

Women in Science and Technology: the Sisyphean Challenge of Change

ABSTRACT

The first report in this series, "Twenty Years of Scientific and Technical Employment," used data from the U.S. Bureau of Labor Statistics (BLS) to document trends in the number of jobs from 1983 through 2003 in over 40 scientific, technological, engineering and mathematical (STEM) occupations. This second report provides similar information on trends in the participation of women in these occupations. Data archives at www.cpst.org include the BLS source statistics and more detailed versions of some of the tabulations presented here.

Striking variations exist among STEM occupations in the employment of women, who hold over half of the jobs in the social sciences but less than 15 percent of those in engineering. The share of jobs held by women has increased in many STEM professions during the last two decades, but often these increases have been small. In computer science, the largest of these occupations, the proportion of women workers peaked during the late 1980s and early 1990s at around a third of the positions; since then their share of these jobs has declined.

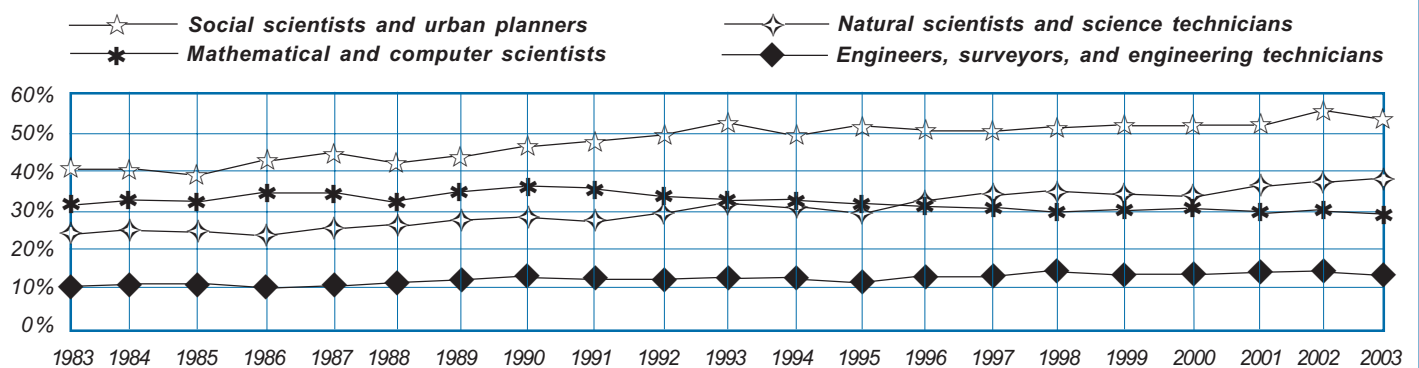
Like the legendary King Sisyphus of Corinth, condemned to push a heavy rock up a steep hill in Hades only to have it roll back down every time it neared the top, growth during the last two decades in the employment of women in some science and technology occupations has been offset by movements in the opposite direction in others, notably computer science. The graph below sums up the record: increasing proportions of jobs for women in the social and natural sciences, but only slight changes in their portion of employment in the much larger occupational group of engineers, and a decline in the share of positions held by women in the equally large group of mathematical and computer scientists.

These will be disappointing findings for science, technology, engineering and mathematical ("STEM")

workforce policymakers. Making better use of the talent of women, minorities, and other groups who have been under-represented in U.S. science and technology has been a prominent policy objective for at least a quarter of a century. Greater diversity in the STEM workforce has been supported by the Congress, academia, business, industry, and professional societies, not only as a matter of equal employment opportunity but also for reasons of simple American self-interest. In an age in which technical skill is a key to economic prosperity, many people believe that every source of skilled labor should be utilized to the fullest possible extent.

This report examines the record of the last 20 years with respect to the employment of women in STEM occupations; a separate report will deal with under-represented minorities. Exhibit 2 on pages

Exhibit 1: Percent of women in broad STEM occupational groups, 1983-2003



For source data, see Exhibits 2 and 3. Group definitions for 2003 do not precisely match those for 1983-2002.

4-5 provides consistent data on women's share of STEM jobs from 1983 through 2002. Exhibit 3 on page 6 provides additional information for 2003, when major revisions were adopted in the occupational definitions used for these statistics. Source data from the Bureau of Labor Statistics (BLS) for these two exhibits were described in the previous report in this series, *Twenty Years of Scientific and Technical Employment*, available on the internet at www.cpst.org. This earlier report provides the baseline numbers used to calculate the statistics provided below on the employment of women. It also contains information on such details as the differences between the occupational categories used for the 20-year period between 1983 and 2002 and the revised categories used for 2003. Data archives at the CPST web site provide additional supporting materials for both this previous report and the current one.

