SECTION 4. ANALYSIS OF ACADEMIC RANK

Our analyses provide evidence that among scientists and engineers in academia, women are more likely to be employed in junior ranks and are less likely to hold the rank of full professor than are men. Differences in placement across academic ranks may be related to the differential influence of family characteristics on men and women. Married women who have older children under their care are more likely to be employed in junior ranks and are less likely to hold the rank of full professor than are similarly situated men.

Gender differences in academic ranks decline if we exclude nontenure-track positions from our analysis. This result is consistent with our earlier finding that after accounting for controls, women are less likely than men to be employed in tenure-track positions.

We have also looked at whether characteristics of the employer or the kind of work done affect estimates of gender differences in academic rank. Although these factors are both related to promotions to higher academic ranks, we do not find consistent evidence that they explain gender differences in career success.

PHASE I RANK ANALYSIS

Like our tenure analysis, the Phase I analysis of academic rank examines gender differences in career outcomes at specific points in individuals' postdoctoral career paths. Data on academic rank by sex and our interpretation of the results of our multivariate Phase I analysis of academic rank are presented below.

PHASE I PLACEMENT IN ACADEMIC RANKS BY SEX

Table 4-1 reports estimates of the proportion of doctorate recipients having either 14–15 or 20–21 years of postdoctoral experience who are employed full time in academia at the rank of assistant, associate, or full professor. Estimates were made from samples used in our Phase I analysis. We estimate, for example, that about 16.1 percent of doctorate recipients with 14 or 15 years of postdoctoral experience hold the rank of assistant professor or other junior rank. The comparable estimates by sex show about 14 percent of men and about 26 percent of women hold that rank. Once doctorate recipients attain 20 or 21 years of experience, we estimate that only about 9.8 percent remain at the assistant-professor rank. When sex is taken into account, however, we found that about 19.3 percent of women hold positions at junior ranks, more than double the percentage for men.

The estimates in table 4-1 show considerable differences by sex in relative composition of academic ranks. We emphasize that the figures in this table are simple sample-weighted population estimates and do not account for other factors that might affect academic rank. We show these estimates to provide a context for interpreting the results of the multivariate rank analyses, which follow.

TABLE 4-1. Phase I academic rank by years since doctorate and by sex

	Total		Male		Female	
Years since doctorate	Sample size	Fraction in rank	Sample size	Fraction in rank	Sample size	Fraction in rank
14 or 15	8823		5951		2872	
Assistant professor/other		0.161		0.141		0.257
Associate professor		0.389		0.377		0.452
Full professor		0.450		0.481		0.291
20 or 21	6533		4905		1628	
Assistant professor/other		0.098		0.087		0.193
Associate professor		0.200		0.192		0.266
Full professor		0.702		0.722		0.542

NOTE: Fractions are sample-weighted estimates of the proportion of doctorate recipients reporting full-time employment in each academic rank.

SOURCE: Survey of Doctorate Recipients, 1981–1997.

Phase I Multivariate Analysis of Academic Rank

Our Phase I multivariate rank analysis considered the likelihood that individual doctorate recipients have attained the rank of full professor, associate professor, or a junior rank. Although most individuals classified as holding a junior rank reported employment as assistant professor, some reported employment in other junior ranks, such as instructor or lecturer. In general, the junior-rank category includes doctorate recipients who did not report having attained the rank of either associate or full professor.

As noted in Section 2 of this report, we estimated multinomial logit models in our Phase I rank analysis. This technique allowed us to estimate the marginal relations between the female and control variables and the probability that individuals have attained any one of the three academic ranks defined above.[1]

The general specifications of the Phase I academic-rank models are similar to those of the Phase I tenure models. We estimated six different variants of the basic model. Each of the six models includes variables for human capital, personal characteristics, and family characteristics, and variables distinguishing survey waves as controls. Models 2, 4, and 6 also include as controls selection variables reflecting the primary work activity and characteristics of the employer. The samples we used to estimate Models 3 through 6 exclude doctorate recipients who reported that rank is not applicable for their positions.[2] The samples we used to estimate Models 5 and 6 exclude doctorate recipients who reported employment in nontenure-track positions. Finally, we estimated each of the six models twice, once without and once with the female-interaction variables.

