Theory at the Meso-level:

Women's (Interdisciplinary) Work in Life Science Organizations

Laurel Smith-Doerr

Boston University
National Science Foundation

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Theories for understanding the gender gap in science

- *Micro-level*
  - social psychological studies of cognitive bias
  - Individual level studies of career attainment—socialization, work/family roles, discrimination
- *Macro-level*—nation-states, patriarchal world system
- ✓ *Meso-level*: Organizational level studies
  - Most often focus exclusively on academic settings
  - ✓ My focus—looking at life science careers across academic and industry contexts
  - ✓ Interdisciplinary research=group-based

Network v. hierarchical organizations

- Network organizations:
  - Indefinite and sequential interaction structure, norms govern relations, partners pool resources, expectations foster collaboration but are not rule bound, unlike hierarchy in flows of non-redundant “freer” info.
  - Life sciences example: biotechnology firms conducting dedicated research in human therapeutics
  - Interdisciplinarity: interdisciplinary project teams fundamental feature of network orgs
- Hierarchies:
  - Employment in formal authority structure patterns interaction, rules govern relations, resources (including information) distributed according to rank, mass production of reliable products of a given quality (Powell 1990).
  - Life sciences examples: multinational pharmaceutical corporations, universities
  - Interdisciplinarity: little contact outside of departmental “silos”

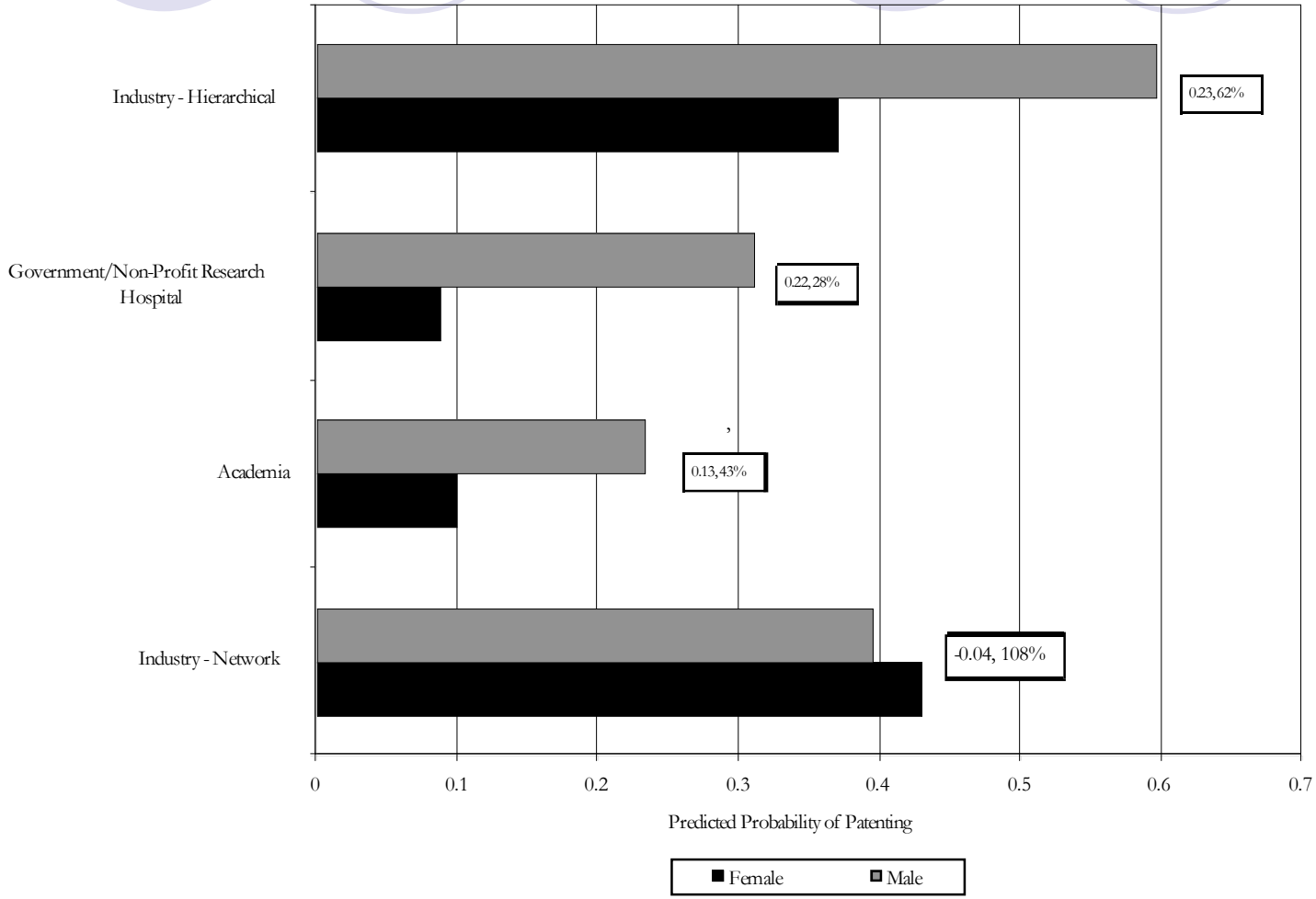
Interdisciplinary contexts benefit women

