6.3 Employment Sectors

Table 6 conducts linear probability estimates of employment sectors for female economists, economists, and females. The sample includes people who have been on tenure track after receiving doctorate degrees, so they should prefer a career in academia than other sectors. This table reveals that compared to other STEM fields, female economists are 14% more likely to work in governmental organizations and 22% less likely to work in a four-year college. In contrast, male economists are 17% more likely to stay in academia than their female counterparts. Notably, both male and female economists are more than 15% less likely to work in the industry. Such results suggest that relative to other STEM fields, women in economics are more likely to work in the government as an alternative to academia. Nevertheless, with this table alone, I cannot distinguish whether women are ”pulled” out or ”pushed” out of the academic ladder.

It is perplexing to judge whether the role of governmental jobs is positive or negative for female economists. On the one hand, governmental jobs could provide female economists an adequate alternative to academia, so women in economics can have more options than women in other STEM fields as they fall off the academic ladder. On the other hand, sufficient demand in governmental jobs attracts women with sizeable income and maternal support and ultimately leads to a wider gender gap in economics relative to other STEM fields.

Table 6: Linear Probability Estimates of Employment Sectors

VARIABLES	(1) 4-Yr College	(2) 2-Yr College	(3) Industry	(4) Government	(5) Not Working
Econ × Female	-0.224***	0.001	0.068	0.139***	0.016
	(0.057)	(0.017)	(0.049)	(0.046)	(0.027)
Economics	0.170***	-0.008	-0.188***	0.039*	-0.013***
	(0.031)	(0.008)	(0.029)	(0.021)	(0.004)
Female	0.072***	0.010*	-0.150***	0.002	0.067***
	(0.015)	(0.005)	(0.014)	(0.008)	(0.007)
Constant	0.299***	-0.068***	0.827***	0.001**	-0.059**
	(0.063)	(0.026)	(0.061)	(0.038)	(0.028)
Controls	YES	YES	YES	YES	YES
Observations	6,147	6,147	6,147	6,147	6,147
R-squared	0.020	0.009	0.052	0.019	0.031

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: The sample includes people who indicate their employment status in the survey 10th year post Ph.D. Standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

7 Conclusion

This paper compares the gender promotion gaps in five different STEM fields and finds that economics has the largest gender gap, though it is not the most math-intensive subject. Roughly two-thirds of the "missing female economists" in academia shift to the government sector, with the remainder moving to industry. On the positive side, the demand for economists in the government offers female economists a prominent alternative as they fall off the academic ladder. Nevertheless, from a cynical perspective, female economists' preference in government sectors is too common to be random or personal; the larger gender promotion gap in economics than other STEM fields needs a closer and deeper examination.

An analysis at the quantitative level with linear probability estimates provides an incomplete picture of the larger gender gap in economics than other STEM fields. However, the majority of female economists moving from academia to government sectors suggests a need for re-examination in economic academia and exploration for possible improvement.

