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Chart 1 Ratio of Women to Men Median Annual Earnings

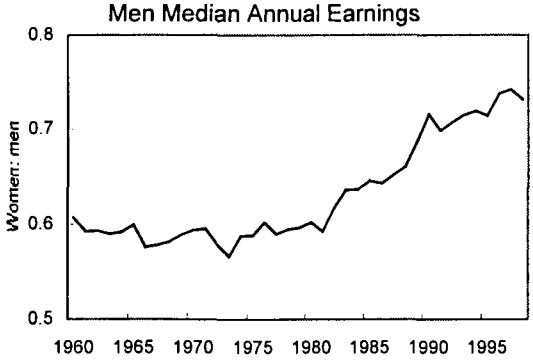


Chart 2 Workers Employed in IT Industries

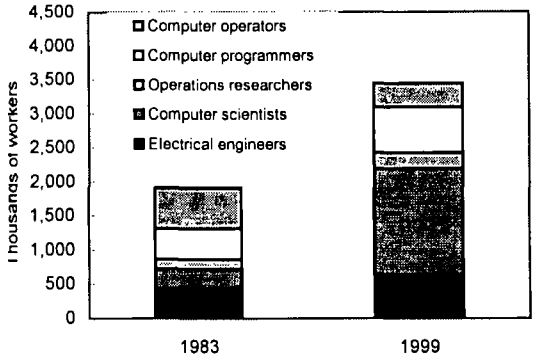


Chart 3 Median Weekly Earnings for All Workers

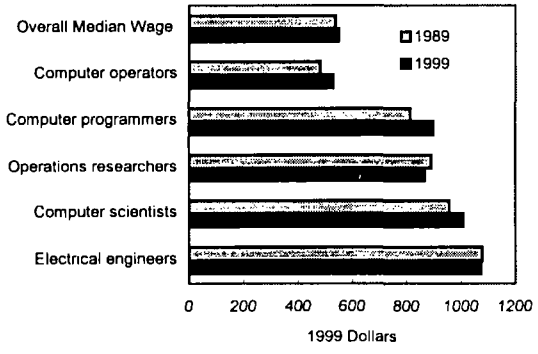


Chart 4 Females as a Percent of Total Workers

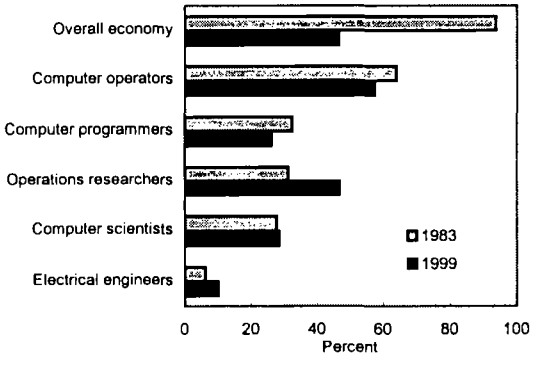


Chart 5 Gender Gap in Earnings in IT, 1997-1999

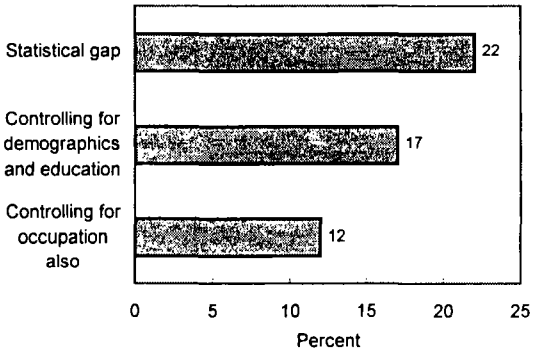


Chart 6 Gender Gap in Earnings, by Education

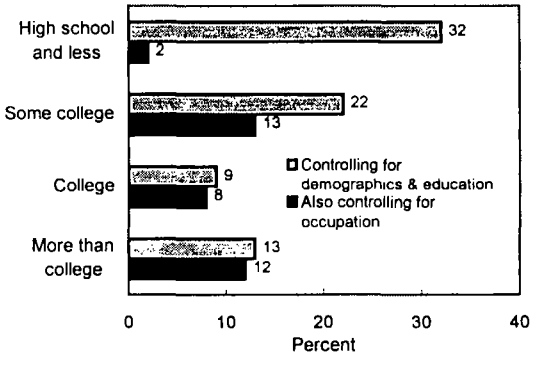
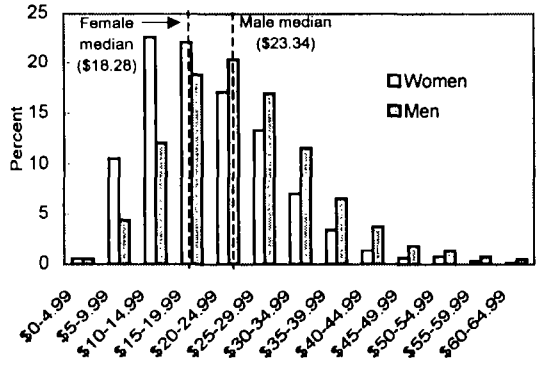


Chart 7 Hourly Wage Distribution by Gender



OPPORTUNITIES AND GENDER PAY EQUITY IN NEW-ECONOMY OCCUPATIONS

May 11, 2000

A Report by
The Council of Economic Advisers

OPPORTUNITIES AND GENDER PAY EQUITY IN NEW-ECONOMY OCCUPATIONS

EXECUTIVE SUMMARY

- The field of Information Technology (IT) has provided extraordinary job growth in the United States. Since 1983, employment in five core IT-related occupations has grown by 81 percent—an increase that greatly exceeded the 32 percent employment growth for the general economy.

- Employment in the five IT-related occupations provides excellent pay for both men and women. For example, the median annual earnings of women employed full-time in IT is over $40,000—nearly 50 percent higher than the $26,900 earned by women working outside of IT.

- However, an important gender employment gap exists in the IT occupations. Women are currently underrepresented in these occupations, making up only 29 percent of these occupations, compared with 47 percent of the workforce in the general economy.

- Furthermore, women are most underrepresented in the IT occupations where pay is highest—for example, in electrical engineering, which is just 10 percent female. This occupational disparity contributes to a lack of women in the highest paid jobs. While 20 percent of men employed in IT earn $69,740 or higher, only 7 percent of women earn this much.

- There is also a gender pay gap within IT occupations. A woman with median earnings in IT earns about 22 percent less than a man at the median. Part of this gap stems from differences in age, education, and occupational composition. Taking these factors into account lowers the gap to 12 percent—a gap similar to that estimated for the labor market more generally.