The major findings of our Phase I multivariate analysis of gender differences in academic rank include the following:

- After accounting for controls, women employed full time in academia who have 14 or 15 years of postdoctoral experience are about 8 percentage points more likely than men to be employed in junior ranks. The estimate for women with 20 or 21 years of postdoctoral experience is similar.
- After accounting for controls, women employed full time in academia who have 14 or 15 years of postdoctoral experience are almost 14 percentage points less likely than men to be employed at the rank of full professor. The comparable estimate for women with 20 or 21 years of postdoctoral experience is similar.
- Our analysis suggests some of the gender differences in academic rank are related to differential influences of family characteristics.
- Gender differences in academic rank decline if doctorate recipients who reported employment in nontenure-track positions are excluded from the sample. This finding is consistent with our Phase I tenure analysis, which showed that women are more likely than men to be employed in nontenure-track positions.
- Estimates of gender differences in placements across academic ranks are relatively insensitive to the characteristics of the employer or to the primary work activity.

Table 4-2 reports estimates of the marginal relations between the female variables of interest and the probability of placement in different academic ranks for individuals with 14 or 15 years of postdoctoral experience. For example, the estimated marginal relation between the female variable and junior ranks for Model 1 is 0.085, meaning that after accounting for controls, women are 8.5 percentage points more likely than men to be employed in these ranks. The negative value of the comparable estimate for the full-professor rank means that after accounting for controls, women are 13.9 percentage points less likely than men to be employed as a full professor. About 45 percent of doctorate recipients with 14 or 15 years of experience are employed at the full-professor rank (table 4-1); thus, the gender difference of 13.9 percentage points is about 31 percent of the overall full-professor placement rate (i.e., 100 x 13.9/45.0).

The estimates in table 4-2 show a pattern in which women are more likely to be employed in ranks below the full professor. Excluding models I-I through I-6, which include the female-interaction variables, our estimates indicate that after accounting for controls, women are 4.8–8.5 percentage points more likely than men to be

[1] See Appendix A for a more detailed, technical description of the logit models.

[2] Models 1 and 2 include doctorate recipients who reported that rank is not applicable in their positions. These individuals are classified as holding junior ranks in these models.

TABLE 4-2. Marginal relations of female variables for Phase I rank models: 14 or 15 years since doctorate

Rank and model	Female	Female interactions		
		Married	Dependents (age <6)	Dependents (age 6 to 18)
Junior ranks				
1	0.085*	–	–	–
2	0.084*	–	–	–
3	0.085*	–	–	–
4	0.083*	–	–	–
5	0.049*	–	–	–
6	0.048*	–	–	–
I-1	0.021	0.062*	–0.027	0.036*
I-2	0.024	0.052*	–0.019	0.039*
I-3	0.026	0.051*	–0.021	0.035*
I-4	0.029	0.044*	–0.016	0.035*
I-5	0.022	0.024	–0.024	0.020*
I-6	0.021	0.021	–0.017	0.020*
Associate professor				
1	0.055*	–	–	–
2	0.051*	–	–	–
3	0.058*	–	–	–
4	0.055*	–	–	–
5	0.078*	–	–	–
6	0.073*	–	–	–
I-1	0.053*	0.010	0.010	–0.005
I-2	0.046*	0.015	0.011	–0.006
I-3	0.052*	0.016	0.006	–0.004
I-4	0.045	0.020	0.008	–0.004
I-5	0.054*	0.029	0.004	0.007
I-6	0.048	0.031	0.005	0.008
Full professor				
1	–0.139*	–	–	–
2	–0.135*	–	–	–
3	–0.143*	–	–	–
4	–0.137*	–	–	–
5	–0.127*	–	–	–
6	–0.121*	–	–	–
I-1	–0.073*	–0.071*	0.017	–0.031*
I-2	–0.070*	–0.067*	0.008	–0.032*
I-3	–0.079*	–0.067*	0.015	–0.031*
I-4	–0.074*	–0.064*	0.008	–0.032*
I-5	–0.076*	–0.054	0.020	–0.027
I-6	–0.069*	–0.052	0.012	–0.028

*Statistically significant at 95 percent confidence.

