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Gender differences in employment and earnings in science and engineering in the US

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Abstract

College-educated women are less than half as likely as men to be employed in science and engineering (S&E); and if they are, earn about 20 percent less. Using data from the 1993 National Survey of College Graduates, we estimate jointly, determinants of S&E employment and earnings in both S&E and non-S&E jobs. Taking account of gender differences in education (including S&E degrees), work experience and occupational characteristics, we can explain 60 percent of the gender differential in S&E employment and up to two-thirds of the earnings differential in S&E jobs. We find some evidence of gender earnings discrimination in S&E jobs, but less of it than in non-S&E jobs. We also show that the likelihood a worker selects S&E employment depends on her expected pay differential between S&E and non-S&E jobs, as well as on expected gender earnings discrimination in both S&E and non-S&E labor markets.

JEL classification: I21; J44; J71

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1. Introduction

It is a truth universally acknowledged that scientific advances provide the fuel for economic growth. High-technology industries have led the most recent sustained growth period in US history, resulting in an unprecedented explosion in the demand for highly skilled labor, creating intense competition for a limited pool of scientific workers. At the same time, real wages have been decreasing in science and engineering fields relative to other highly skilled occupations such as medicine, law and business (North, 1995), and the overall pool of scientists and engineers has been growing only slowly (Romer, 2000). As the demographic composition of the US labor force continues to change, in favor of women, minorities and immigrants, many of these workers are reported to hold perceptions of unfair treatment in the scientific labor market (Dix, 1987; Stossel, 1999).

This paper focuses on gender differences in aggregate employment and earnings in science and engineering (S&E) relative to other occupational fields. Our definition of S&E follows the National Science Foundation (NSF, 1999a, b) which regularly tracks the educational and employment characteristics of the college-educated

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workforce involved in occupations that have the greatest potential to generate research and development payoffs. There were roughly 3.5 million college-educated individuals in the US in 1999 working in one of five broadly defined S&E fields—computer/math, life sciences, physical sciences, social sciences and engineering (NSF, 2003). Women were just 24 percent of all S&E workers (even though they are 46 percent of all workers) and earned on average 22 percent less than men. The main goals of this paper are to explain the causes of these gender differences in S&E employment and earnings and to assess the relationship between S&E employment and earnings. Our focus on S&E occupations as a whole rather than specific S&E jobs is consistent with a long tradition of economic analysis of the sources of gender earnings discrimination as exemplified in a recent article by O'Neill (2003).

Economist Paula Stephan (1996) has observed one reason science commands our attention is that the S&E labor market offers fertile ground for testing the human capital model which relates earnings to education, training and experience (see Becker, 1964; Mincer, 1974, among many others). To the extent S&E jobs value measurable skills and knowledge over less tangible traits such as personality or appearance (which may be more important in some non-S&E jobs such as management, sales and service), then a small set of human capital variables might be expected to capture a large portion of the variation in individual earnings and may also account for a significant portion of the gender pay gap. By contrast, sociologist Laurie Morgan (1998) offers an alternative view of S&E which emphasizes the importance of "old-boy" networks and the "glass ceiling." She argues that since S&E jobs have been traditionally male-dominated, women may find themselves at a disadvantage in terms of entry, pay and promotion. This view suggests that factors other than human capital are likely to account for much of the gender differential in pay.

In this paper, we combine these two schools of thought, arguing that a worker's decision whether or not to seek employment in an S&E occupation depends both on the earnings differential between S&E and non-S&E jobs and on perceptions of discrimination in the two fields. To model both pay and discrimination, we need unbiased estimates of what a worker could expect to earn in both S&E and non-S&E jobs. After reviewing our dataset and sketching a theory of occupational selection, we present maximum likelihood estimates of the determinants of selecting an S&E occupation and of earnings in S&E and non-S&E fields, by gender. We then offer quasi-structural equation estimates of how differences in earnings between S&E and non-S&E jobs and gender discrimination in the two fields affect the likelihood that a college-educated worker is employed in S&E.

2. An overview of the S&E labor market

The NSF sponsored the National Survey of College Graduates (NSCG) in spring 1993, a survey of 215,000 individuals under age 75 with at least a bachelor's degree at the time of the 1990 Census. The resulting database merges each individual's 1990 long-form Census data with information from the 1993 follow-up questionnaire on fields of study, level of education, occupation, earnings and other demographic information. Since the Census did not collect information in the field of study, the NSCG includes individuals, both with and without S&E backgrounds, and as such, is a nationally representative database of all college graduates. In this paper, we look at all 111,158 individuals in the survey who worked full time in 1993 and had positive earnings (or self-employment income), and we focus in particular on the 23,805 men and 5709 women working in S&E.

Table 1 provides an overview of the mean annual earnings and distribution of college-educated full-time workers by whether or not employed in an S&E occupation, by S&E educational background, and by gender. Our classification of S&E occupations and degree fields follows the guidelines established by the NSF (and is detailed in the appendix to this paper). In general, S&E occupations are those which employ a high proportion of individuals with training in an S&E educational field who are engaged in some research or development activities and whose output directly or indirectly involves the production of scientific ideas and new knowledge. Any definition of S&E necessarily involves a number of controversial and potentially arbitrary judgments about specific jobs: for example, the NSF list of S&E jobs includes postsecondary but not pre-college teachers of S&E; medical researchers but not doctors or nurses; and computer hardware and software developers but not computer programmers or technicians. Although workers in these excluded fields may have a substantial amount of scientific education and training, their primary output is not deemed to be basic research or development.

Among all college-educated full-time workers, women earned on average $40,119 per year, or 73 percent of the $55,135 mean earnings of men. About one in three men and one in seven women worked in an S&E occupation.[1] Among S&E workers, women earned on average $45,456, or 84 percent of what men did. Among non-S&E workers, the gender pay gap was much greater:

[1]NSCG respondents are more likely than college graduates as a whole to be employed in S&E. In 1993, 14.3 million male and 8.5 million female year-round, full-time workers with income had a college degree or more (US Bureau of the Census, 1995). At the NSCG rate of S&E employment, 4.8 million men and 1.2 million women would be working in S&E, about twice the number estimated by the NSF for 1997.