- IT occupations provide especially large rewards for education to women. The gender pay gap narrows sharply for women who have higher levels of education. Women who do not have college degrees face a pay gap of 13 to 20 percent, after adjusting for age and occupation. By contrast, women with a college degree or more face an 8 to 12 percent gap. At present, 49 percent of women in IT do not have a college degree.

- Reducing the pay gap in IT will require a relative increase in the proportion of young women who choose educational programs that prepare them for the higher-paying occupations in IT. In addition, policies that assist women in their career development, as through on-the-job training and mentoring, and that open greater possibilities for promotion can also enhance women's investment in these occupational skills and their retention rates, and can thus be expected to help close the gender wage gap.

OPPORTUNITIES AND GENDER PAY EQUITY IN NEW-ECONOMY OCCUPATIONS

1. INTRODUCTION

The progress made by women in the paid labor market has been one of the most important economic changes of the 20th century. The past century has seen an enormous increase in the proportion of women who work for pay. In 1999 about three-fifths of the adult female population were in the labor force (either employed or looking for work), a rate three times as high as the rate in 1900. And far more women today enter previously male-dominated professions.

The opening of opportunities in the labor market for women has gone hand in hand with improvements in labor market outcomes for women. One way of assessing this progress is in the earnings of women relative to men (see Chart 1). In 1967 a woman with median earnings was paid about 40 percent less than a man with median earnings (based on annual earnings of full-time, full-year workers). This pay gap, which resulted in an earnings ratio of about 0.60, remained little changed over the 1960s and 1970s, but subsequently narrowed, so that the earnings ratio was 0.73 for 1998 (the last year for which data on full-year workers is available). In 1999 a slightly different measure of pay equity—the average weekly earnings—indicated that the average full-time female worker earned about 77 percent of men's earnings.