NOTES: Models 1, 3, and 5 exclude selection variables; Models 3 through 6 exclude Ph.D.s who reported rank was not applicable; Models 5 and 6 exclude Ph.D.s who reported nontenure-track positions. Models I-1 through I-6 include female-interaction variables. See Appendix C, tables C-41–52, for detailed estimates of complete models.

SOURCE: Survey of Doctorate Recipients, 1981–1997.

employed in junior ranks. In contrast, women are 12.1–13.9 percentage points less likely than their male counterparts to be employed at the full-professor rank.[3]

Table 4-3 reports estimates of the marginal relations of interest for individuals with 20 or 21 years of postdoctoral experience. These estimates can be interpreted similarly to those reported in table 4-2.

The estimated marginal relations in table 4-3 show that like women with less experience, women with 20 or 21 years of postdoctoral experience are also more likely to be employed in junior and associate ranks and less likely to hold the rank of full professor. Ignoring the models that include the female-interaction variables, these women are 4.2–8.9 percentage points more likely to be employed in junior ranks and 9.4–14.1 percentage points less likely to be employed at the full-professor rank than similarly situated men.

Results for Female-Interaction Variables

Models in tables 4-2 and 4-3 that include the female-interaction variables as controls are labeled with the prefix "I." These are the same interaction variables used earlier in our tenure analysis and include three variables reflecting family characteristics—marital status, the number of dependents under 6 years of age, and the number of dependents between ages 6 and 18. We included these variables to see if gender differences in the marginal relations of family characteristics affected estimates of gender differences in promotions to higher academic ranks.

The results in table 4-2 suggest links between women's chances for promotion to higher ranks and gender differences in the influence of family characteristics. In Model 1 for junior ranks, the estimated marginal relation for the female variable is 0.085 and is statistically significant. In comparison, the value for this variable in Model I-1 is 0.021 and is statistically insignificant. The value for the marital-status variable in Model I-1 is 0.062, meaning that after accounting for controls, a married woman is 6.2 percentage points more likely to be employed in junior ranks than a similarly situated married man. The estimated marginal relation for the "Dependents (age 6 to 18)" interaction variable is also

[3] The marginal relations for a given variable must sum to zero across all three ranks. Thus, if the female variable is positively related to chances for employment in both the junior and associate ranks, it must necessarily be negatively related to the likelihood of employment at the full-professor rank.

TABLE 4-3. Marginal relations of female variables for Phase I rank models 20 or 21 years since doctorate

Rank and model	Female	Female interactions: Married	Female interactions: Dependents (age <6)	Female interactions: Dependents (age 6 to 18)
Junior ranks				
1	0.089*	–	–	–
2	0.081*	–	–	–
3	0.076*	–	–	–
4	0.072*	–	–	–
5	0.044*	–	–	–
6	0.042*	–	–	–
I-1	0.047*	0.048*	0.002	0.010
I-2	0.049*	0.038*	0.004	0.008
I-3	0.045*	0.034*	0.004	0.008
I-4	0.046*	0.030*	0.003	0.006
I-5	0.027*	0.018	–0.023	0.008
I-6	0.027*	0.015	–0.021	0.007
Associate professor				
1	0.052*	–	–	–
2	0.051*	–	–	–
3	0.056*	–	–	–
4	0.054*	–	–	–
5	0.057*	–	–	–
6	0.053*	–	–	–
I-1	0.023	0.030	0.099	0.013
I-2	0.020	0.033	0.098	0.013
I-3	0.023	0.036	0.107	0.014
I-4	0.020	0.036	0.102	0.014
I-5	0.026	0.034	0.112	0.009
I-6	0.022	0.034	0.112	0.010
Full professor				
1	–0.141*	–	–	–
2	–0.132*	–	–	–
3	–0.131*	–	–	–
4	–0.126*	–	–	–
5	–0.101*	–	–	–
6	–0.094*	–	–	–
I-1	–0.070*	–0.078*	–0.101	–0.023
I-2	–0.069*	–0.070*	–0.093	–0.021
I-3	–0.068*	–0.069*	–0.111	–0.022
I-4	–0.066*	–0.066*	–0.106	–0.021
I-5	–0.053*	–0.052	–0.097	–0.017
I-6	–0.049*	–0.049	–0.092	–0.017

*Statistically significant at 95 percent confidence.