Likelihood of life scientists moving into supervisory positions, by gender and employment setting

	Biotechnology firms	Hierarchies
Women	Compared to women in hierarchies, 7.9 times more likely	Compared to men in hierarchies, 60% decrease in odds
Men	Compared to men in hierarchies, no difference	Compared to men in biotech, no difference

Source: Smith-Doerr (2004, *Women's Work*, table 5.4), all else being equal based on logistic regression models

Figure 1. Probabilities of Patenting, by Gender and Sector



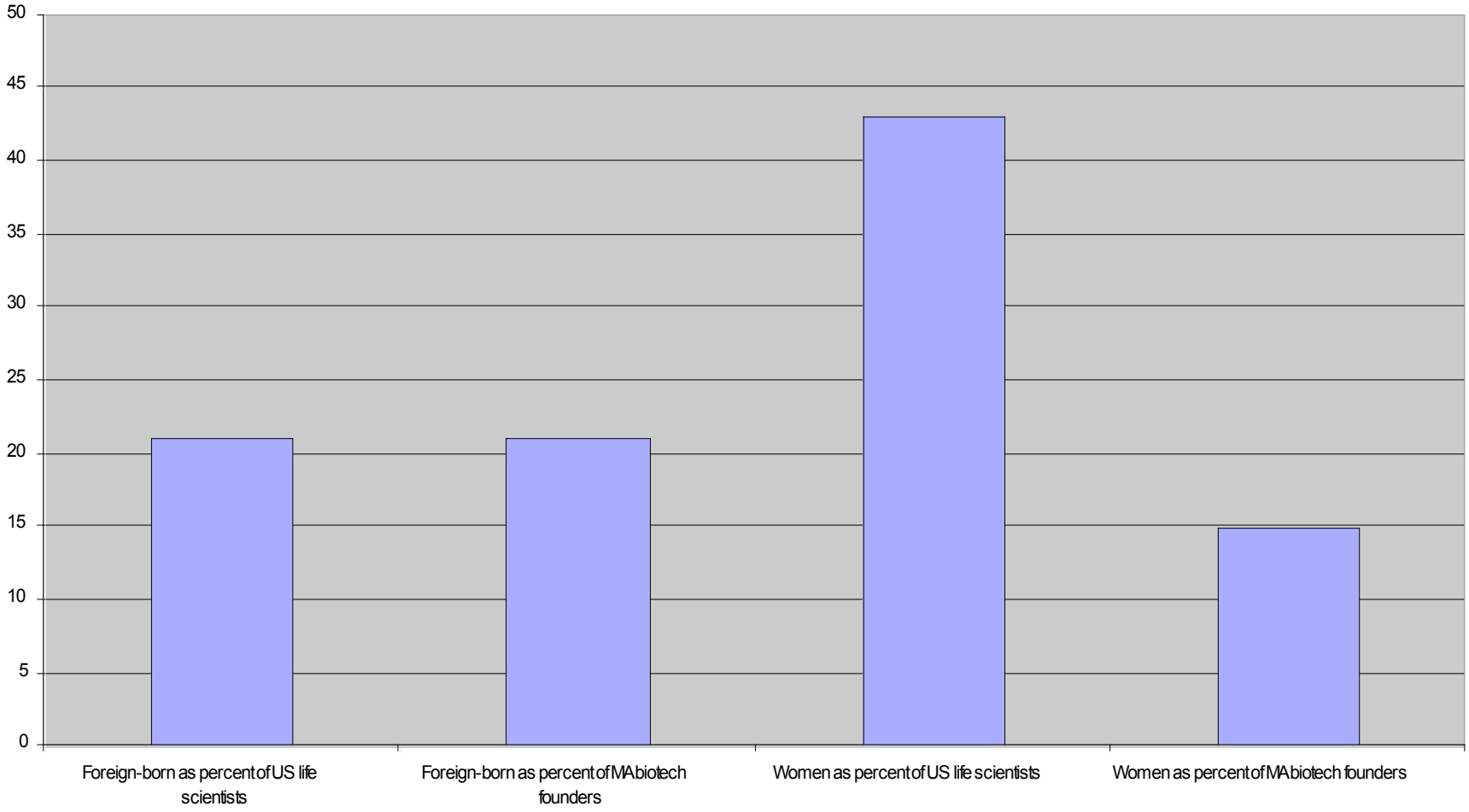
Note: Numbers in boxes refer to the difference in probabilities between men and women (M-F), and the F/M predicted probability ratio (multiplied by 100).
[a]All other variables are held at mean. Source: Whittington and Smith-Doerr (forthcoming). N=961.