This report provides evidence about the source of this pay gap by focusing on a narrow, but interesting, subset of occupations in the labor market—occupations related to Information Technology (IT). The report's focus on IT stems from the highly visible role IT has played in the new economy. IT is a highly paid, dynamic, and rapidly growing sector of the labor market. In fact, employment in the five core IT occupations grew 81 percent since 1983, dwarfing the 32 percent growth in the economy at large . Women in this sector have earnings that considerably exceed those outside IT, for example: an average woman working full-time in the IT occupations we studyearns $40,200 annually, compared to $26,900 in other occupations.

However, challenges still remain to enable women to share fully in the benefits of IT jobs. Currently, women are significantly underrepresented in IT, especially in the higher-paid IT occupations. In addition, much like in the economy at large,a gender earnings gap exists within IT jobs; weekly pay in the IT occupations is 23 percent less for women than for men—about the same as in the rest of the labor market. One distinctive feature of the IT sector, however, is how increased educational levels are rewarded for women; within IT jobs, the pay gap for women with college education is significantly smaller than for women with less education. And that gap closes more dramatically in the IT sector than in the economy at large. (Check) Studying the sources of this pay gap in IT is useful as a means of understanding the pay structure in this rapidly growing sector, and is instructive for illuminating gender differences in pay in the labor market more generally. In Section 2 we provide a brief background on the IT sector, and in Section 3 we report a statistical analysis of the gender wage gap in IT. Section 4 provides a discussion placing our results in a broader context. Section 5 concludes.

2. THE IT WORKFORCE

By most accounts the U.S. economy is experiencing a technological transformation that has changed the nature of work and placed a premium on a new set of skills. While this transformation

has affected many jobs in the economy, there is a core set of occupations at the forefront of the revolution—occupations in information technology. Although there is no exact definition of an IT worker, there are a number of occupations that quite clearly fall into the general domain of IT.[1] The analysis in this report considers a number of core IT occupations for which data are available from the Current Population Survey (CPS), a large nationally representative sample with information on the wages earned by a worker, their gender, and their occupation. These core IT occupations are:

- electrical and electronic engineers;
- computer systems analysts & scientists;
- operation and systems researchers & analysts;
- computer programmers; and
- computer operators.

Definitions of these occupations are provided in Box 1.

Box 1. Descriptions of IT Occupations

Electrical and Electronic Engineers design, develop, test, and manage the assembly of electrical and electronic equipment. Electrical and electronic engineers specialize in multiple areas including communications, computer electronics, power generation, transmission, and manufacturing. Electrical and electronic engineers develop new products as well as write performance requirements and maintenance schedules for previously designed ones. They are also frequently employed in testing equipment and solving operational problems.

Computer Systems Analysts and Scientists include computer engineers, software engineers, database administrators, and computer support analysts. Computer engineers work with the hardware and software aspects of system design and development often creating new computing devices while software engineers design and develop software for those systems. Database administrators work with database management software to reorganize and restructure data and are often responsible for preserving efficiency and security within the system. Computer support analysts provide assistance to users in the form of technical support for hardware, software, and systems.

Operations and Systems Researchers and Analysts conduct research and perform analyses to support management in increasing the performance of an organization. The analyst begins by defining the problem in terms of information technology and then selecting the appropriate technique to evaluate what changes should be made. Upon completion of the analysis and further research, the analyst generates and makes his recommendations to management.

Computer Programmers write and update the detailed instructions, called "programs" or "software," that delineate in a logical order the steps that a computer must execute in order to perform its specific function. In larger organizations, programmers follow descriptions related by systems analysts that are familiar with the task the computer system will need to perform. The transition from mainframe to personal computers has blurred the once clear distinction between users and programmers. More than ever, adept users and analysts are now writing their own programs using software designed to allow them to do so.

[1] For a further discussion of these and related issues see Carol Ann Meares et al. "The Digital Workforce: Building Infotech skills at the Speed of Innovation" U.S. Department of Commerce, Technology Administration, Office of Technology Policy, June 1999.