NOTES: Models 1, 3, and 5 exclude selection variables; Models 3 through 6 exclude Ph.D.s who reported rank was not applicable; Models 5 and 6 exclude Ph.D.s who reported nontenure-track positions. Models I-1 through I-6 include female-interaction variables. See Appendix C, tables C-53—64, for detailed estimates of complete models.

SOURCE: Survey of Doctorate Recipients, 1981–1997.

positive and significant, suggesting that women with older children are more likely than men with older children to be employed in junior ranks.[4]

The marginal relations for the full-professor rank in table 4-2 provide further evidence for gender differences in the influence of family characteristics on placements in academic ranks. The marginal relation for the female variable in Model 1 is –0.139, indicating that after accounting for controls, women are 13.9 percentage points less likely than men to be employed at the full-professor rank. The comparable estimate for Model I-1 is –0.073; thus, allowing for gender differences in the influence of family characteristics reduces the negative relation between the female variable and the full-professor rank by about 47 percent. The marginal relations for both the marital status and the older-dependent interaction variables are negative, suggesting that gender differences in the influence of these family characteristics reduce women's chances for promotion to full professor relative to similarly situated men.

Comparing the results for Models 2 through 4 with Models I-2 through I-4 in table 4-2 shows that differences in the influence of family characteristics on the careers of men and women appear to account for some of the gender differences in placements across academic ranks.[5] The estimated marginal relation between the female variable and the full-professor rank, however, is both negative and statistically significant even when the female-interaction variables are included as controls.

Table 4-3 provides evidence on the influence of gender differences in family characteristics on the careers of women with 20 or 21 years of postdoctoral experience. Estimated marginal relations between the female variable and the likelihood of employment in junior ranks are statistically significant in Models 1 through 4; however, allowing for gender differences in the influence of family characteristics reduces the marginal relations for the female variable by 36 to 47 percent. The influence of family characteristics also appears to be related to

[4] The marginal relation for dependents younger than age six in Model I-1 is negative and statistically insignificant. This finding is consistent with our earlier result for the Phase I tenure analysis. As we noted earlier, women with 14 or 15 years of postdoctoral experience who have young children are likely to have had children after tenure and promotion decisions occurred.

[5] The results for Models 5, 6, I-5, and I-6 are somewhat different. These models exclude doctorate recipients who reported employment in nontenure-track positions. See "Results for Nontenure-Track Positions," below.

women's chances for employment in the full-professor rank. For example, the marginal relation between the female variable and the full-professor rank is –0.141 for Model 1. The comparable estimate for Model I-1 is –0.070, about 50 percent of the Model 1 estimate. Results are similar for Models 2 through 4 and I-2 through I-4.

In table 4-3, for Models I-2 through I-4 the marginal relations between the female-interaction variables and the junior and associate ranks are all positive, and for the full-professor rank, they are all negative. This suggests that gender differences in the influence of family characteristics increase women's chances for employment in junior ranks and reduce their chances for employment at the full-professor rank. Only the marginal relations between the variable for marital status and the junior and full-professor ranks, however, are statistically significant. The lack of statistical significance for the dependents variables may be due to the fact that relatively few women have dependents (especially younger children) at home at this stage in their careers.[6] It is possible that the variable "married" in table 4-3 captures some of the cumulative effects of raising children on women's careers. This could occur if married women with 20 or 21 years of experience were more likely to have raised children earlier in their careers than were unmarried women with the same level of postdoctoral experience.

Results for Nontenure-Track Positions

Models 5 and 6 exclude observations on individuals who reported employment in nontenure-track positions. Excluding these positions tends to reduce women's relative representation in junior ranks. This phenomenon is shown in tables 4-2 and 4-3, where the estimates for the female variable for Models 5 and 6 are on average more than 40 percent less than those for the first four models.[7] These results are consistent with the results reported in Section 3 for our tenure analysis, where we found that women are more likely to be employed in nontenure-track positions.