Small improvements, but a long way to go. Progress during the last 20 years in raising women's participation in science and technology has been mixed, at best. Overall trends provide the context for details about the STEM occupations. In 1983, 44 percent of all jobs in the U.S. were held by women. By 2002, this level of labor force participation had risen only slightly, to 47 percent. In managerial and professional specialty occupations, rises in women's shares of work were larger, from 41 to 50 percent. In the professional specialties alone, the percentage of jobs held by women went from 48 to 55 percent.

In STEM occupations, the percentages of employment

for women were lower, ranging from 16 to 19 percent of those jobs in 1983 (exact figures depend on how STEM professions are defined, as Exhibit 2 shows), to 23 to 26 percent of them in 2002. On the whole, women's representation in science and technology increased by about the same amounts as did their representation in professions in general, but this did little to reduce the differences between STEM occupations and other kinds of professional work. In 1983, there was a gap of 29 percentage points between the representation of women in all professions and their representa-

tion in STEM professions — and despite some growth in both of these numbers during the next 20 years, there was still a 29-point gap in 2002. Many reasons may account for this gap, including behavioral tendencies both of employers and of employees of either gender. Purely statistical factors also play a part. High rates of participation by women in all professional occupations combined are to be expected when the two largest professions are nursing and elementary and secondary teaching. Outside those two fields, many of the remaining professional specialties resemble STEM occupations in their representation of women.

Comparisons within the STEM occupations. Social scientists are more likely to be women than are other broad types of STEM occupations. In 1983, more than half of all psychologists were women, and by 2002 their share of these jobs was close to two-thirds. During the same period, the portion of women in economics increased from a third of those positions to over half of them, although most of this increase came from market and survey researchers, who were treated as part of economics in these BLS data until 2003.

Jobs for nonacademic sociologists are rare enough that the BLS data for 1983 through 2002 do not support estimates of the proportion of them held by women. Levels of women's employment are lower in the residual set of "other" social science occupations, but here, too, there was significant growth over the twenty-year period in the representation of women.

The natural and mathematical sciences are in the middle

About the STEM Workforce Data Project

The purpose of the STEM Workforce Data Project is to identify and distribute reliable statistics on scientific, technological, engineering and mathematical workers in the United States. Like the similar IT Workforce Data Project (see www.cpst.org for those reports), the STEM project draws on the full range of statistical resources offered by U.S. federal agencies as well as other private sources of information.

This is a project of the Commission on Professionals in Science and Technology (CPST) in Washington, D.C., supported by a grant from the Alfred P. Sloan Foundation. Queries about the STEM project are welcome. The principal investigators are Eleanor Babco, CPST's Executive Director (202-326-7080; ebabco@cpst.org), and Richard Ellis of Ellis Research Services in Carlisle, PA (717-218-9818; raellis@earthlink.net). Dr. B. Lindsay Lowell of the Center for the Study of International Migration at Georgetown University will work on foreign content in the U.S. STEM workforce. Dr. Ronil Hira of the Rochester Institute of Technology will comment on policy implications of STEM workforce data. Robert Weatherall, the retired past director of the Office of Career Services at MIT, is participating in the project as a reviewer of draft reports. Patricia Eng of NASA and the Nuclear Regulatory Commission, who is also an expert on statistics for the Society of Women Engineers, also participated in reviews of this report.

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of the range of STEM occupations in terms of participation by women. There are striking variations within these broad groups. Greater representation of women characterizes all natural science professions, especially medical science, where women accounted for over half of all employment by 2002. The only other natural science occupation to reach similar levels of participation by women is the group of biological technicians, but notable rises in women's representation can also be observed over the 20-year period in agriculture and forestry science, biological science, and the residual groups of "other natural scientists" and "other science technicians."

In mathematical and computer sciences, strong increases are also evident in the number of women employed as operations and systems researchers and analysts (this is the complete occupational title used by BLS; Exhibit 2 uses a condensed version). The remaining mathematical occupations are small enough that reliable estimates of women's shares of employment cannot be made. In computer science, the percentage of jobs held by women in the very large group of computer systems analysts, scientists, programmers, and related faculty was lower at the end of the 20 year period than it was at its outset. Overall growth in these information technology (IT) occupations was so strong during the decade of the 1990's that even while the women's *share* of these jobs was declining, their *absolute numbers* in this occupational group continued to increase through the year 2000. Considered as a proportion of the total, however, women's employment in computer science peaked between 1989 and 1991 at better than 35 percent of all of the positions, and since that time this share has declined.

Only 10 percent of the jobs in engineering were held by women in 1983, and 20 years later in 2002 their share of employment was only four percentage points higher. The largest gains were in chemical engineering, which has produced significant numbers of women graduates for many years.

Data for 2003. Exhibit 3 on page 6 provides similar information for the most recent year of complete statistics from BLS. As explained in more detail in the first report in this series, a completely revised set of occupational categories was adopted in 2003, so many detailed results are no longer precisely comparable with the time series for 1983-2002. Nevertheless, most results for 2003 are very similar to those for 2002. Where differences are apparent, they are likely to be due to changes in the makeup of the occupational groups. For example, social scientists are now included with other kinds of scientists in broad summary datasets, and so this new combined "life, physical, and social science" category has higher proportions of women workers than did the earlier set of life and physical scientists alone. Another striking change is a large drop in women's share of jobs for economists, which is a consequence of separating out the market and survey researchers who were previously included in that group.