Computer Operators supervise the operation of computer hardware systems ensuring the maximum efficiency of the system. They often work with mainframes, minicomputers, or networks of personal computers. Computer operators respond to problems that result during operations and are in addition proactive in anticipating future problems. As increasingly sophisticated automation has encroached upon the operators traditional role, the responsibilities of operators has been gravitating towards other areas including network operations and database maintenance.

IT Occupations: High Wages and Rapid Growth

The combined employment levels in these five occupations has grown by almost 81 percent since 1983, with particularly strong growth in the last five years (Chart 2). In contrast, total employment in the overall economy grew by just 32 percent since 1983. Today these five IT occupations comprise approximately 3.4 million workers (about 2.6 percent of all employed workers). Employment projections by the Bureau of Labor Statistics suggest that rapid growth for computer-related occupations is expected to continue well into the 21st century.

Looking at specific occupations, the most notable feature is the strong and steady growth of computer system analysts and scientists. In 1983, this occupation has just over one quarter of million workers, or 14 percent of the total IT workforce. By 1999, there were 1.5 million workers in this occupation, 45 percent of the total. Also notable is the steady decline in the number of computer operators, perhaps stemming from changes in computing technology.

In addition to experiencing high employment growth, these occupations are also characterized by high wages. The median weekly wage for four of the five IT occupations—all but computer operators—easily exceeded median weekly earnings for all workers over the last 10 years (Chart 3). The median earnings for the highest-paid occupation—electrical and electronic engineers—were almost twice that of all workers ($1,073 vs. $549 in 1999).

Female Representation in IT

As in many other highly technical occupations, women are underrepresented in IT. In 1999 women represented 46.5 percent of all employed workers, but only 28.9 percent of the IT workforce (Chart 4). The percentage of women in these occupations has actually been declining since 1983 when it was 35.3 percent. These aggregate percentages, moreover, mask considerable variation across the five IT occupations. In 1999, women were particularly underrepresented in the higher-paying IT occupations. For example, in electrical and electronic engineering—the highest-paid of these IT occupations—women made up just 10.1 percent. In comparison, women made up 57.3 percent of computer operators—the lowest paid IT occupation. Part of the overall downward trend in female representation in IT can be accounted for by the general shift in employment away from computer operators toward occupations in which women are less well represented. Programs geared toward increasing the role of women in technical fields are discussed below.

3. An Analysis of the Gender Wage Gap in IT

Although women in IT earn far more than women in other sectors, the median weekly earnings of women who work full time in IT is about 23 percent less than men—about the same pay gap as is experienced in the labor market generally. A small part of this difference is plausibly due to women in the sample working fewer hours than men, but use of a measure of earnings per hour changes the gender pay gap only modestly—to about 22 percent.

The objective of this analysis is to explore the factors that underlie this hourly pay gap. A portion of the gap is due to differences in the characteristics of men and women, such as education

and age. Regression analysis can control for these differences, and thus compare the wages of similar men and women—of those with comparable education and age. In particular, a series of standard earnings regression models are estimated using a pooled sample of the 1997, 1998, and 1999 monthly CPS.[2] The dependent variable is the log of individuals' per hour earnings, and explanatory variables control for the year in which the individual was working and individual characteristics.[3]

The basic pay difference between women and men—the 22 percent pay gap—diminishes to 17 percent after controlling for educational attainment, age, and race (see Chart 5 and Appendix Table 1).[4] Women tend to be younger and slightly less well-educated than men in IT, thus controlling for these differences narrows the gap slightly. This gap might also narrow further if data were available on women's labor force experience (rather than age), since lower levels of experience at each age level could limit women's pay growth relative to men's.

Another factor affecting the differential pay of men and women in IT is that women tend to be employed in IT occupations that are lower paid than are men. For example, women are more likely to be computer operators than men are, and women are less likely to be computer systems analysts. Controlling for these occupational differences within the IT sector explains a significant portion of the pay gap—the gap falls to 12 percent after adding controls for occupational choices.[5] It may be tempting to conclude that this estimated 12 percent pay gap is therefore a rough measure of the extent of gender discrimination in the IT labor market. However, this measure may underestimate the true extent of pay discrimination. If capable women are promoted into higher-paying computer-related occupations at lower rates than men, then looking at the pay differentials between men and women within that occupation doesn't reveal the extent of pay discrimination—the glass ceiling limits their promotions and thus elevates the pay disparity between women and men.[6]

Differences in the Pay Gap Across Educational Levels

The average gender pay gap at the median—22 percent—masks striking differences in the gap between men and women at varying levels of education. Among women and men who have a high school degree or less, the pay gap is 32 percent even after accounting for differences in demographics. Similarly, the gap for workers with some college education is 22 percent after controlling for age and race. Since 16 percent of all women in IT have a high-school degree or less,

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[2] [Give sample size, and mention adjustments for changes in the monthly CPI.]