Why greater equity in biotech firms?

Clues from interviews (Smith-Doerr 2004, N=47).

- 1. Flexibility in collaboration
  - "the university department under [Chairman] was an autocracy…could do science there [at biotech firm]—working with who they wanted to rather than dealing with [Chairman]."
- 2. Transparency
  - "we are not compartmentalized—and get to work with many good scientists both here and outside the firm. And we choose who to work with based on non-financial considerations, like how good they are in their field."
- 3. Collective rewards
  - "at [prestigious academic institute], people collaborated somewhat, on the fringes of their work, but still had their main turf which they guarded carefully."

Inequity in biotech: entrepreneurship gap by gender (but not by foreign-birth)



Sources: CPST; Monti, Smith-Doerr & McQuaid (2007); NSF

Some outcomes of interdisciplinary research in the biotech industry:

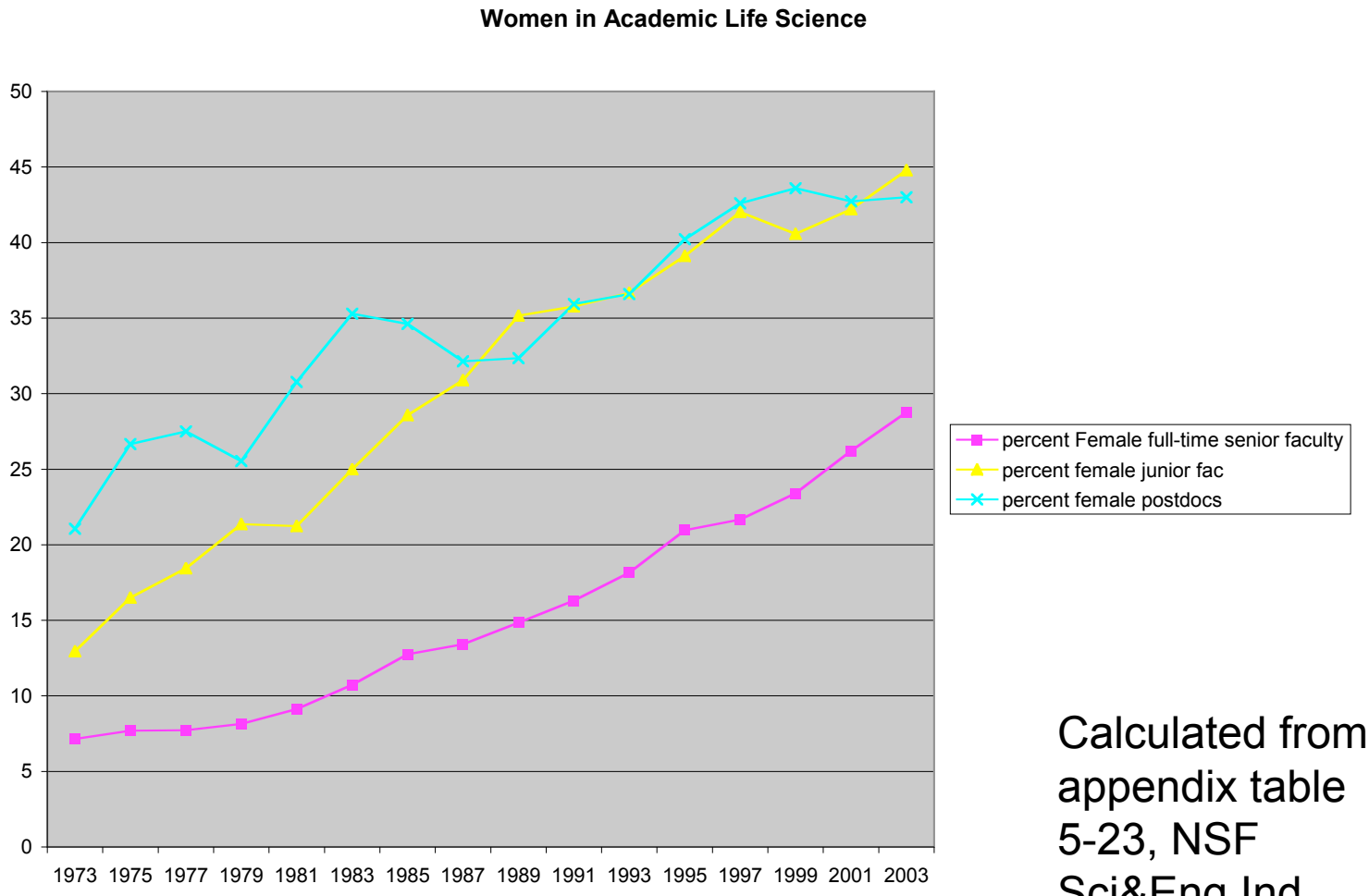
- Innovation
- Equity
  - Less ‘horizontal segregation’ across an industry may lead to less ‘vertical segregation’ by gender
  - Issues for diversity by nationality/ethnicity probably differ from gender integration
    - Limits to women’s entrepreneurship
- Risk

Concluding thoughts

- Importance of investigating interdisciplinarity in a variety of employment contexts.
- When do rules help? When do bureaucratic procedures help hide bias or stifle creativity?
- Can the university change toward flexibility, transparency, collective rewards?

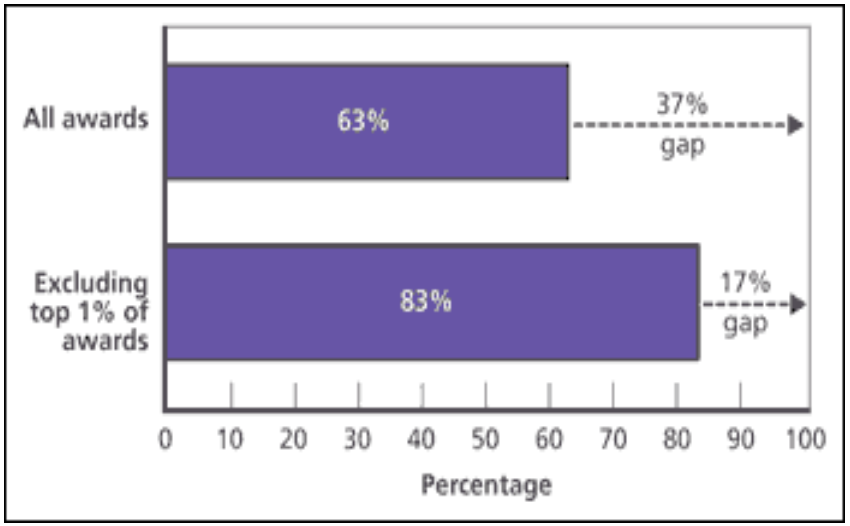
Additional tables, figures, etc.