Women's unemployment. Additional BLS datasets are available which are consistent with the Current Population Survey (CPS) time series used for Exhibits 2 and 3 (and also for the previous report in this series). These support examination of gender differences in unemployment rates and compensation. The source tabulations are stored in the data archive for this report at <http://www.cpst.org>; they can also be downloaded directly from the BLS file transfer site

at <ftp://ftp.bls.gov/pub/special.requests/lf/>.

A ten year time series can be formed for unemployment statistics on men and women. As noted elsewhere, data for 2003 use new occupational titles that are not always consistent with those used in earlier years, but problems of comparability diminish if the time series are limited to the broad summary groups. An equally compelling reason to limit results to broad STEM occupations is that CPS samples are not large enough to generate reliable estimates of women's unemployment for most of the detailed STEM job titles.

Results are provided in Exhibit 4 on page 7. A simple ratio obtained by dividing rates for women by those for men provides a convenient summary statistic: ratios greater than 1.0 mean that women have higher rates of unemployment than men, while results lower than 1.0 mean that women have the lower rates. All these data are for the "experienced unemployed," and do not include new graduates seeking work for the first time, persons who may have accepted work outside their field of specialization as a temporary expedient, or discouraged workers who have given up seeking work and so are no longer included at all in federal statistics on the labor force.

Across all occupations, unemployment rates for women during the last 10 years have been a little lower than those for men. However, this is not the case for women who have been working in STEM occupations, who are 14 percent *more* likely than similar men to be among the experienced unemployed. This finding is based on the average ratio for STEM occupations during the decade covered by the time series. Because estimates for unemployed persons are necessarily small, possible sampling errors in the re-

(text continues on page 6)

Exhibit 2**Percentages of women in STEM occupations, 1983-2002**

(For the population counts on which these proportions are based, see Exhibit 2 in the first report in this series.)

	1983	1984	1985	1986	1987	1988	1989
Larger aggregates, for comparisons:							
All employed persons, 16 years and over	43.7%	43.7%	44.1%	44.4%	44.8%	45.0%	45.2%
All managerial and professional specialty occupations	40.9	41.6	42.7	43.4	44.3	44.7	45.2
All professional specialty occupations	48.1	48.5	49.1	49.4	50.1	49.8	50.4
STEM summaries:							
All occupations combined	18.9	19.9	19.9	20.4	21.3	21.1	22.6
All occupations except social scientists	17.0	18.1	18.4	18.6	19.2	19.2	20.7
All occupations except science and engineering technicians	18.4	19.4	19.6	20.6	21.7	21.1	23.1
All occupations except social scientists and technicians	15.9	17.0	17.6	18.3	19.0	18.6	20.6
STEM details:							
Natural scientists and science technicians	23.5	24.9	24.2	23.5	25.2	25.7	27.2
Natural scientists	20.9	20.0	20.0	21.5	22.5	23.3	26.1
Agricultural and forestry scientists and faculty	9.0	10.2	13.8	13.8	18.0	15.0	20.6
Biological and life scientists, including faculty	35.8	27.9	30.0	33.3	32.6	35.6	34.4
Chemists and chemistry faculty	23.3	22.8	20.9	22.3	22.7	23.2	26.9
Medical scientists, including faculty	--	--	--	--	31.5	--	42.4
Physicists, astronomers, and physics faculty	--	--	--	--	--	--	--
Other natural scientists and faculty	16.1	15.1	14.6	16.0	15.9	10.7	18.0
Science technicians	29.2	35.5	33.2	27.9	31.4	31.0	29.5
Biological technicians	38.5	47.3	42.6	36.4	42.4	41.8	37.3
Chemical technicians	26.8	26.4	25.0	24.4	24.7	27.2	21.6
Science technicians, n.e.c.	25.0	35.6	35.7	27.0	29.2	27.5	31.0
Mathematical and computer scientists (includes programmers)	30.7	32.9	32.6	34.9	34.9	32.4	35.2
Computer systems analysts, scientists, programmers, and faculty	30.5	33.2	31.9	34.3	34.4	30.7	33.8
Operations and systems researchers and analysts	31.0	31.4	34.8	39.5	37.6	39.5	41.0
Actuaries	--	--	--	--	--	--	--
Statisticians	--	--	--	--	--	--	--
Mathematical scientists, n.e.c.	--	--	--	--	--	--	--
Mathematical science faculty	--	--	28.0	--	--	--	31.5
Engineers, surveyors, and engineering technicians	10.0	10.3	10.6	10.0	10.3	11.1	11.4
Engineers and surveyors	5.8	6.2	6.7	6.0	6.9	7.3	7.5
Engineers	5.9	6.3	6.8	6.0	7.0	7.3	7.6
Aerospace engineers	7.5	3.8	4.2	7.5	7.7	6.1	3.6
Agricultural engineers	--	--	--	--	--	--	--
Chemical engineers	6.0	8.9	9.4	8.5	11.1	12.3	14.9
Civil engineers	3.8	6.3	4.5	2.6	4.3	6.0	5.6
Electrical and electronics engineers	6.2	7.1	8.3	6.9	7.2	7.9	8.4
Industrial engineers	11.0	9.4	10.7	10.8	13.6	12.7	11.6
Marine engineers and naval architects	--	--	--	--	--	--	--
Mechanical engineers	2.7	4.9	3.7	3.5	4.3	3.7	4.8
Metallurgical and materials engineers	--	--	--	--	--	--	--
Mining engineers	--	--	--	--	--	--	--
Nuclear engineers	--	--	--	--	--	--	--
Petroleum engineers	--	--	--	--	--	--	--
Engineers, n.e.c., including sales engineers (1992 onward)	4.7	4.7	6.5	5.2	5.9	7.0	8.0
Engineering faculty	--	--	--	--	--	--	--
Surveyors and mapping scientists	--	--	--	--	--	--	--
Engineering and related technologists and technicians	18.4	18.3	18.0	17.7	17.1	18.8	19.2
Drafting occupations	17.6	15.4	17.5	19.4	15.9	16.2	20.6
Electrical and electronic technicians	12.3	13.9	13.2	12.5	14.4	14.3	14.1
Industrial engineering technicians	--	--	--	--	--	--	--
Mechanical engineering technicians	--	--	--	--	--	--	--
Surveying and mapping technicians	--	11.7	9.4	10.0	6.2	12.8	11.4
Engineering technicians, n.e.c.	28.1	31.0	28.8	25.8	26.6	31.3	26.3
Social scientists and urban planners	40.5	40.7	38.5	42.4	45.4	42.4	44.5
Economists, including faculty	33.3	34.1	31.9	38.6	37.8	32.6	39.1
Psychologists, including faculty	55.0	51.3	48.5	51.1	52.9	54.2	52.2
Sociologists, including faculty	--	--	--	--	--	--	--
Other social scientists and faculty	20.0	28.6	25.4	29.5	39.1	25.4	30.9