[3] All coefficients have been standardized to that they can be interpreted as the *percent change in earnings* associated with the explanatory variable. That is, we report e^b-1, where b is the estimated coefficient from the regressions.

[4] The results reported in Appendix Table 1 were estimated using median regression, rather than ordinary least squares (OLS). One advantage of median regression is that it allows one to safely ignore top-coding of the CPS data (for 1.7 percent of the sample, earnings are reported at the top-code value). A second advantage is that this allows easy comparison to the quantile regressions discussed below. Differences in "average" or "typical" individuals, described in the text, always refer to differences in the median. The same regressions were estimated using OLS, leading to similar inferences.

[5] This 12 percent "unexplained" pay gap is the same as one study feature in the Council of Economic Advisers (1998), "Explaining trends in the Gender Wage Gap."

[6] To illustrate this point, consider a hypothetical example. Suppose that a firm pays all of its programmers—men and women alike—the same wage. This firm also pays all systems analysts—again, men and women alike—a higher wage. Suppose further that this firm discriminates against women in promotion—that a higher fraction of men than women are promoted from the programming positions into the higher-paying systems analyst positions. Using a regression approach that looks at pay only within occupations (as we did to calculate the 12 percent reported above), there would be no evidence of pay discrimination within occupations in this hypothetical firm, even though in fact pay discrimination exists—operating through lower promotion rates for women.

and an additional 33 percent have some college (but no college degree), the persistently large pay gap between these women and men is certainly noteworthy.

For women with higher levels of education, in contrast, the gender pay gap is substantially lower—about 9 to 13 percent after accounting for differences in demographics (see Chart 6). Put another way, in IT jobs the measured return to an investment in education is greater for women than for men.

Notably, education plays a more important role in narrowing the pay gap in IT jobs than in the economy at large. In the general economy, the pay gap is xx for workers with high school or less, xx for workers with some college, and xx for workers with college. The higher premium that high-paying IT jobs pay to education further underscores the need to encourage more women to enter and complete higher education, particularly in scientific and technical fields.

The Pay Gap across the Pay Distribution

The IT sector is well known for its high average pay rates, and also for having a substantial number of people who earn exceptionally high incomes on their jobs, such as people in jobs with successful start-up companies. In the IT sector 20 percent of men earn more than $32.53 or more per hour—which translates to annual earnings of $67,660 or higher.[7] Ten percent of men earn $80,790 or more.

Women, however, do not fully share in this high earnings jobs. Only 7 percent of women more than $67,660 and only 3.7 percent earn more than $80,790. Conversely, at the lower end of the earnings distribution, 20 percent of all women have earnings that translate to $24,900 or less per year, but only 9 percent of men fall in this earnings category.

Evaluating the Pay Gap at the High End of the Distribution. Women who are on the "fast track" among IT professionals—who have invested in the highest levels of education and for whom pay is highest—earn less than their male counterparts. In fact, a woman at the 80th percentile of the earnings distribution for females earns 17 percent less than a man at the 80th percentile of the male distribution. The 17 percent gap between the top-earning men and women declines to 14 percent after controlling for education and age. Controlling for occupation closes the gender gap at the 80^{h} percentile further, to 12 percent (about the same gap measured at the median).

Evaluating the Pay Gap at the Low End of the Distribution. At the low end of the pay distribution, specifically at the 20th percentile, the percent gap is 24 percent, somewhat higher than the gap at the median (22 percent) or at the 80th percentile (17 percent). As was the case with other points in the pay distribution, part of this gap is because of differences in demographics and education—the gap declines to 20 percent when these factors are included. Further, women and men at the 20th percentile are generally in different occupations, and after controlling for these differences as well, the pay gap declines to 13 percent.