Removing nontenure-track positions from the sample does not eliminate the statistically significant gender differences we found for the female variable reported in tables 4-2 and 4-3. The results for Models 5 and 6 show a pattern in which women are significantly more likely than men to be employed in the junior and associate ranks and less likely to hold the full-professor rank.

Excluding nontenure-track positions tends to reduce the statistical significance of the female-interaction variables. This result might be expected. If women are less likely to be employed in tenure-track positions because of the gender differences in the influence of family characteristics, limiting the sample to tenure-track positions is likely to reduce the influence of these variables on academic rank.[8]

Results for Selection Variables

The even-numbered rank models reported in tables 4-2 and 4-3 include selection variables as controls. Selection variables include variables distinguishing the primary work activity (teaching, research, other) and characteristics of the employing institution (private versus public; research, doctoral, other). The results reported in tables 4-2 and 4-3 indicate that our estimates of gender differences in placements across academic ranks are not sensitive to the primary work activity or to characteristics of the employing institutions. Differences in the estimated marginal relations for the female variables between odd and even numbered models are relatively small and are certainly within the range of statistical error.

This result does not mean that we find no relation between the selection variables and the likelihood of employment in different ranks. For example, we find that after accounting for other controls, doctorate recipients who report teaching as a primary work activity are less likely to be employed in junior ranks and more likely to be employed at the associate professor rank than are doctorate recipients who report engaging in other primary work activities. Also, doctorate recipients employed at private institutions are more likely to hold junior ranks and less likely to be employed at the full-professor rank than are doctorate recipients who work at public institutions.[9] That the estimates of the marginal relations for

[6] Family characteristics in table 4-3 are observed 20 or 21 years after earning the doctorate.

[7] Because the marginal relations for the female variable must sum to zero across all three ranks, the sum of the marginal relations for the associate and full-professor ranks must increase when the marginal relations for the junior ranks fall. Note that the marginal relations for both the associate and full-professor ranks increase in table 4-2 when nontenure-track positions are excluded. When we excluded nontenure-track positions for doctorate recipients with more experience (table 4-3), the marginal relations for the associate rank were virtually unchanged, but the marginal relation for the full-professor rank increased (became less negative).

[8] This interpretation warrants some caution. We have adopted a 95 percent confidence level for reporting statistical significance in this report; however, several of the female-interaction variables in Models I-5 and I-6 are statistically significant at a 90 percent confidence level.

[9] See Appendix C, tables C-42, C-44, C-46, C-48, C-50, C-52, C-54, C-56, C-58, C-60, C-62, and C-64 for estimates of the marginal relations for the selection variables.

the female variables are relatively insensitive to selection variables suggests that work activities and employer characteristics do not appear to affect measures of gender differences in academic ranks.

Results for Rank Not Applicable

Our estimates of gender differences in placements across academic ranks also appear to be relatively insensitive to whether we exclude observations on doctorate recipients who reported employment in positions for which academic rank was not applicable. For example, although Models 3 and 4 in tables 4-2 and 4-3 exclude observations for these positions, estimates of the marginal relations for the female variables are relatively close to those of Models 1 and 2, which include them. The differences between Models 1 and 2 and Models 3 and 4 are within the range of statistical error. The same conclusion holds for comparisons across models that include the female-interaction variables (i.e., comparing results for Models I-1 and I-2 with Models I-3 and I-4).

Phase II Rank Analysis

The Phase II analysis uses a sample of doctorate recipients who reported full-time academic employment in the 1997 SDR wave and includes work-history variables as controls.

Phase II Placements in Academic Ranks by Gender

Our objective in Phase II of the rank analysis, in which we used multivariate hazard analysis, was to estimate gender differences in the likelihood of doctorate recipients receiving promotion to senior ranks at any given point in their careers. The hazard model allowed us to take into account whether an individual had received promotion to a senior rank (associate or full professor) as of the date of the 1997 SDR wave as well as the amount of time it took to receive the promotion (measured from the date that the doctorate was earned).[10]

Table 4-4 reports sample-weighted estimates of promotion rates to senior academic rank and years to promotion by sex, based on the samples used in our Phase II rank analysis. For example, we estimate that 57.9 percent of the population of doctorate recipients represented by the sample had been promoted to associate professor as of the date of the 1997 SDR wave. Comparable estimates by sex show that 61.6 percent of men and 49.1 percent of women in the sample had been promoted to that rank. Of those who earned the rank of associate professor, the average time to promotion was about 8.32 years, measured from the date of the doctorate.[11] Estimated times to promotion for men and women were 8.31 and 8.39 years, respectively. Estimates of promotion rates and time to promotion for the full-professor rank can be interpreted similarly.[12]

[10] The hazard model also considers the amount of time elapsed since earning the doctorate for those individuals who have not yet received promotions to senior ranks.