Notes: dashes mean sampled data cannot support estimates of the number of jobs held by women; "n.e.c." means "not elsewhere classified"; "faculty" are postsecondary teachers. Adapted from "Employed persons by detailed occupation (3-digit census code) and sex, annual averages 1983-2002," U.S. Bureau of Labor Statistics. See STEM Workforce Data Project Report 1, "Twenty Years of Scientific and Technical Employment."

TIPS ON VIEWING THESE DATA: although the Adobe Acrobat reader will support viewing two adjacent pages of a report at the same time, the size and level of detail in this tabulation will make such an approach unsatisfactory for many users, especially those whose computer monitors use lower levels of resolution (such as 640 x 480 or even 800 x 600). We recommend that the report be printed out. Users who would like to manipulate these numbers can download them from the STEM Workforce Data Project archive at www.cpst.org.

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
45.2%	45.4%	45.6%	45.7%	46.0%	46.1%	46.2%	46.2%	46.2%	46.5%	46.5%	46.5%	46.6%
45.8	46.3	47.3	47.8	48.1	48.0	48.6	48.9	49.0	49.5	49.8	50.0	50.5
51.1	51.6	52.5	53.1	52.7	52.9	53.3	53.3	53.3	53.5	53.9	53.7	54.7
23.3	23.5	23.3	24.4	24.2	23.5	23.8	24.1	24.9	24.9	25.5	25.4	26.1
21.2	21.1	20.9	21.8	21.8	20.8	21.3	21.9	22.6	22.6	23.3	23.3	23.7
23.6	24.2	23.9	24.9	24.4	23.9	23.8	24.3	24.6	25.1	25.6	25.1	25.9
21.0	21.2	20.8	21.6	21.3	20.5	20.7	21.5	21.9	22.3	22.9	22.5	23.0
27.6	27.1	29.3	31.8	31.6	29.9	31.2	33.3	34.4	33.4	36.0	36.9	38.2
25.5	26.0	26.4	29.3	29.3	27.4	28.7	30.5	30.3	30.4	33.7	33.3	34.1
15.1	13.8	19.4	22.9	21.3	16.2	20.0	27.8	22.1	19.7	27.7	19.4	24.7
39.4	37.1	31.3	39.6	35.5	33.8	37.2	43.6	38.1	43.3	45.6	42.6	41.6
26.6	30.3	30.8	27.2	35.0	32.1	28.4	24.7	33.1	27.7	30.5	30.1	29.3
33.3	32.8	36.4	42.3	40.0	38.4	44.3	41.7	41.0	42.7	46.6	47.4	56.9
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19.1	16.2	16.8	19.3	18.6	19.0	16.8	22.3	18.8	18.5	24.0	27.5	26.1
31.7	29.6	36.0	37.5	36.8	35.5	37.6	39.4	43.2	40.6	41.8	45.4	47.4
40.6	38.5	51.3	59.3	52.8	50.0	58.2	57.5	68.5	64.2	59.6	62.2	59.5
28.2	25.8	27.3	25.7	26.0	21.4	26.9	22.4	21.3	29.1	21.1	26.1	32.8
28.1	28.1	31.0	27.9	31.0	33.3	28.7	34.4	33.3	26.9	35.5	37.4	39.6
35.9	35.7	33.4	32.3	32.5	31.4	30.5	30.3	29.2	30.0	30.3	29.4	29.9
35.0	33.7	31.1	30.8	30.7	29.7	29.0	29.0	27.5	27.9	28.5	27.2	27.2
41.3	43.3	45.3	39.6	41.4	39.2	42.6	40.8	42.0	46.5	45.2	47.2	48.7
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29.4	36.0	--	--	--	--	25.5	--	--	--	--	--	--
11.9	11.6	11.5	11.7	12.0	11.4	12.3	12.4	14.2	13.2	13.2	13.6	13.9
7.9	8.2	8.5	8.7	8.4	8.6	8.8	9.7	11.2	10.6	9.8	10.2	10.7
8.0	8.2	8.5	8.8	8.5	8.5	8.7	9.7	11.2	10.6	9.9	10.3	10.8