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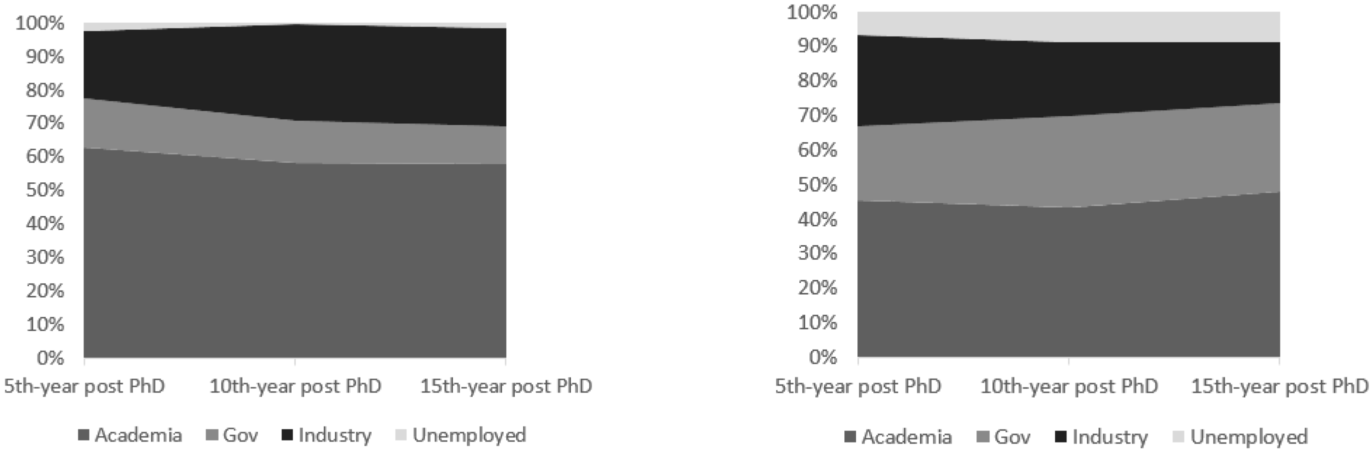
Appendices

A Additional Tables

B Additional Figures

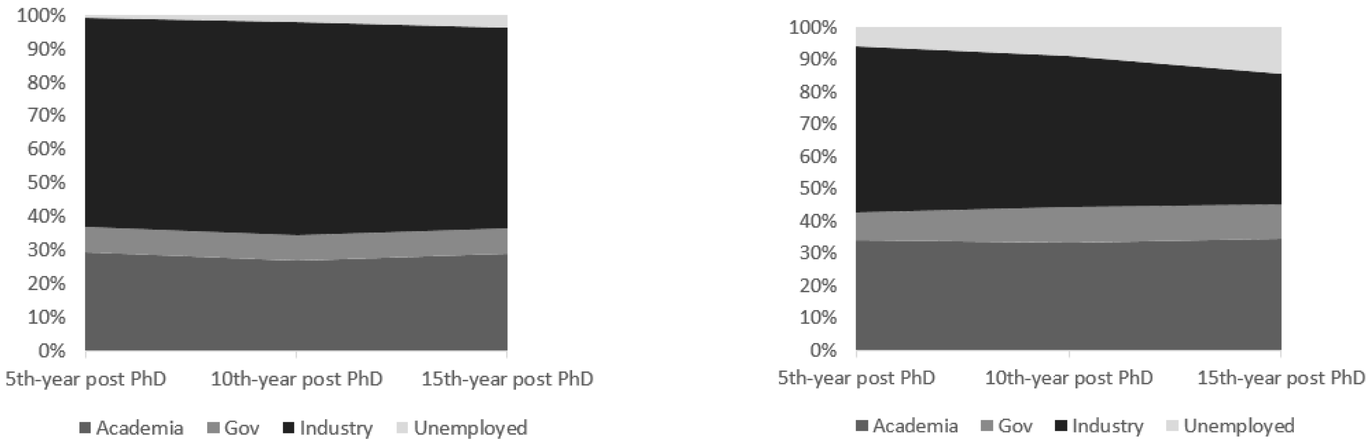
Figure B1: Distribution of Employer Sector for Female and Males in Economics