[11] The samples used to compute average times to promotion in table 4-4 include only individuals who reported receiving promotions in the SDR.

[12] The sample size for the full-professor rank is smaller because we excluded individuals with fewer than 12 years of postdoctoral experience from this analysis. The sample used for the associate-professor analysis excluded individuals with fewer than 6 years of postdoctoral experience.

TABLE 4-4. Phase II promotion rates and years to rank by sex

	Total		Male		Female	
Rank and outcome	Sample size	Rank outcome	Sample size	Rank outcome	Sample size	Rank outcome
Associate professor						
Fraction in rank	5305	0.579	3548	0.616	1757	0.491
Years to promotion	3015	8.32	2138	8.31	877	8.39
Full professor						
Fraction in rank	2495	0.344	1745	0.380	750	0.241
Years to promotion	783	12.65	597	12.64	186	12.67

NOTE: Fractions in rank and years to promotion (years since earning the doctorate) are sample-weighted estimates. Years-to-tenure estimates exclude censored observations.

SOURCES: Sample drawn from Survey of Doctorate Recipients, 1997; work-history data drawn from Survey of Doctorate Recipients, 1981–1997.

Gender differences in promotion rates and time to promotion reported in table 4-4 should be interpreted cautiously. These are simply sample-weighted estimates from the samples used for the Phase II rank analysis and do not account for other factors that affect promotions to senior ranks. Also, the estimates of time to promotion exclude censored observations. An observation was censored if the individual had never reported being promoted as of the date of the 1997 SDR wave.[13]

Phase II Multivariate Analysis of Academic Rank

Most of our findings from the Phase II rank analysis are consistent with the results of our Phase I rank analysis and our tenure analysis. The results of our Phase II rank analysis indicate that after accounting for controls, women are less likely than men to be promoted to senior ranks. We also found that allowing for gender differences in the influence of family characteristics reduces gender differences in promotions to the full-professor rank. Having children is negatively related to women's success rates. Finally, we note that women are less likely than men to have missing observations for the rank outcomes before they are promoted to associate professor. This might have caused us to understate gender differences in success rates.

Table 4-5 reports the results of our Phase II analysis of promotions to the associate-professor rank for four alternative model specifications. All four models include as controls variables for human capital and for personal and family characteristics and include a set of variables distinguishing when the doctorate was earned.[14] In addition, Model 2 includes a variable for outcome status. This measures, as a percentage of time before promotion, how long an individual was employed in a position for which academic rank was not applicable. Model 3 includes a set of work-history variables as controls but does not include the variable for outcome status. Model 4 includes variables for both outcome status and work history.

The estimated marginal relations in table 4-5 are interpreted differently from those for the Phase I rank analyses. Specifically, the estimates in table 4-5 show the relations between the variables of interest and women's promotion success rates relative to men's. A marginal relation less than 1.0 means that the variable of interest is negatively related to women's chances for promotion relative to similarly situated men. Similarly, a marginal relation greater than 1.0 indicates the variable of interest is positively related to women's relative chances for promotion. For example, the estimated marginal relation for the female variable for Model 1 is 0.829; thus, after accounting for controls, the chance of a woman being promoted to the associate professor rank is about 82.9 percent of man's chance of being promoted.

The estimated marginal relations for Models 1 through 4 are all less than 1.0 and are statistically significant, indicating that after accounting for controls, women are less likely than men to be promoted to the associate-professor rank. The estimates range from 0.829 to 0.882, suggesting that women's chances for promotion are about 83 to 88 percent of the chances of their male counterparts.