7.3	8.8	6.8	7.3	14.7	5.1	5.0	4.6	8.1	11.4	9.1	8.1	7.8
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11.4	9.9	5.6	10.3	7.1	11.3	14.7	17.4	15.9	15.9	10.6	12.0	16.9
5.1	5.8	7.8	9.5	8.3	7.4	7.0	7.7	12.2	9.4	9.6	10.5	10.9
8.7	8.7	8.5	7.7	6.7	8.7	8.0	9.2	9.1	10.2	9.9	9.7	10.3
11.8	13.5	14.2	16.4	14.7	14.8	13.2	16.3	18.3	16.9	15.4	17.4	17.0
--	--	--	--	--	--	--	--	--	--	--	--	--
5.4	4.8	5.3	5.4	5.3	4.5	6.9	6.0	6.9	7.1	6.4	6.2	7.0
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8.8	10.3	10.6	8.5	10.5	8.6	7.1	10.0	13.3	10.9	10.3	10.4	9.8
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19.8	18.5	17.5	17.8	19.5	17.8	19.9	18.5	20.8	19.0	20.5	21.0	20.8
18.9	17.3	19.1	18.3	19.7	18.3	21.0	16.7	19.3	18.3	23.3	20.0	21.5
15.4	13.6	12.0	15.4	15.2	11.1	12.7	14.3	16.9	14.4	17.2	18.5	19.2
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5.3	10.3	8.2	5.5	7.4	12.9	12.3	10.5	12.7	10.4	7.6	13.2	9.2
32.1	28.7	25.9	24.9	27.0	27.8	33.5	30.5	33.5	31.6	30.6	30.1	27.8
47.4	49.4	49.8	53.2	50.0	52.2	51.5	50.8	51.7	53.2	53.3	53.1	56.0
41.4	41.6	40.6	44.3	41.1	46.7	50.0	47.4	43.4	45.7	47.2	47.1	51.5
56.7	59.2	59.9	62.9	58.4	59.2	58.8	58.0	62.0	62.3	62.3	59.9	64.8
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29.4	31.9	36.2	36.2	34.9	37.9	32.9	35.4	39.6	34.9	34.9	42.9	35.2

(text continued from page 3)

sults for even broad STEM occupational groups dictate caution in interpreting these results, especially when groups like natural scientists, science technicians, and social scientists are still relatively small, and when changes in occupational codes have changed the composition of groups like science technicians in 2003. Still, it seems clear that the groups for engineers and science technicians are par-

ticularly likely to contribute to this overall outcome for all scientific and technical occupations combined.

Women’s Compensation.

Data for wages are available for all women, and so they are much more robust than those for unemployment, which rely on estimates for a small part of the labor force. Exhibit 5 on page 8 resembles Exhibit 4, but in this case the time series is limited to nine years, because

data for 1994 are not available. Again, some review of issues that can influence interpretations of these results is advisable before drawing conclusions. The dollar wage amounts are median weekly earnings. Even if there is *no* actual gap in compensation between men and women in the STEM occupations, one should expect wage data for many of the groups of women in these data to be lower than the earn-

Exhibit 3

Percentages of women in STEM occupations, 2003

(For the population counts on which these proportions are based, see Exhibit 3 in the first report in this series.)