(a) Males in Economics

(b) Females in Economics

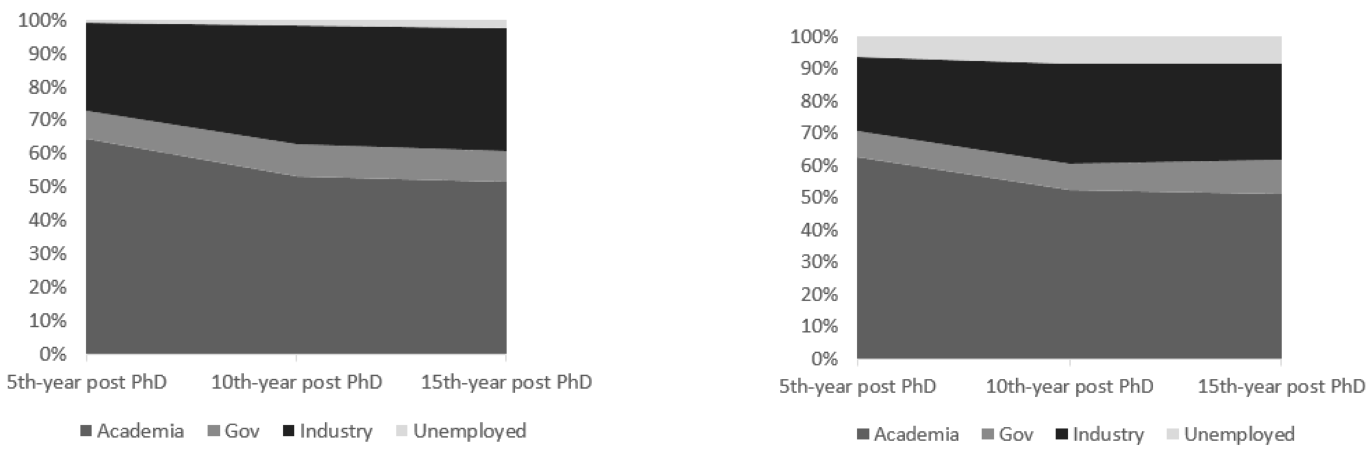
Figure B2: Distribution of Employer Sector for Female and Males in Engineering



(a) Males in Engineering

(b) Females in Engineering

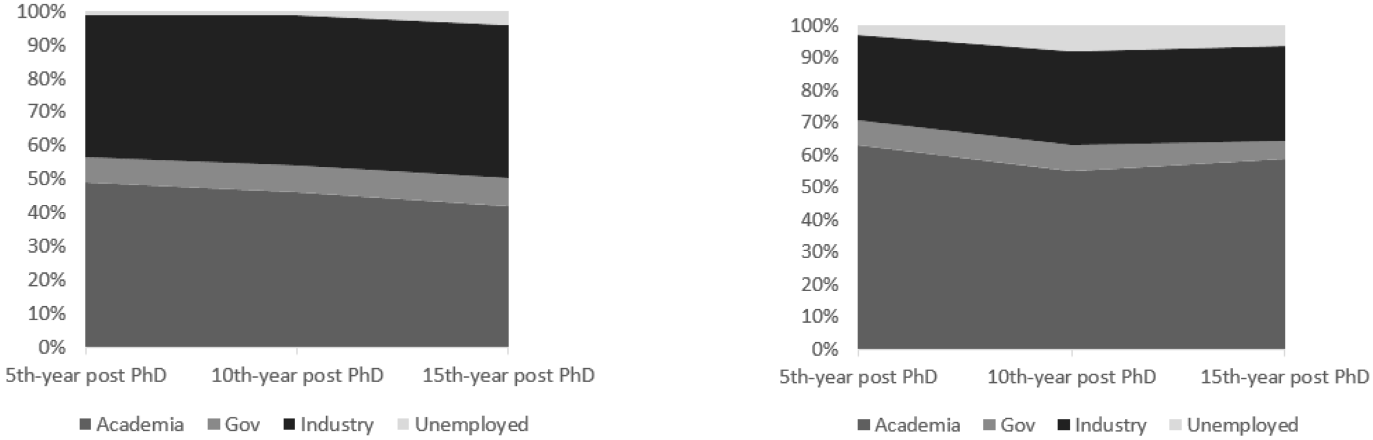
Figure B3: Distribution of Employer Sector for Female and Males in Biological Sciences



(a) Males in Biological Sciences

(b) Females in Biological Sciences

Figure B4: Distribution of Employer Sector for Female and Males in Physics and Math