Table 4-6 reports the results of our Phase II analysis of promotion to the full-professor rank for the same four alternative model specifications described above. These estimates can be interpreted similarly to those in table 4-5. Each of the estimated marginal relations for the female variables in Model 1 through 4 is less than 1.0 and is statistically significant.

TABLE 4-5. Marginal relations of female variables for Phase II rank models: Associate professor

		Female interactions		
Model	Female	Married	Dependents (age <6)	Dependents (age 6 to 18)
1	0.829*	–	–	–
2	0.848*	–	–	–
3	0.826*	–	–	–
4	0.882*	–	–	–
I-1	0.903	1.068	0.865*	0.789*
I-2	0.931	1.016	0.859*	0.852*
I-3	0.908	1.030	0.896	0.777*
I-4	0.982	0.989	0.877	0.832*

* Statistically significant at 95 percent confidence.

NOTES: Model 1 excludes selection variables for outcome status and employment; Model 2 excludes outcome status but includes work history; Model 3 includes outcome status, but excludes work history; Model 4 includes both outcome status and work history. Models I-1 through I-4 include female-interaction variables. See Appendix D, tables D-9–16, for detailed estimates of complete model.

SOURCES: Sample drawn from Survey of Doctorate Recipients, 1997; variables constructed from Survey of Doctorate Recipients, 1981–1997.

[13] The hazard model used information on the amount of time elapsed since earning the doctorate for censored observations. As a result, the sample sizes used in the Phase II multivariate analysis are those reported in table 4-4 for promotion rates, not the smaller samples used to compute average time to promotion.

[14] See Section 2, table 2-4, for a detailed list of control variables.

TABLE 4-6. Marginal relations of female variables for Phase II rank models: Full professor

Model	Female	Female interactions: Married	Female interactions: Dependents (age <6)	Female interactions: Dependents (age 6 to 18)
1	0.747*	–	–	–
2	0.730*	–	–	–
3	0.748*	–	–	–
4	0.763*	–	–	–
I-1	1.046	0.938	0.835	0.642*
I-2	0.872	1.064	0.876	0.704*
I-3	1.058	0.908	0.838	0.651*
I-4	0.992	1.009	0.890	0.723*

* Statistically significant at 95 percent confidence.

NOTES: Model 1 excludes selection variables for outcome status and employment variables; Model 2 excludes outcome status but includes work history; Model 3 includes outcome status but excludes work history; Model 4 includes both outcome status and work history. Models I-1 through I-4 include female-interaction variables. See Appendix D, tables D-17–24, for detailed estimates of complete models.

SOURCES: Sample drawn from Survey of Doctorate Recipients, 1997; variables constructed from Survey of Doctorate Recipients, 1981–1997.

Results for Female-Interaction Variables

The last four rows of tables 4-5 and 4-6 report results for Models I-1 through I-4, which include female-interaction variables.[15] The estimated marginal relations for the female-interaction variables can be interpreted similarly to the estimates for the female variables. For example, the marginal relation in table 4-5 for the variable "dependents (age 6 to 18)" in Model 1 is 0.789. This means that after accounting for other controls, the last child between the ages of 6 and 18 reduces a woman's chances for promotion to the associate-professor rank to 78.9 percent of the chances for a similarly situated man.

The results for the female-interaction models in tables 4-5 and 4-6 show that allowing for gender differences in the influence of family characteristics tends to lower estimates of gender differences in promotion rates. The estimates of the marginal relations for the variables for interaction between "female" and "dependents" are consistently less than 1.0 and are statistically significant for older dependents. Moreover, the estimated marginal relations for the female variable are statistically insignificant, both for the associate- and full-professor analyses. Accordingly, after allowing for gender differences in the influence of family variables, we cannot reject the hypothesis that men and women have the same chances for promotion to senior ranks after allowing for gender differences in the influence of family variables.

This finding differs from our conclusions from the Phase I analysis, and thus warrants further comment. In the Phase I analysis, we observed statistically significant gender differences in the likelihood of promotion to the full-professor rank, even after we allowed for gender differences in the influence of family characteristics. In the Phase II analysis, however, the estimated marginal relations for the female variable in Models I-1, I-3, and I-4 are very close to 1.0 and are statistically insignificant, suggesting no gender differences in promotion rates (table 4-6). The marginal relation for Model I-2 is less than 1.0 but is not statistically significant.

