

THE ECONOMICS OF GENDER DIFFERENCES IN EMPLOYMENT OUTCOMES IN ACADEMIA*

Donna K. Ginther
Department of Economics
University of Kansas

Abstract

This paper summarizes research that examines the relationship between hiring, promotion, and salary for tenure track science and social science faculty using data from the Survey of Doctorate Recipients (SDR). Gender differences in hiring and promotion can be explained by observable characteristics. However, gender differences in salaries persist at the full professor rank. In particular, women in science and social science are less likely to have tenure track jobs within five years of the doctorate when compared with men. However, when controls for marital status and children are included in the analysis, the research finds that unmarried women are significantly more likely to have tenure track jobs than unmarried men. Marriage provides a significant advantage for men relative to women. Presence of children, especially young children, significantly disadvantages women while having no impact on men in obtaining tenure track jobs. The research also finds no significant gender differences in the probability of obtaining tenure in life science, physical science, and engineering. These results also hold for promotion to full professor. However, significant gender promotion differences are evident in the social sciences, in particular, economics. Finally, the research finds large gender differences in salaries are partially explained by academic rank. However, gender salary differences for full professors, on the order of 13% in the sciences, are not fully explained by observable characteristics.

In his examination of the salaries and appointments of men and women in academia, the Director of Research at the American Association of University Professors (AAUP) observes: “Substantial disparities in salary, rank, and tenure

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between male and female faculty persist despite the increasing proportion of women in the academic profession” (Benjamin, 1999). While the evidence presented by AAUP is striking, the gender comparisons of salaries do not control for characteristics that contribute to pay differentials such as academic field or publication record. Simply comparing salaries of male and female academic scientists without taking into consideration these factors could overstate the gender salary gap. Disentangling the causes of gender disparities in employment outcomes requires an in-depth examination of the data. This report summarizes research that examines the relationship between hiring, promotion, and salary for tenure track faculty using data from the Survey of Doctorate Recipients (SDR).

The Economic Perspective

Economic theory provides the underpinnings of this research. I start by assuming that employment outcomes are determined by market forces. Wages and hiring are determined by the supply of and demand for PhD scientists. Equally productive workers regardless of gender will be paid the same and hired in similar numbers given market forces. Given these assumptions, one should not observe hiring, promotion, and salary differences for equally productive workers of either gender. However, persistent gender wage and employment differentials persist on average in the market as a whole (Altonji and Blank, 1999) and for scientists in particular (Ginther, 2001). I use economic theory to explain observed gender differences in hiring, promotion and salary.

Beginning with Becker’s seminal work on discrimination (Becker, 1971), economists have developed models to understand gender and racial disparities in employment outcomes. Becker argues that taste-based discrimination (prejudice) will be eliminated by competitive forces. Given employer, employee, or customer prejudice, those firms that pay premiums to favored workers will have higher costs. Thus, the nondiscriminating firm will have a competitive advantage by hiring women or minorities, and the market will eventually compete away the discriminating wage differential. Becker’s prediction relies on the assumption that markets are perfectly competitive—an assumption one can reject for academic institutions.

Given Becker’s results, economic theory has developed other explanations besides discrimination to account for observed gender differences in employment outcomes. These explanations may be divided into differences in “preferences” or choices and other factors. The preference-based explanations argue that gender differences in employment outcomes result from choices, in particular, differences in productivity. Economic theory holds that equally productive workers will be paid the same, thus, gender salary differences are the result of differences in productivity. A second preference-based explanation is that women chose to marry and have children, which in turn affects their attachment to their careers and overall productivity.

Other theoretical explanations include monopsony models of the labor market. A monopsonist is a single employer of labor that has more bargaining power in the employment contract than the worker. Monopsonists pay workers less than the competitive wage and may be able to pay different wages to different types of workers depending upon their relative mobility. Thus if female faculty have fewer outside job opportunities, this will generate a gender wage differential. One may convincingly argue that academic institutions have monopsony power relative to faculty in most fields. However, for monopsony to explain gender employment disparities, women would need to be less mobile than men.