Summary of Statistical Results

Analysis indicates that at the median, the gender pay gap in IT of 22 percent narrows to 17 percent among individuals with similar age and education, and to 12 percent when also accounting for gender differences in occupation. As argued above, one cannot know if this last number is an over-estimate or under-estimate of the effect of gender discrimination.

[7] All examples in this report with annual earnings extrapolates for a worker who is paid for 2080 hours per year.

Other notable findings that emerge from the statistical analysis are:

- While women in IT generally earn considerably less then men, this gap is especially large for women who are not college educated. Among IT workers with no college education, women earn about one-third less than men with similar demographics. In contrast the gap for thosewith a BS or BA is 9 percent.

- Similarly, women who are in the lower end of the earnings distribution earn about 24 percent less than men. Among "fast track" workers, the gap is somewhat narrower 17 percent.

- Much of the wage gap in IT is the consequence of differences in occupational composition by gender. Accounting for occupation differences (along with demographics and education) the wage gap closes to 12-13 percent for workers whose wages are lagging, for average workers, and for "fast track" workers.

4. Lower Representation of Women in Technical Fields

The results above indicate that women are paid less than men in IT occupations, even after accounting for observed factors that influence pay. As we have noted, this gap is not by any means unique to the IT sector. It largely mirrors what happens in the economy at large and is similar to trends in the broad fields of science and engineering, where women are also greatly underrepresented particularly in the highest paying fields. A portion of the difference in pay is a consequence of underrepresentation of women, so it is important to understand why this underrepresentation occurs.

Some of the gender differences in representation in scientific or IT occupations are due to the differences in the proportion of men and women who prepare for technically-oriented careers. While the evidence suggests that men and women are receiving the same level of science and math preparation in high school, among those earning bachelors degrees women were much less likely than men to earn a degree in science and engineering. In 1996, 41 percent of the men and 29 percent of the women selected degrees in this area. The percentage differences are even larger when focussing specifically on engineering (9.4 percent versus 1.7 percent). A recent study by the Department of Commerce concluded that "increasing women's participation in the education pipeline that leads to many IT jobs may require efforts to get more college-bound women to choose science and engineering as a field of study, especially computer science and engineering disciplines" (p. 95).[8] A number of federal programs are now in place to facilitate the entry of women into these fields (see Box 2).

Box 2. Federal Programs to Increase Participation by Women in Science, Technology, and Engineering

The federal government has developed a range of programs aimed at promoting increased participation of women in science, technology and engineering (ST&E). The National Science and Technology Council recently issued a report in which many of these programs were described. Some of these programs are national in scope, while others encourage greater participation by women within specific agencies. Examples include:

NASA WISE program. The National Aeronautical and Space Administration's WISE (Women in Science and Engineering) program is an undergraduate academic and research program whose goal is increasing the number of highly qualified minority and disadvantaged women in scientific and technical careers. Its strong mentoring and research components are designed to encourage

[8] [Cite.]

women as well as minorities to pursue graduate studies and/or advanced degrees. Participants are provided opportunities for research experiences at all NASA Centers, the Jet Propulsion Laboratory, universities, and other federal laboratories.

EPA WISE program. The goals of the Environmental Protection Agency's WISE (Women in Science and Engineering) council are to increase the number of female scientists and engineers at EPA through recruitment and community outreach; to update and expand their skills; to enhance their careers and work environment; and identify barriers to professional advancement and take action to correct inequities that may exist. The WISE council represents the concerns of all of EPA's women scientists and engineers.

NSF POWRE program. The National Science Foundation's Professional Opportunities for Women in Research and Education (POWRE) program helps women who want to re-enter science careers, improve their academic standing or advance to tenure track positions. The program supports more than 200 women in science and engineering. Co-sponsored by the National Institutes of Health, POWRE provides support for visiting researchers, research and educational enhancement. It also supplements existing NSF-funded activities that promote academic career advancement of women in ST&E fields.

NIH Re-entry Program. The Re-entry Program at the National Institutes of Health focuses on workers who had to withdraw from their careers because of family responsibilities such as caring for children or an ill family member. Supplements to existing research grants provide salary support and some research costs to assist the re-entering scientist in the transition back to the laboratory, under the sponsorship of a mentor. A similar program is the mentored Research Scientist Development Award for more senior re-entering scientists. Under these awards, scientists who have had a hiatus from their research career can apply for support for a period of supervised training to update their skills and knowledge.