The different results for the Phase I and Phase II interaction models have several possible explanations. One possibility is that we systematically overstate the relative time required for male promotions in Phase II because of missing responses in the SDR data. Time to promotion was measured by searching SDR waves for the first occurrence of an individual reporting employment at a senior rank. If an individual fails to complete the section of the SDR questionnaire on academic rank after being promoted, we will overstate the time the individual required to achieve the full-professor rank.[16] Women, however, are about 3.5 percent less likely than men to omit information on their rank before promotion to associate professor, and they are about 3.0 percent less likely to omit information on their rank before promotion to full professor.[17] This raises the possibility that the Phase II analysis overstates the relative time it takes men to be promoted. To the extent that this occurs, our estimates of gender differences in promotion rates will be understated.

Second, we used different samples for the Phase I and Phase II analyses. The Phase I analysis looked at doctorate recipients at specific points in their careers and used a sample of doctorate recipients who reported full-time academic employment anytime in the 1981–1997 SDR waves. In contrast, the Phase II analysis used a

[15] The Phase II analysis of promotion to the associate-professor rank measures all family characteristics—including the female-interaction variables—3 survey waves, or about 6 years, from the date that the doctorate was earned. The Phase II analysis of promotion to the full-professor rank measures family characteristics 6 survey waves, or about 12 years, from the date of the doctorate.

[16] The same bias is possible in our measure of time to promotion to the rank of associate professor.

[17] The gender difference in response rates for the associate-professor analysis is statistically significant. Although the difference for the full-professor analysis is not statistically significant, there is still potential for bias in the measure of time to promotion.

sample of individuals who reported full-time employment in the 1997 SDR wave. Individuals included in the Phase II sample on average earned the doctorate more recently than those in the Phase I sample. Also, because of the recent trend of increased female representation in academia, the Phase II sample has a higher proportion of women than the sample we used for the Phase I analyses. Differences in the Phase I and II results could be due to differences in these samples.

Finally, the statistical methods we used in Phases I and II are different. As noted earlier, we used multinomial logit analysis in Phase I and multivariate hazard analysis in Phase II. Differences in underlying assumptions implicit in these modeling techniques could contribute to differences in Phase I and Phase II results.[18]

Results for Outcome-Status and Work-History Variables

Several of the alternative model specifications included in tables 4-5 and 4-6 are designed to determine whether variables for outcome status and work history affect estimates of gender differences in promotion rates. The outcome-status variable measures the percentage of time that doctorate recipients were employed in positions where rank was not applicable before they received promotions. The work-history variables include measures of the percentage of time before promotion that individuals report not being employed full time in academia or report employment at a research institution, employment at a doctoral institution, teaching as the primary work activity, or research as the primary work activity.

Although there is some variation in the estimated marginal relations for the female variable across alternative model specifications in tables 4-5 and 4-6, the differences are within the range of statistical error.[19] Accordingly, we do not find statistical evidence that including outcome-status and work-history variables as controls affects our estimates of gender differences in promotion rates.

In most cases, however, the outcome-status and work-history variables are statistically significant determinants of promotion rates. As might be expected, spending time in positions where rank is not applicable is negatively related to chances for promotion to senior ranks. The same is true for spending time in jobs that are not full-time academic positions. Being employed in either a research or a doctoral institution reduces a doctorate recipient's chances for promotion, perhaps because promotion requirements at these kinds of institutions are more stringent than at other institutions. Finally, spending time in positions for which teaching is a primary work activity is negatively related to chances for promotion to the full-professor rank.[20]

[18] The logit analysis looked at the likelihood that an individual with a given level of postdoctoral experience will receive a promotion, whereas the hazard analysis considered how long it took an individual to receive a promotion. The two modeling techniques also adopted different assumptions about underlying statistical error. See Appendix A for more technical descriptions of the logit and hazard models.

[19] Differences in the estimated female coefficients of the hazard function are all within two standard deviations across alternative model specifications. See Appendix D, tables D-9–24.

[20] See Appendix D, tables D-10–12, 14–16, 18–20, and 22–24.