Job-matching models may also explain gender differences in employment outcomes. In this model workers who are the best match for the job earn the highest salaries. In loose terms, the job-matching model suggests that women are paid less because they are not as capable (not as good of a match) in science compared to men.

If the researcher cannot explain the gender differences in employment outcomes using one of the above explanations, then the residual gender difference in hiring, promotion, or salary may be attributed to discrimination. Statistical discrimination suggests that imperfect information on the part of employers generates wage differentials. In this model, an employer attributes the average characteristics of a group to an individual member of this group—essentially the employer uses a stereotype in making hiring decisions or setting wages. As a result, we observe gender differences in employment outcomes. However, direct measures of statistical discrimination are difficult to come by. Thus, discrimination may be inferred when other plausible explanations have been ruled out.

Using economic theory as a guide, the research summarized in this report is organized using three basic principles. First, there is no single scientific labor market. As a result, this research disaggregates the data by scientific field. Second, gender differences in employment outcomes need a context in order to make meaningful comparisons. Thus, the research compares employment outcomes across academic fields in order to ascertain the relative status of women in academic science and social science. Finally, employment outcomes are inter-related. One cannot understand gender differences in salary without considering related outcomes of hiring and promotion. Given these principles, my research poses the question: Does science discriminate against women? I evaluate gender differences in hiring, promotion, and salary and can largely explain the first two outcomes using observable characteristics. However, I find large gender differences in the salaries of full professors that I cannot explain as a function of productivity or other choices.

Data and Methods

This study uses data from the Survey of Earned Doctorates (SED) and the Survey of Doctorate Recipients (SDR) to examine the distribution of women

across scientific fields and gender differences in salary. The SED is a census of doctorates awarded in the United States each year. I use the 1974–2004 waves of the survey to evaluate changes in the distribution of women in scientific fields. The SDR is a nationally representative sample of PhD scientists in the United States used by the National Science Foundation to monitor the scientific workforce and fulfill its congressional mandate to monitor the status of women in science. This study uses data from the 1973–2001 waves of the SDR. The SDR collects detailed information on doctorate recipients including demographic characteristics, educational background, employer characteristics, academic rank, government support, primary work activity, productivity, and salary. Although the SDR has comprehensive measures of factors that influence academic salaries, the data lack information on some quantitative measures, such as laboratory space and extensive measures of publications. Measures of academic productivity are largely missing from the SDR data, but the SDR does ask questions about publications in the 1983, 1995, and 2001 surveys. I use these data to create rough measures of productivity for each year following the doctorate.¹

Academics in the life sciences, physical sciences, engineering, and social science are included in the analysis. Life science includes biological sciences and agriculture and food science. Physical science includes mathematics and computer science, chemistry, earth science and physics. Social science includes economics, psychology, sociology and anthropology, and political science. Engineering includes all engineering fields. The SDR collected information on doctorate recipients in the humanities between 1977 and 1995. In some of the analysis that follows, I include comparisons across the three broad disciplines of humanities, sciences, and social sciences.

I begin the analysis by analyzing the percentage of doctorates awarded and the percentage of tenured faculty who are female. Figures 2-1 and 2-2 indicate that women are not equally distributed across scientific fields. Figure 2-1 graphs the percentage of doctorates awarded to females between 1974 and 2004 using data from the SED. If we consider only life science fields, we may conclude, like the National Research Council (2001), that women have indeed moved ‘from scarcity to visibility’ in terms of doctorates granted. By 2004 almost half of all doctorates in life science and more than half of all doctorates in social science were awarded to women. However, both physical science and engineering awarded less than one-third of doctorates to women. In the year 2004, less than 18% of engineering doctorates and less than 27% of physical science doctorates were granted to women.

Despite the increasing numbers of doctorates awarded to women, the representation of women among tenured academic scientists remains quite low. Figure 2-2 uses data from the 1973–2001 waves of the SDR to graph the percentage of

¹Specifics of the data creation may be found in Ginther (2001) and Ginther and Kahn (2005).