Percent female in academic life science positions (NSF Science & Engineering Indicators 2006)



Calculated from appendix table 5-23, NSF Sci&Eng Ind 2006

Women scientists receive 63 cents for every $1 men get from NIH



- In FY 2001-3, controlling for age, education, institutional and grant factors.
- Source: RAND study 2005, Hosek et al., *Gender Differences in Major Federal External Grant Programs*. (http://www.rand.org/publications/RB/RB9147/)

Data sources

- US life scientists' holding leadership roles in different organizational settings by gender: Smith-Doerr (2004).
- USPTO patenting by organizational setting and gender: Bunker Whittington and Smith-Doerr (in progress).
- Massachusetts biotechnology firm founders by gender and immigrant status: Monti, Smith-Doerr and McQuaid (in progress).

dependent variable—leadership role

TABLE 2

PhD Positions and Supervisory Level

Academic Position	*Industry Position*	*Supervisory Level*
Student in another discipline, RA		0
	Assistant, technician	0
Postdoctoral fellow		0
	Scientist	0
	Team director	1
Assistant professor		1
Associate professor		1
	Department/section head	1
Full professor		1
	Upper research administration	1
Dean/administration		1
	Board of directors, CEO	1

Source: Smith-Doerr (2004, *Soc Perspectives*)

TABLE 4

Effects of Gender on Mobility into Leadership Positions by Form of Economic Organization: Results of Logistic Regression Analyses

	(1)			(2)		
Variable	*Logistic Coeff. (S.E.)*	*Sig. Level*	*Percent Change in Odds*	*Logistic Coeff. (S.E.)*	*Sig. Level*	*Percent Change in Odds*
Constant	−2.1387 (.1447)			−2.7914 (.4879)		
Education rank 11–50[a]	−.2988 (.1296)	.0212	26 decrease	.3991 (.5048)	.4292	n.s.
Education rank below 50[a]	−.1064 (.1370)	.4375	n.s.	.6624 (.5740)	.2485	n.s.
Gender (F)	−.3837 (.1225)	.0017	32 decrease	−.9178 (.4506)	.0417	60 decrease
Years since PhD	.2340 (.0159)	.0001	26 increase	.2504 (.0165)	.0001	28 increase
Biotech affiliation				.6600 (.4999)	.1867	n.s.
Educ rank 11–50[a] × biotech				−.7912 (.5221)	.1297	n.s.
Educ rank <50[a] × biotech				−.9134 (.5902)	.1217	n.s.
Gender (F) × biotech				1.4087 (.4688)	.0027	Significant increase[b]
−2 Log-likelihood	2194.104			2151.987		
Chi-square	299.864	.0001		341.982	.0001	
Degrees of freedom	4			8		

$N = 2{,}062$

[a] The relevant comparison is to education in PhD program ranked in the top ten.

[b] See text for discussion of percent change in odds in this interaction coefficient.

Source: Smith-Doerr (2004, *Soc Persp*)

Table 5.4 Likelihood of male and female scientists moving into supervisory positions, in biotechnology firms compared to hierarchical settings

Gender	Change in odds of supervising in biotech	Change in odds of supervising in hierarchy
Male	No difference	No difference
Female	7.9 times more likely	60% decrease in odds

Source: All else being equal, based on logistic regression results reported in Appendix,

Source: Smith-Doerr (2004, *Women's Work*)

TABLE 1

Description of Variables Used in Logistic Regression Analyses

Variable	*Minimum-Maximum Value*	*Percent in Category or Mean (S.D.)*
Gender	0 = male	71.7
	1 = female	28.3
Rank of PhD education	1 = 50–200	33.3
	2 = 11–50	43.9
	3 = 1–10	22.9
Years since PhD	0–39 years	5.30 (4.50)
Biotech affiliation	0 = nonbiotech	93.7
	1 = biotech	6.3
Period of entry into biotech industry	0 = after 1988	61.6
	1 = to 1988	38.4
Supervisory position	0 = nonleader	71.3
	1 = leader	28.7

N = 2,214.