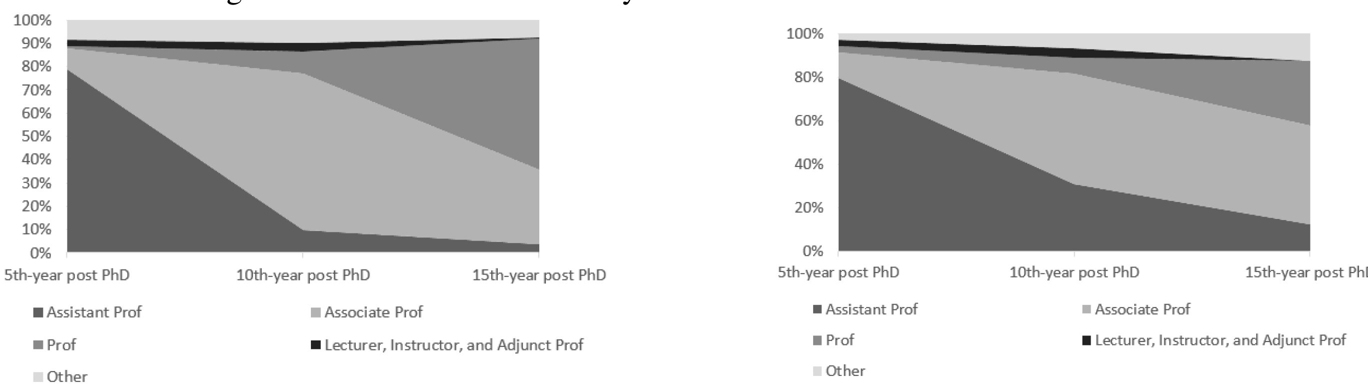


(a) Males in Physics and Math

(b) Females in Physics and Math

Notes: This figure illustrates the changes of distribution of females and males by four STEM Field over time.

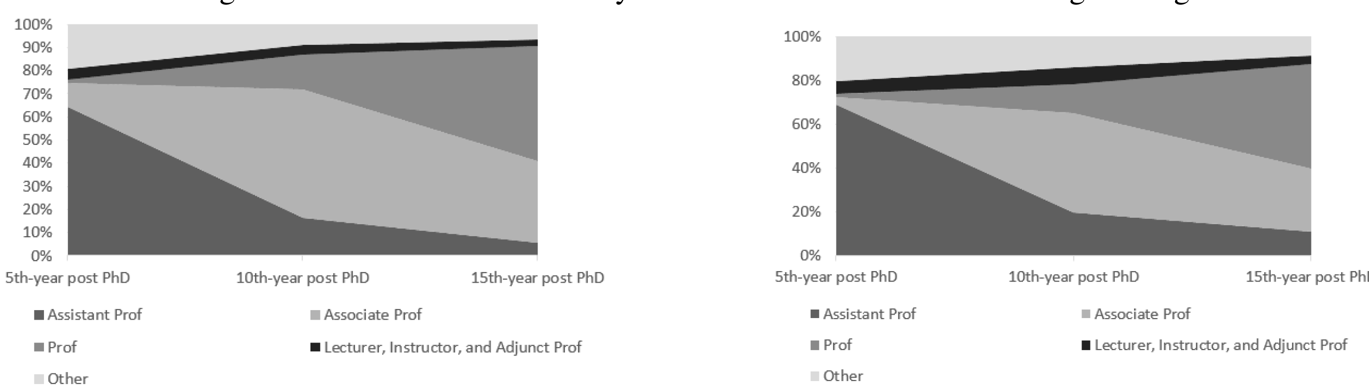
Figure B5: Distribution of Faculty Rank for Female and Males in Economics