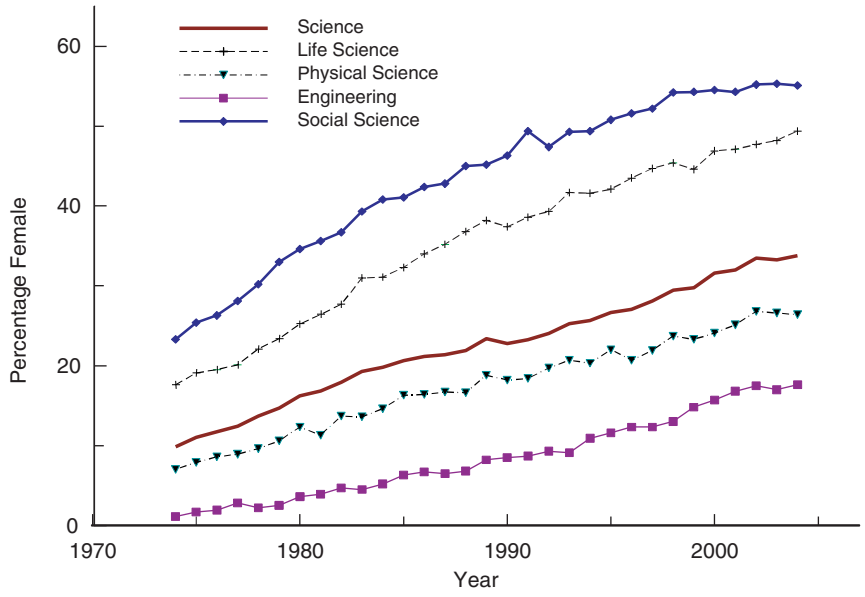


FIGURE 2-1 Percentage of doctorates granted to females, 1974–2004.
SOURCE: 1974–2004 Survey of Earned Doctorates.

tenured faculty who are female in life science, physical science, social science, and engineering. As expected, social science and life science have the highest percentages of tenured female faculty at 28 and 25% respectively in 2001. Physical science and engineering have far fewer tenured female faculty at 11 and 5%, respectively. Given the large differences between the percentages of doctorates awarded to women and the percentages of tenured faculty who are women, I turn to potential explanations.

Gender Differences in Hiring and Promotion

Hiring

The underrepresentation of women in tenured academic ranks may result from gender differences in hiring or promotion. Ginther and Kahn (2005) examine gender differences in hiring by evaluating whether women in science are more or less likely than men to get tenure track jobs within five years of receiving their doctorate. Women and men who leave academia immediately following the doctorate are dropped from the sample. Figure 2-3 shows three sets of estimates of the effect of being female on getting a tenure track job using samples of over