Source: Smith-Doerr 2004, *Sociological Perspectives*

Table 5.2 Characteristics of life scientists in the statistical sample, by gender

Characteristic	Category	Male % (or mean)	Female % (or mean)
Prestige ranking of PhD program	Lower ranked (50–200)	31.9	25.7
	Middle ranked (11–50)	37.6	42.3
	Top-ten programs	30.5	31.9
Years since PhD		4.54 (st. dev. = 4.02)	3.97 (st. dev. = 3.59)
Biotech employment	Not employed in biotech	91.9	91.7
	Employed in biotech	8.1	8.3
Supervisory position	Nonleadership position	68.4	77.2
	Has a supervisory role	31.6	22.8

Source: Smith-Doerr (2004, *Women's Work*)

Table 5.3 Likelihood of scientists moving into supervisory positions, across all organizational settings

Characteristic	% change in odds of supervising
From middle ranked university, compared to top ten	26 decrease
From lower ranked university, compared to top ten	No difference
Female, compared to male	32 decrease
Number of years since received PhD	26 increase per year

Source: All else being equal, based on logistic regression results reported in Appendix,

Source: Smith-Doerr (2004, *Women's Work*)

Table 1. Means and Standard Deviations for Inventor characteristics used in the analysis of engagement and propensity to patent.

Variables	Involved in Patenting Activity (N = 225)	Not Involved in Patenting Activity (N = 736)
Explanatory Variables		
Gender		
Female	.18	.36
Male[a]	.82	.64
*Female * Organizational Context*		
Female * Academia[a]	.09	.27
Female * Industry (all)	.08	.03
Female * Hierarchical	.03	.01
Female * Network	.05	.02
Female * Gov/NPRH	.02	.06
Control Variables		
Organizational Context		
Academia[a]	.54	.75
Industry (all)	.28	.09
Industry, Hierarchical	.16	.04
Industry, Network	.12	.05
Gov/NPRH	.18	.16
Supervisory Position		
Yes	.34	.31
No[a]	.66	.69
PhD University Rank		
High[a]	.23	.18
Middle	.53	.52
Low	.24	.31
Foreign PhD University		
Yes	.14	.16
No[a]	.86	.84
Years Since PhD	16.2 (5.52)	14.4 (6.26)

Notes: Numbers in parentheses are standard deviations.
[a] Reference Category
[b] Statistics in this column only apply to those in category who have patented at least once

Source: Bunker Whittington & Smith-Doerr (in progress)