Source: National Science and Technology Council, "Ensuring a Strong U.S. Scientific, Technical, and Engineering Workforce in the 21st Century," April 2000.

Among those women who do prepare for and enter technically-oriented occupations, exit rates are often high, further reducing the overall representation of women working in these occupations. In general both male and female exit rates from the science and engineering occupations are higher than for other similar professional occupations (such as law and health professions), but women exit from science and engineering at twice the rate of men. One reason that is cited by women for their higher exit rate is the greater responsibilities of women for family care. In one sample of scientists, 56 percent of the women and 34 percent of the men were married to spouses with advanced degrees, and women were almost twice as likely as men to have spouses who worked full time. Women were also roughly twice as likely as men to have altered location decisions and sacrificed career opportunities to satisfy a spouse's career. Men, in contrast, were more likely to perceive family responsibility as a need to increase the amount and stability of their income. Thus, some women make the choice to compromise their careers by choosing occupations that are more family-friendly.[9] Policies that address these family needs are likely to raise retention rates.

However, women also cite differential treatment as a primary reason for their higher exit rates relative to men. Of women who leave science, 19 percent state that they left in part because "science and engineering are unfriendly to women." To explore this general response more fully, 52 women in science and engineering were interviewed at length.[10] Based on these interviews, the

[9] Preston cite.
[10] Preston (1997) cite.

researcher concludes that successful women who remain in science and engineering almost always have important mentors supporting them, whereas those who leave cite lack of support in a male-dominated work place. More than half of these women also said they perceived that the performance standards were more stringent for women than for men. These perceptions, whether accurate or not, influence their desire to stay and to invest in the ongoing development that is necessary in science-related fields.[11] If women have been passed over for promotion or perceive that their future professional opportunities are poorer than those of men, they will rationally choose to focus more on their family responsibilities. As a result, they will be under-represented in the higher paying occupations.

In general, reduction of the pay gap in IT will require a relative increase in the proportion of young women who choose educational programs that prepare them for the higher-paying occupations in IT. Because the gender pay gap tends to be lower for individuals with higher levels of education, so an increase in education of women entering IT might prove an especially effective means of narrowing the pay gap. In addition, policies that assist women in their career development, as through on-the-job training and mentoring, and that open greater possibilities for promotion can also enhance women's investment in these occupational skills and their retention rates. This is turn will contribute to a reduction in the gender pay gap in IT.

5. Conclusion

Women in IT occupations earn more than those women who hold all other types of jobs: the average earnings of women in IT is $40,220 compared to $26,900 for women in other occupations. However, the average pay for women within IT is considerably less than that of men within IT; women earn 22 less than men. Part of this pay differential is associated with lower education and experience for women, so that after controlling for these factors, women earn 17 percent less than men. An additional part of the gap occurs because women are underrepresented in the highest-paid IT occupations. When controls for occupational differences are introduced, women earn 12 percent less than men. However, this 12 percent may underestimate the true earnings gap if there is, for example, a "glass ceiling" that limits women's access to the higher paying occupations.

Women's underrepresentation in IT occupations remains pronounced, particularly in the higher paying occupations such as computer systems analysts and electrical and electronic engineering. Part of this differential is associated with less preparation among women for technical fields. But, if the evidence from scientific fields as a whole is representative of IT conditions for women, women also have higher exit rates for technical jobs than do men. Employers can address this gap in exit rates with improved mentoring and training on the job for women. The data shows that more highly educated women earn wages that are more comparable to men's, so the hiring and retention of these well-educated women is also a potential key for reducing the pay gap between men and women in IT.

Therefore, science & tech training for ♀ can help.

[11] In science, the factors that influence promotion are so multi-faceted that it is difficult to pin down statistical evidence on discrimination. Direct evidence of discrimination in hiring does exist for some skilled non-science occupations. In auditions for symphony orchestras, females' chances of successful entry are considerably higher when the jury listening to the audition cannot see the gender of the applicants. Similarly, in high-paying restaurants, where the wait staff tend to contain more men, when a man and woman submit identical resumes, the man is more likely to be hired.