STEM FIELDS	Percent Women	STEM FIELDS	Percent Women
Larger aggregates, for comparisons:		(STEM details, continued)	
Employed persons, 16 years & over	46.8%	Computer & mathematical scientists	29.0%
Managers & professionals	50.5	Computer systems managers & scientists	28.4
Professional occupations	56.4	Computer systems managers	30.5
STEM summaries:		Computer scientists	28.1
All occupations combined	26.1	Computer scientists & systems analysts	30.4
All occupations except the social scientists	24.4	Computer software engineers	24.4
All occupations except technicians	25.9	Computer programmers	28.1
All occupations except social scientists & technicians	23.9	Computer support specialists	37.4
STEM details:		Database administrators	40.1
Life, physical, & social scientists & technicians	43.0	Network & systems administrators	21.7
Life, physical, & social scientists	44.1	Network & data communications analysts	23.6
Natural science managers & scientists	37.4	Mathematical occupations	42.7
Natural science managers	38.0	Actuaries	20.2
Life & physical scientists	37.4	Mathematicians	27.6
Agricultural & food scientists	21.4	Operations research analysts	50.6
Astronomers & physicists	8.0	Statisticians	35.4
Atmospheric & space scientists	19.7	Miscellaneous mathematical scientists	—
Biological scientists	46.1	Engineers & engineering technicians	13.4
Chemists & material scientists	36.4	Engineering managers & engineers	10.4
Conservation scientists & foresters	12.7	Engineering managers	10.4
Environmental scientists & geoscientists	29.8	Engineers	10.4
Medical scientists	50.5	Aerospace engineers	11.0
All other physical scientists	41.8	Agricultural engineers	4.0
Social scientists	54.6	Biomedical engineers	15.5
Economists	19.7	Chemical engineers	14.9
Market & survey researchers	56.6	Civil engineers	8.7
Psychologists	65.8	Computer hardware engineers	10.4
Sociologists	45.8	Electrical & electronics engineers	7.1
Urban & regional planners	34.6	Environmental engineers	20.6
Miscellaneous social scientists	41.0	Industrial engineers, including health & safety	19.2
Life, physical, & social science technicians	39.4	Marine engineers & naval architects	9.2
Agricultural & food science technicians	39.8	Materials engineers	10.8
Biological technicians	47.8	Mechanical engineers	5.5
Chemical technicians	28.8	Mining & geological engineers	27.0
Geological & petroleum technicians	33.2	Nuclear engineers	—
Nuclear technicians	38.0	Petroleum engineers	7.2
Other life, physical, & social science technicians	44.7	Surveyors, cartographers & photogrammetrists	13.3
		Other engineers	12.5
		Engineering technologists & technicians	21.3
		Drafters	21.7
		Surveying & mapping technicians	16.9
		All other engineering technicians	21.8

(STEM details continued in next column)

ings of comparable men. What explains this seemingly contradictory statement? The answer is that recruitment of women into many areas of science and technology is a relatively recent development. To be sure, significant numbers of women have been employed for many years in such occupations as biology, chemistry, computer science, and psychology. In other STEM occupations, however, shares of women practitioners have increased in recent years. The case of chemical engi-

neering is instructive. For some years now, increasing proportions of the graduating classes in this professional specialty have consisted of women. Movement of these graduates into the workforce means that women chemical engineers tend to be younger than the men in this profession, and in turn that means that as a group, they are less experienced than men and so they will tend to have lower wages.

Accordingly, thorough examinations of gender gaps in compensa-

tion need to allow for variations in experience (or age, which is a workable substitute for experience). This has not been possible here, so data in Exhibit 4 that show women earning less than men are not conclusive evidence of gaps in real wages.

There is a statistic in Exhibit 5 that is less vulnerable to this problem of interpretation: the trend across time. As in Exhibit 3, simple ratios have been used to summarize gross differences between wages of men and those of