(a) Males in Economics

(b) Females in Economics

Figure B6: Distribution of Faculty Rank for Female and Males in Engineering

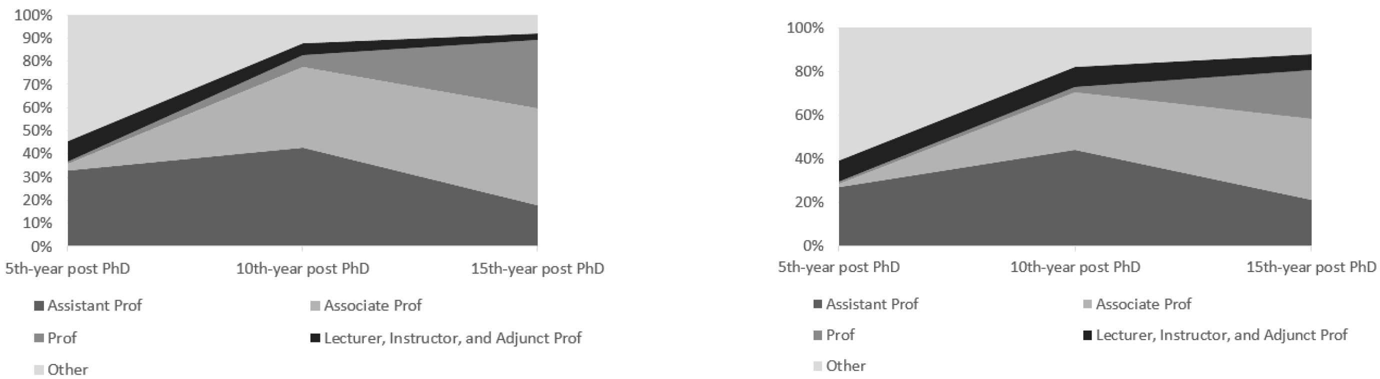


(a) Males in Engineering

(b) Females in Engineering

Notes: This figure illustrates the changes of faculty rank for females and males by four STEM Field over time.

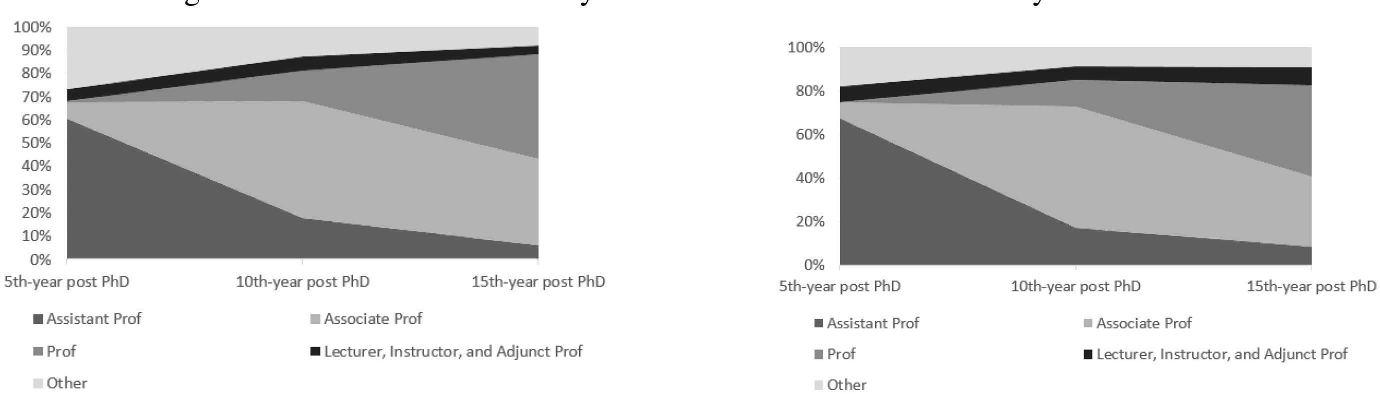
Figure B7: Distribution of Faculty Rank for Female and Males in Biological Sciences



(a) Males in Biological Sciences

(b) Females in Biological Sciences

Figure B8: Distribution of Faculty Rank for Female and Males in Physics and Math



(a) Males in Physics and Math

(b) Females in Physics and Math