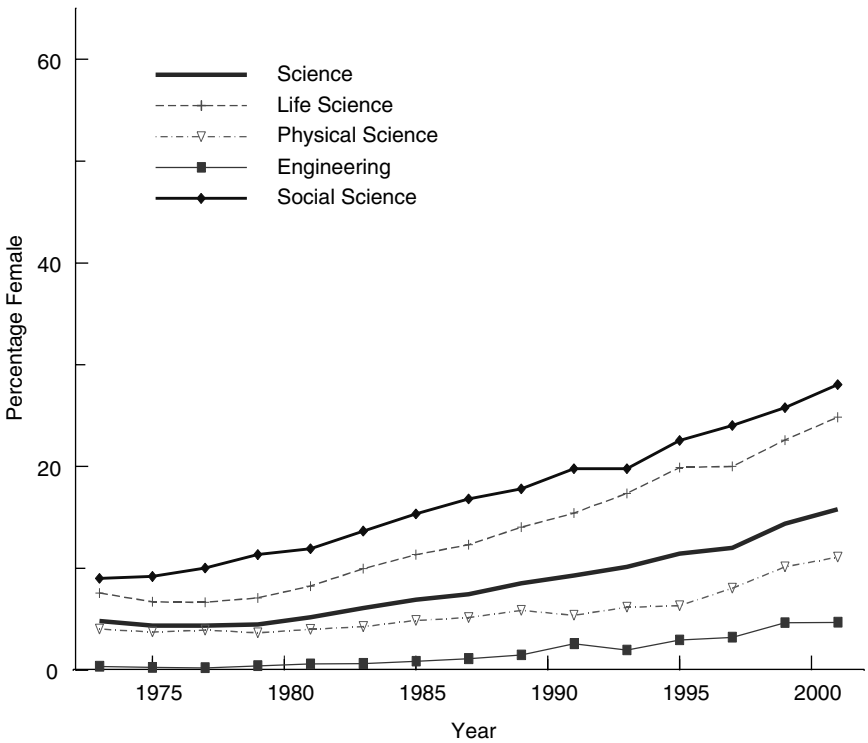


FIGURE 2-2 Percentage of tenured faculty who are female, by discipline, 1973–2001. SOURCE: 1973–2001 Survey of Doctorate Recipients.

12,000 scientists and over 3,000 social scientists from 1973–2001. Negative numbers indicate that women are less likely whereas positive numbers indicate that women are more likely to get a tenure track job within five years of PhD. Numbers that are underlined are statistically significant at the 5% level. The first bar in Figure 2-4 shows that women are between 4 to 6% less likely than men to have tenure-track jobs in all science fields combined, social science, and life science. There is no significant difference between men and women getting a tenure-track job in physical science and engineering. The second bar in Figure 2-4 includes controls for academic field, race, age at PhD, year of PhD, marital status, and children. The estimated gender gap falls for all science and social science fields but does not change appreciably for the disaggregated science fields.

The third bar includes controls that interact female with marital status and children. These interaction terms allow the impact of marriage and children to be different for men and women in the model. The estimates are strikingly different.

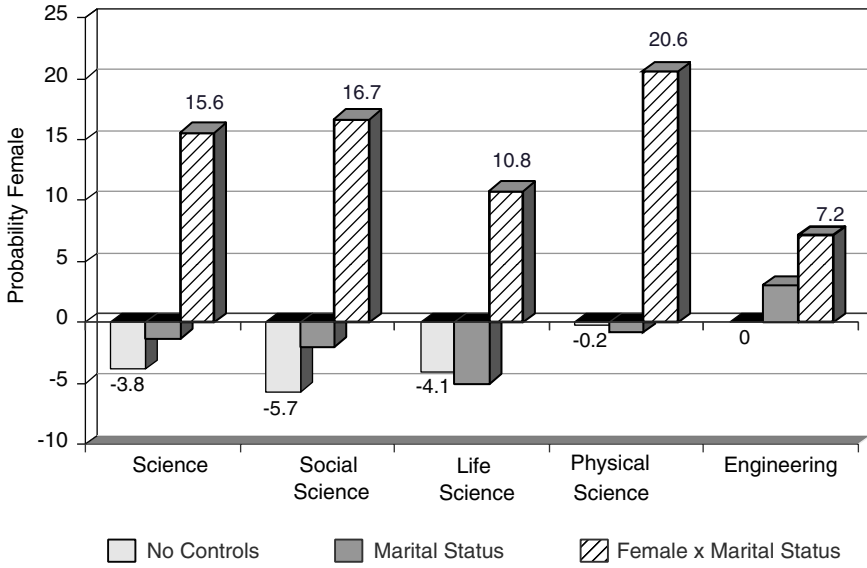


FIGURE 2-3 Gender differences in tenure-track job within 5 years of PhD.
 Notes: Estimates from Ginther and Kahn (2005) using 1973-2001 Survey of Doctorate Recipients.