Exhibit 4

Unemployment rates by gender: broad STEM occupational groups, 1994-2003

STEM FIELDS	GENDER	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Larger aggregates, for comparisons:											
<i>All Occupations, age 16 years and over</i> (average ratio, all years: 0.976)	Women	5.8%	5.4%	5.2%	4.8%	4.4%	4.1%	3.9%	4.5%	5.5%	5.5%
	Men	6.2%	5.5%	5.3%	4.8%	4.2%	4.0%	3.8%	4.7%	5.9%	6.3%
	Ratio	0.935	0.982	0.981	1.000	1.048	1.025	1.026	0.957	0.932	0.873
<i>Executive/managers plus prof. specialties</i> (average ratio, all years: 1.076)	Women	2.9%	2.6%	2.5%	2.1%	2.0%	2.0%	1.9%	2.3%	3.1%	3.1%
	Men	2.5%	2.4%	2.3%	1.9%	1.7%	1.8%	1.6%	2.3%	3.3%	3.4%
	Ratio	1.160	1.083	1.087	1.105	1.176	1.111	1.188	1.000	0.939	0.912
<i>Professional specialty occupations</i> (average ratio, all years: 1.006)	Women	2.6%	2.6%	2.4%	2.2%	2.0%	1.9%	1.9%	2.1%	2.6%	3.0%
	Men	2.5%	2.4%	2.3%	2.0%	1.8%	1.9%	1.6%	2.3%	3.3%	3.8%
	Ratio	1.040	1.083	1.043	1.100	1.111	1.000	1.188	0.913	0.788	0.789
All STEM occupations (average ratio, all years: 1.143)	Women	2.7%	2.6%	2.4%	2.2%	2.0%	1.9%	2.4%	3.1%	4.7%	5.0%
	Men	2.9%	2.5%	2.1%	1.6%	1.6%	1.8%	1.6%	2.9%	4.4%	4.9%
	Ratio	0.931	1.040	1.143	1.375	1.250	1.056	1.500	1.069	1.068	1.020
<i>Science/computer/engineering managers</i> (average ratio, all years: 1.659)	Women	—	—	—	—	—	—	—	—	—	6.8%
	Men	—	—	—	—	—	—	—	—	—	4.1%
	Ratio	—	—	—	—	—	—	—	—	—	1.659
<i>Natural scientists</i> (average ratio, all years: 1.415)	Women	1.1%	3.0%	3.4%	2.1%	2.7%	2.4%	0.9%	1.7%	2.7%	1.7%
	Men	1.1%	2.7%	1.8%	2.5%	2.1%	0.6%	0.9%	1.3%	2.6%	2.5%
	Ratio	1.000	1.111	1.889	0.840	1.286	4.000	1.000	1.308	1.038	0.680
<i>Science technicians</i> (average ratio, all years: 1.800)	Women	8.2%	8.2%	6.5%	3.5%	2.4%	2.5%	3.5%	3.7%	5.1%	10.5%
	Men	5.4%	2.2%	2.6%	2.9%	2.5%	2.3%	1.9%	1.9%	5.2%	4.7%
	Ratio	1.519	3.727	2.500	1.207	0.960	1.087	1.842	1.947	0.981	2.234
<i>Mathematical and computer sciences</i> (average ratio, all years: 1.022)	Women	2.4%	1.7%	1.7%	1.7%	1.4%	1.7%	2.1%	2.8%	5.2%	4.8%
	Men	1.9%	1.8%	1.4%	1.3%	1.3%	2.3%	1.7%	4.0%	5.4%	6.2%
	Ratio	1.263	0.944	1.214	1.308	1.077	0.739	1.235	0.700	0.963	0.774
<i>Engineers and surveyors</i> (average ratio, all years: 1.473)	Women	3.0%	3.4%	1.1%	2.0%	2.5%	2.6%	3.2%	3.1%	4.8%	7.1%
	Men	3.6%	2.3%	2.0%	1.3%	1.6%	1.4%	1.3%	2.2%	3.8%	4.0%
	Ratio	0.833	1.478	0.550	1.538	1.563	1.857	2.462	1.409	1.263	1.775
<i>Engineering & related technicians</i> (average ratio, all years: 1.291)	Women	4.5%	3.2%	3.8%	3.4%	3.0%	1.6%	4.3%	5.1%	5.9%	7.8%
	Men	3.9%	3.6%	3.5%	1.8%	1.8%	2.7%	2.9%	3.6%	5.3%	4.8%
	Ratio	1.154	0.889	1.086	1.889	1.667	0.593	1.483	1.417	1.113	1.625
<i>Social scientists and urban planners</i> (average ratio, all years: 1.276)	Women	1.1%	1.4%	1.9%	2.2%	1.5%	1.7%	2.0%	2.8%	3.7%	1.8%
	Men	1.5%	3.9%	2.4%	1.9%	1.1%	1.2%	0.8%	1.2%	2.2%	4.3%
	Ratio	0.733	0.359	0.792	1.158	1.364	1.417	2.500	2.333	1.682	0.419

Note: many of these occupational groups changed significantly in 2003. In particular: data for science, computer system, and engineering managers are only available for 2003, and are presented separately in order to help keep the time series from 1994 through 2003 as consistently defined as possible. Data for 1994 through 2002, but not those for 2003, include university faculty. Revised occupational titles for computer fields in 2003 result in reclassifying many people formerly counted as engineers.

women. Success in reducing gender differences in pay should lead to larger values for these ratios over time, and indeed the data for the workforce as a whole show signs of this kind of change, with pay for women at 75.5 percent of that for men in 1995 and 79.4 percent in 2003. Among managerial and professional occupations, however, trends appear to be running in the opposite direction. Within the STEM professions, a trend toward larger differences between the wages of men and women seems fairly clear in math

and computer science, and may be a possibility in some other science and technology occupations.