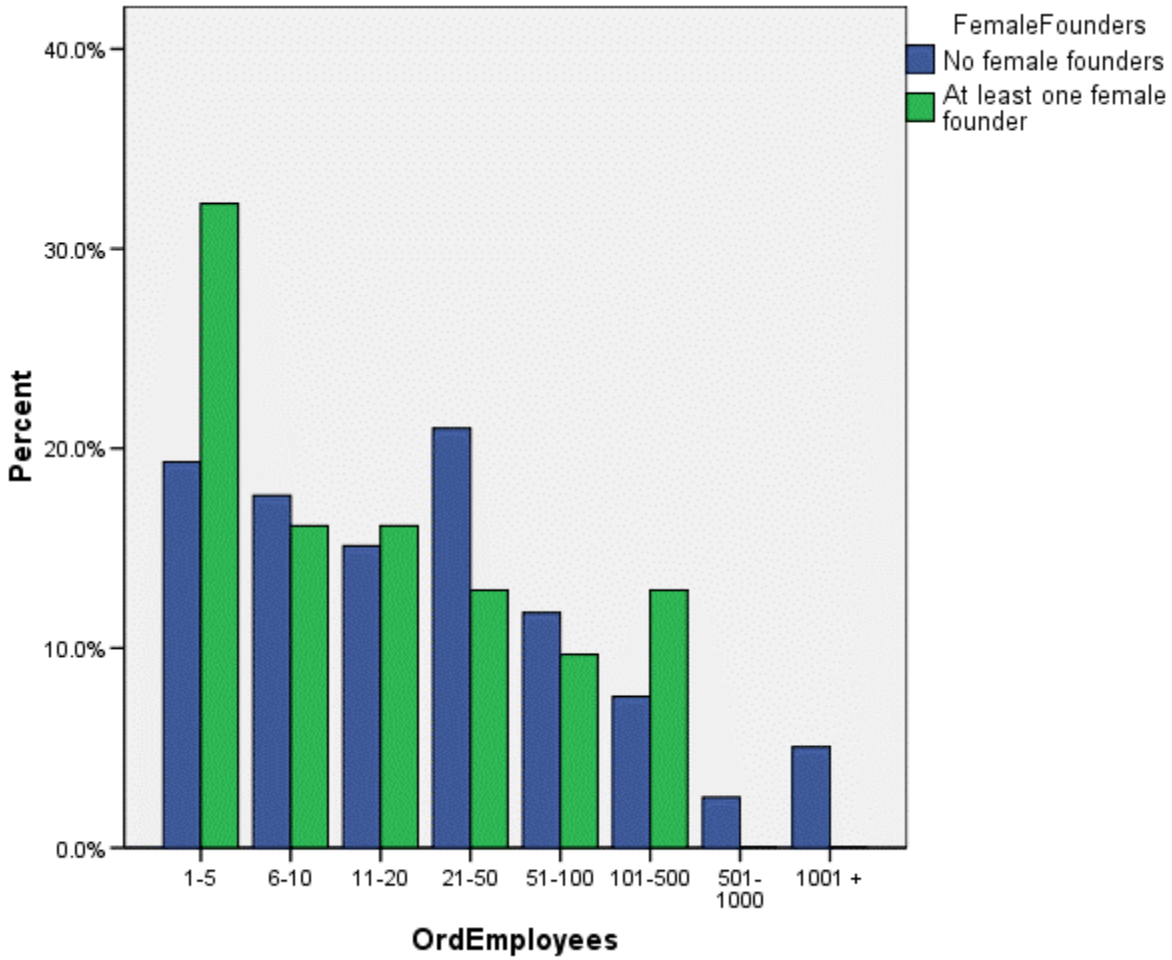
Table 2. Maximum Likelihood Estimates from Logit Models Predicting the Probability of Scientists patenting (N = 961).

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
PhD Univ Rank[a]						
Middle	-.489**	-.423**	-0.309	-0.285	-0.341	-0.326
Low	-.904***	-.808***	-0.684**	-0.665**	-0.706**	-0.685**
Foreign PhD University[a]	.142	.100	0.182	0.181	0.187	0.165
Years Since PhD	.055***	.053***	0.047***	0.047***	0.047***	0.047***
Supervisory Position[a]	-.092	-.164	0.047	0.044	0.046	0.063
Female[a]		-.903***	-0.936***	-1.014***	-0.918***	-1.010***
Organizational Setting[a]						
GOV/NPRH			0.309	0.394	0.308	0.396
Industry			1.399***	1.229***		
Industry-Hier.					1.599***	1.584***
Industry-Network					1.176***	0.763**
Female * Org. Setting						
Female * GOV/NPRH				-0.551		-0.551
Female * Industry				0.594		
Female * Ind. Hier						0.087
Female * Ind. Net.						1.156**
Constant	-1.481***	-1.24***	-1.610***	-1.605***	-1.592***	-1.585***
N	961	961	961	961	961	961
LR Chi-Square	24.86	50.08	93.18	96.40	94.53	100.12
Degrees of Freedom	5	6	8	10	9	12

[a] The omitted categories are "High" rank of PhD institution, Non-Foreign PhD University, Not a Supervisory Position, Male, and Academia, respectively.
* p<.1; ** p<.05; *** p<.01 (two-tailed)

Source: Bunker Whittington & Smith-Doerr (in progress)

MA biotech firms, by female founder and size



Some wider implications?

- For Theory: the organizational context is vital to understand
- For Methods: multi-level analysis is useful
- For Policy: Attempts at changing culture may be limited by inflexible structures