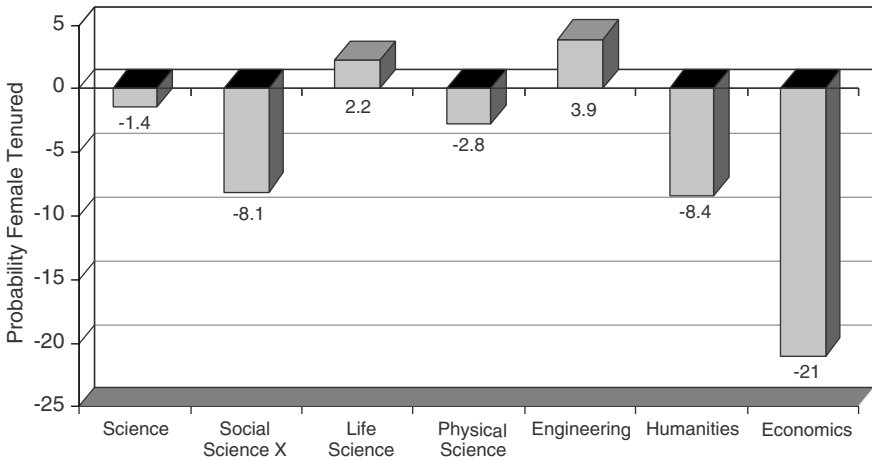


FIGURE 2-4 Gender differences in promotion to tenure 10 years past PhD.
 Notes: Estimates from Ginther and Kahn (2004) and Ginther and Hayes (2003). Science and Social Science estimates from 1973-2001 SDR. Humanities estimates from 1977-1995 SDR. Economics, humanities, and social science X (excluding economics) are statistically significant ($p = 0.01$).

Women are between 7 to 21% more likely than men to get a tenure-track job within 5 years of PhD provided they are unmarried and do not have children. These results indicate that much of the underrepresentation of women in academic science is the result of having children. Single women are 16% more likely in science and 17% more likely in social science to get tenure-track jobs than single men. Marriage has a positive and significant impact of 22% on men getting a tenure-track job whereas the effect of marriage on women ranges between 0 and 8% for all science, life science, and social science fields. The exception is engineering where marriage increases women's chances of having a tenure-track job by 23%. Children, especially young children, significantly decrease the likelihood of women obtaining a tenure-track job between 8 to 10% in all science fields, life science, and social science while having no significant impact on men.

The positive impact of marriage and children on men's tenure-track employment echoes the positive impact of men's marriage and children on wages and promotion in the labor market as a whole. The negative impact of children on women's tenure-track employment may result from a number of factors. Women may choose to have children instead of pursuing an academic career because of the coincident timing of the tenure and biological clocks. The dual-career problem may also play a role. Career hierarchies in marriage often result in the husband's career taking precedence over the wife's career. If it is difficult to obtain two tenure-track jobs, she may choose to have children instead of investing in her career.

Furthermore, women are often the primary caregivers of children and this may hamper investments in their careers. The availability of tenure-track jobs may be limited to such an extent that women choose to invest more in marriage and family than in their careers. I suggest that the relative lack of academic jobs may be playing a significant role. By way of example, approximately half of all medical students are women and increasing numbers of women are practicing medicine. The demand for doctors is much higher than the demand for academic scientists, and this demand results in more women practicing medicine. It follows that the lack of academic jobs may be contributing to women's underrepresentation in academic science.

Finally, the timing of women's departure from academia may also indicate problems with the post-doctoral system in academic science. Studies suggest that the post-doctoral process is taking longer because the number of post-doctoral positions has expanded without a similar expansion of academic jobs (Davis, 2005). These results suggest that some combination of factors at the early stages of women's careers are affecting married women's choice of or access to tenure-track jobs. I now examine what happens to women as they progress through the tenure track.

Promotion

Once women have tenure-track jobs, their prospects for getting tenure in science are very promising but less so in social science. Figure 2-4 is derived from estimates in Ginther and Kahn (2004, 2005) and Ginther and Hayes (2003). It shows gender differences in the promotion to tenure 10 years past the doctorate in the fields of science, social science excluding economics, life science, physical science, engineering, humanities, and economics. These latter two disciplines are included to provide a context for the remaining fields. Women are between 1 to 3% less likely to get tenure in all scientific fields combined and in physical science 10 years past the doctorate. Women are between 2 and 4% *more likely* to get tenure in life science and engineering. These results indicate that gender differences in promotion to tenure are small for women in scientific fields.

This is not true for social science (excluding economics) and the humanities where women are 8% less likely than men to get tenure. Economics is the outlier—women are 21% less likely to get tenure than men 10 years past the doctorate. These differences in economics cannot be fully explained by gender differences in productivity, marital status, or presence of children (Ginther and Kahn, 2004).