Clearly, more work is needed on this question. The literature on gender gaps in compensation is very large and includes many competing claims, but findings of widening differences in pay would be consistent with at least some of the most recent work. In early 2002, a report on this question done for the Congress by the U.S. Government Accountability Office* con-

* The GAO recently changed its name.

cluded that wage differences were on the rise (see Shannon Henry, "Male-Female Salary Gap Growing," *The Washington Post*, January 24, 2002, page A2). Additional evidence is available from recent editions of compensation surveys conducted by the American Chemical Society and IEEE-USA. These surveys use regression models to generate estimates of the *net* influence, after allowance for all other factors, of particular variables on pay. Gender is included as a possible predictor, and results indicate that its effect has increased in recent years.

Exhibit 5

Wage rates (median weekly earnings) by gender: broad STEM occupational groups, 1995-2003

STEM FIELDS	GENDER	1995	1996	1997	1998	1999	2000	2001	2002	2003
Larger aggregates, for comparisons:										
<i>All Occupations, age 16 years and over (average ratio, all years: 0.763)</i>	Women	\$406	\$418	\$431	\$456	\$473	\$491	\$511	\$530	\$552
	Men	\$538	\$557	\$579	\$598	\$618	\$646	\$672	\$680	\$695
	Ratio	0.755	0.750	0.744	0.763	0.765	0.760	0.760	0.779	0.794
<i>Executive/managers plus prof. specialties (average ratio, all years: 0.718)</i>	Women	\$605	\$616	\$632	\$655	\$681	\$709	\$732	\$756	\$758
	Men	\$829	\$852	\$875	\$905	\$952	\$994	\$1,038	\$1,058	\$1,059
	Ratio	0.730	0.723	0.722	0.724	0.715	0.713	0.705	0.715	0.716
<i>Professional specialty occupations (average ratio, all years: 0.742)</i>	Women	\$632	\$647	\$662	\$682	\$707	\$725	\$749	\$773	\$739
	Men	\$827	\$857	\$883	\$895	\$939	\$977	\$1,021	\$1,037	\$1,105
	Ratio	0.764	0.755	0.750	0.762	0.753	0.742	0.734	0.745	0.669
All STEM occupations (average ratio, all years: 0.801)										
<i>Science/computer/engineering managers (average ratio, all years: 0.885)</i>	Women	—	—	—	—	—	—	—	—	\$1,280
	Men	—	—	—	—	—	—	—	—	\$1,446
	Ratio	—	—	—	—	—	—	—	—	0.885
<i>Natural scientists (average ratio, all years: 0.789)</i>	Women	\$663	\$674	\$668	\$732	\$731	\$726	\$758	\$879	\$750
	Men	\$794	\$822	\$878	\$908	\$939	\$1,007	\$996	\$1,025	\$980
	Ratio	0.835	0.820	0.761	0.806	0.778	0.721	0.761	0.858	0.765
<i>Science technicians (average ratio, all years: 0.750)</i>	Women	\$439	\$443	\$462	\$463	\$480	\$460	\$558	\$576	—
	Men	\$605	\$598	\$588	\$623	\$656	\$678	\$689	\$733	\$859
	Ratio	0.726	0.741	0.786	0.743	0.732	0.678	0.810	0.786	—
<i>Mathematical and computer sciences (average ratio, all years: 0.842)</i>	Women	\$732	\$775	\$813	\$821	\$855	\$894	\$891	\$927	\$906
	Men	\$850	\$889	\$924	\$959	\$1,024	\$1,032	\$1,113	\$1,154	\$1,130
	Ratio	0.861	0.872	0.880	0.856	0.835	0.866	0.801	0.803	0.802
<i>Engineers and surveyors (average ratio, all years: 0.842)</i>	Women	\$806	\$793	\$837	\$831	\$933	\$938	\$1,022	\$1,011	\$906
	Men	\$934	\$961	\$995	\$1,012	\$1,056	\$1,122	\$1,149	\$1,180	\$1,193
	Ratio	0.863	0.825	0.841	0.821	0.884	0.836	0.889	0.857	0.759
<i>Engineering & related technicians (average ratio, all years: 0.825)</i>	Women	\$519	\$542	\$529	\$529	\$625	\$586	\$608	\$620	\$569
	Men	\$613	\$621	\$631	\$668	\$673	\$721	\$743	\$781	\$788
	Ratio	0.847	0.873	0.838	0.792	0.929	0.813	0.818	0.794	0.722
<i>Social scientists and urban planners (average ratio, all years: 0.763)</i>	Women	\$612	\$642	\$625	\$661	\$682	\$708	\$750	\$738	\$833
	Men	\$776	\$736	\$897	\$878	\$847	\$963	\$1,056	\$996	—
	Ratio	0.789	0.872	0.697	0.753	0.805	0.735	0.710	0.741	—

See notes for Exhibit 3. Based on the BLS "AAT39" series of special tabulations, available in the data archive for this report at www.cpst.org. No data are available for 1994; 2003 statistics for STEM managers are limited to computer and engineering managers for men and computer managers only for women; many other small occupational groups are not always included in the source data.