Ginther and Kahn (2005) estimate gender differences in promotion to tenure and promotion to full professor in scientific fields. They find no statistically significant gender differences in promotion to either rank. Thus, we can conclude that gender differences in promotion in science are negligible. However, gender differences in promotion in social science are large, especially in economics. I now consider gender differences in salaries.

Gender Differences in Salaries

There are several factors that affect the salaries of academics. Demographic characteristics such as race, marital status, fertility, and years of work experience may have a positive or negative effect on salaries. For example, on average, marriage increases male salaries while having a negative effect on female salaries. Employer characteristics such as working at a public or private institution, liberal arts or a doctoral institution, and the Carnegie ranking of the employer may also affect salaries. Top research institutions pay more than liberal arts colleges. Public institutions have state-mandated salary scales that tend to be more restrictive than those at private institutions. Employee characteristics such as the academic rank and tenure status of the individual also influence salaries, with salaries increasing with academic rank and tenure.

Measures of productivity also affect salaries. These include factors such as whether the individual receives government support, primary work activities, and publications. If men are more likely to work at top-ranked research universities, the gender salary gap will be larger. Salary differences may also result from dif-

ferential treatment reflected in differences in estimated coefficients. For example, at private institutions if men are paid more than women and private institutions are equally likely to employ both, then the gender salary gap will increase. Taken together, these observable characteristics may explain a substantial portion of the gender salary gap.

The analysis reported here updates estimates in Ginther (2001, 2003, 2004) and Ginther and Hayes (2003) using the 2001 SDR data. The first bar in Figure 2-5 shows the average gender salary gap for all tenure-track and tenured faculty combined in science, social science, life science, physical science, engineering, and humanities. The salary gap ranges from a low of 11% in the humanities² to a high of 21% in engineering. This combined gender salary gap is very large. However, previous research by Ginther and Hayes (1999, 2003) shows that the majority of the gender salary gap in the humanities disappears when separate salary regressions are estimated for each academic rank.

The remaining bars in Figure 2-5 show the gender salary gap for assistant, associate, and full professor ranks. Similar to Ginther and Hayes (1999, 2003), the gender salary gap at the assistant and associate professor ranks falls from close to 20% to just over 5% for assistant and associate professors in science and social science. However, the full professor salary gap increases to 8% for social science and as high as 14% for life scientists. In contrast, the gender salary gap for full professors in the humanities is less than 2%.

Using regression techniques, these salary gaps can be decomposed into factors that are explained by observable characteristics and factors that result from differential treatment of men and women. One-third of the salary gap for all science fields combined cannot be explained by observable characteristics such as productivity. Three-quarters of the salary gap for engineering cannot be explained by observable characteristics. I now evaluate whether economic theory can explain the gender salary gap for full professors.

Explanations for the Salary Gap

To determine whether publication differences could account for a substantial portion of the unexplained salary gap for full professors, I use publications measures from the 2001 SDR (Ginther, 2004). The sample includes measures of papers published and papers presented at conferences within the last five years. Including productivity measures only reduced the unexplained portion of the gap by 0.3 percentage points from 3.8 to 3.5%. Thus, productivity does not appreciably reduce the unexplained gender salary gap for full professors for all science fields combined. However, productivity differences do explain a significant portion of the salary gap in physical science and engineering.

²This estimate is based on 1995 SDR data, the last year information on the humanities was available.

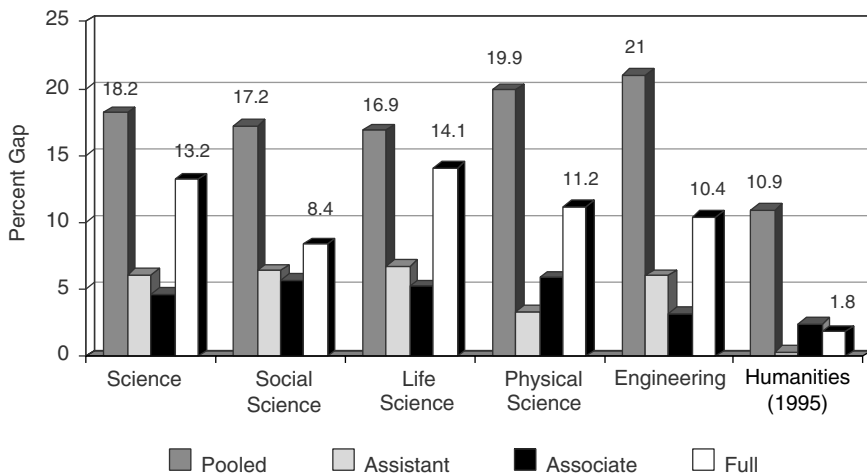


FIGURE 2-5 Gender salary gap by academic rank, 2001 SDR.

Notes: Estimates for Humanities from Ginther and Hayes (2003) based on 1995 SDR.

Next, I consider other factors that may explain the gender salary gap. In particular, women who have children are often paid less than women without children (Waldfoegel, 1998). Since women are often the primary care-givers for children, having a child may reduce a woman’s productivity. My analysis shows that the total number of children and presence of children under the age of six have little or no impact on either the explained or unexplained portion of the gender salary gap for full professors.

Economic models of monopsony (where the university acts as the sole purchaser of labor) may also explain the gender salary gap. In monopsonistic models of academic labor markets developed by Ransom (1993), senior faculty have higher moving costs and receive lower salary offers. It is possible that tenured women faculty have higher moving costs than their male colleagues because of dual career considerations or fewer job opportunities. In related research, Booth, Frank, and Blackaby (2002) suggest that universities may consider women to be “loyal servants” who are less likely to change academic employers. As a result, universities can make lower salary offers and adjustments to women scientists. Both the monopsony and loyal servant explanations would be evident in the effect of job tenure on wages. If women have higher moving costs due to monopsony or are perceived to be “loyal servants,” their wages would be reduced more than men’s for each additional year of job tenure with the same employer. However, the data show the opposite is true. Male salaries are reduced more than female salaries for each additional year of job tenure. Thus, neither monopsony models nor the loyal servant hypothesis provide an adequate explanation of the gender salary gap in science.

Job matching models suggest that women are paid less than men because they are not as well suited (matched) to scientific careers. Whereas this may explain part of the salary gap for lower ranks, it is difficult to argue that women full professors of science are not well suited to academic science.

Although productivity, children, and economic models do not provide an adequate explanation for the gender salary gap, there are other variables that are associated with the gender gap. In my analysis, the single most important factor contributing to both the explained and unexplained gender gap is work experience—measured by years since PhD. Virtually all of the explained salary gap for full professors results from men having relatively more work experience. In addition, virtually all of the unexplained salary gap for full professors results from men having a higher return on experience than women. Although the effect of experience on wages is almost the same for men and women in the assistant and associate professor ranks, it differs for men and women at the full professor rank. Each additional year of work experience increases the salaries for male full professors but has zero effect on the salaries of female full professors, thus contributing to the unexplained salary gap.

The effect of experience suggests that the gender salary gap may result from a subtle mechanism such as the cumulative advantage model described by Zuckerman (1987). In this model, some groups receive greater opportunities than others. Recipients are enriched and nonrecipients are impoverished. Over time as advantages and disadvantages accumulate, a gender gap develops. The estimated impact of experience on the salary gap is consistent with the cumulative advantage model.

Conclusions and Policy Recommendations

I began this analysis by posing the question: does science discriminate against women in hiring, promotion, and salaries? The answers to these questions provide questions for further research and policy recommendations.

First, women in science and social science are less likely to have tenure track jobs within 5 years of the doctorate when compared with men. However, when controls for marital status and children are included in the analysis, the research finds that unmarried women are significantly *more* likely to have tenure track jobs than unmarried men. Marriage provides a significant advantage for men relative to women. Presence of children, especially young children, significantly disadvantages women while having no impact on men in obtaining tenure track jobs. Second, the research finds no significant gender differences in the probability of obtaining tenure in life science, physical science, and engineering. These results also hold for promotion to full professor. However, significant gender promotion differences are evident in the social sciences, in particular, economics. Finally, the research finds large gender differences in salaries are partially explained by academic rank. However, gender salary differences for full professors, on the

order of 13% in the sciences, are not fully explained by observable characteristics. The gender differences in salaries are most consistent with the cumulative advantage model where advantages accrue to men more often than women and generate salary differentials.

The results of this research provide both research and policy recommendations. The gender differences in hiring and salary summarized in this paper can only be partially explained with existing data. In order to understand the complex causes of gender disparities in employment outcomes for women in science and social science, better data are required. The Survey of Doctorate Recipients is the best source of data on academic labor markets. However the quality of the data should be enhanced along two dimensions. First, additional questions should be included in the SDR to allow for the comparison of resource allocations. These questions include the following:

- Information on publications and citations
- Dollar amount and duration of grant awards
- Laboratory size
- Numbers of graduate students and post-doctoral students advised.

This series of questions would allow researchers to determine whether gender differences in resource allocation and productivity contribute to the gender salary gap.

Second, additional questions related to post-doctoral appointments and dual career issues should be include in the SDR. These questions include:

- Number, quality, and productivity of post-doctoral appointments
- Spouse information including education, employment and earnings
- Childcare time

This series of questions would allow researchers to determine whether the post-doctoral process or work-family trade-offs lead to fewer women in academic science.

In addition to the SDR, I recommend that agencies such as the NSF and NIH collect information on the demand for scientists. In particular, researchers could make great use of data on the number of academic and nonacademic jobs available in scientific fields. It is my belief that the excess supply of scientists in certain fields disproportionately disadvantages women. Finally, I recommend that the NSF create an advisory panel of researchers who use the SDR to make recommendations on data collection, survey design, survey questions, and dissemination of the data.

The hiring and salary gaps summarized in this research also lead to specific policy recommendations. In terms of hiring, universities should be encouraged to develop family friendly policies such as tenure clock stops for childbirth, paid parental leave, and on-site childcare. These policies would ease the burden of having and caring for children. Dual career hiring policies may also benefit

women. At most institutions, accommodations for the trailing spouse are ad hoc or nonexistent. This poses a special problem for women who are more likely to married to professional or academic spouses. Universities that wisely invest in academic couples may be able to hire and retain higher quality faculty because couples are less mobile than individuals. Finally, I would recommend institutional review of salaries on a regular basis in order to adjust obvious gender salary discrepancies.

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BIOPSYCHOSOCIAL CONTRIBUTIONS TO COGNITIVE PERFORMANCE*

Diane F. Halpern

Berger Institute for Work, Family, and Children

Claremont McKenna College

Abstract

Females and males are both similar and different in their cognitive performance. There is no evidence to support claims for a smarter sex. Males and females have different average scores on different cognitive measures; some show an advantage for females and others show an advantage for males. Females are achieving at higher rates in school at all levels and in all subjects, including subjects in which they obtain lower scores on aptitude/ability tests (e.g., advanced mathematics). Although there is much overlap in the female and male distributions, on average, females excel on many memory tasks including memory for objects and location, episodic memory, reading literacy, speech fluency, and writing. Males excel at visuospatial transformations, especially mental rotation, science achievement, mathematics tests that are not tied to a specified curriculum (possibly due to use of novel visuospatial representations and transformations), and males are more variable on many cognitive tests. A biopsychosocial model that recognizes the reciprocal relationships among many types of variables is used as an explanatory framework.

There have been remarkable changes in the lives of women and men in the blink of history that was the 20th century. College enrollments went from consisting largely of men from the privileged classes near the start of the 20th century to men from all socioeconomic classes and literally, all stripes, as they returned from World War II near mid-century. College enrollments for women at the same time consisted mostly of women of privilege, or exceptional talent, or high moti-

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Some authors prefer to use the term “gender” when referring to female and male differences that are social in origin and “sex” when referring to differences that are biological in origin. In keeping with the biopsychosocial model that is advocated in this paper and the belief that these two types of influences are interdependent and cannot be separated, only one term is used in this chapter. “Sex” is used without reference to the origin of any observed differences or similarities and is not meant to imply a preference for biological explanations. These terms are often used inconsistently in the literature.