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Multiple Disadvantages? The Earnings of Asian Women Computer Scientists in the United States

Yu Tao

Stevens Institute of Technology, New Jersey, US

ABSTRACT
This study examines the earnings of an under-researched group: Asian women in computer science, in the United States (U.S.). I distinguish three subsets of college-educated Asian female computer scientists working full time in the U.S.: 1) U.S.-born, U.S.-educated Asian Americans, 2) Asian-born, U.S.-educated Asian immigrants, and 3) Asian-born, Asian-educated Asian immigrants. Results from multivariate regression and quantile regressions (at the 10th, 25th, 50th, and 75th percentiles) show that U.S.- and Asian-educated Asian immigrant women earn less on average (at the mean level) and at the 10th, 50th, and/or 75th percentile levels than their white male counterparts. Only Asian American women do not earn less than their white male counterparts at any level. Further analysis reveals that Asian immigrant women earn less due to their gender, but not because of a combination of their gender and race. Neither the immigrant women's birthplace or the origin of their degree further disadvantage their earnings. The lack of multiple disadvantages may be explained by white women earning less than expected, but not Asian immigrant women earning more than expected. Suggestions for further research are discussed.

KEYWORDS
Earnings; multiple disadvantages; double jeopardy; Asian women; immigrants; computer scientists

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INTRODUCTION

In the United States (U.S.), Asians are overrepresented in science, technology, engineering, and mathematics (STEM) fields, based on reports from the National Science Board (NSB) (2010). Asians (and Pacific Islanders) represent 5% of the U.S. population, but 7% of college graduates and 14% of employees in STEM occupations.[1] Among faculty with STEM doctorates, a larger proportion of Asians than other racial/ethnic groups are in computer science, mathematics, or engineering (Burrelli, 2006). Yet, partly due to their overrepresentation, studies of scientists and engineers in the U.S. typically neglect Asians. Furthermore, the limited number of studies of Asian scientists and engineers previously published do not always disaggregate data by gender.

In STEM fields in the U.S., women have been underrepresented based on their percentage in the U.S. population overall. Over time, however, women have increased their participation and have been receiving more STEM degrees than men at all degree levels, both in absolute numbers and in percentage shares (NSB, 2010). Nevertheless, women's shares among scientists and engineers, particularly among engineers and computer scientists, remain low. They also still face various barriers to their careers, according to studies, such as those by the Committee on Science, Engineering, and Public Policy (COSEPUP) (2007). Although an increasing number of sociological studies examine the impact of the intersection of gender and race, including minority women in STEM, we do not know much about how Asian women scientists and engineers fare compared with other racial/ethnic and gender groups.

Asians in the U.S. tend to go into science, engineering, and medicine because they perceive these fields as being relatively objective and universalistic. In addition, these occupations provide better financial returns than many others. Thus, in STEM, Asians can maximize their opportunities for upward social mobility and financial reward (Xie and Goyette, 2003). Computer science in the U.S. is a lucrative field, partly due to the high demand for, and the strategic role of, information and other technologies in economic development, as the National Research Council (NRC) (2001) reports. Among all bachelor's and master's degree holders in STEM and health fields graduating in 2001 and 2002, engineering and computer science graduates earned the highest salaries (Tsapogas, 2005).

In such a well-paid field where Asians are overrepresented but women are underrepresented, examining the earnings of Asian women computer scientists provides an excellent opportunity to fill gaps in knowledge about under-researched Asian STEM workers in the U.S. Examining the earnings of Asian women computer scientists allows us to understand how Asians, especially Asian women, fare financially—whether they earn less than their non-Hispanic, white male counterparts, and, if so, whether their earning disadvantages are due to a combination of gender and race.[2] This study examines full-time, college-educated Asian women computer scientists in the U.S. Thus, the findings and analyses are applicable to STEM fields in the U.S., but not necessarily in other countries.

WOMEN IN STEM IN THE U.S.: THEIR EARNINGS AND ADVANCEMENT

In general, women scientists and engineers in academia in the U.S. are underrepresented in high-level positions, such as tenured and full professor positions, but overrepresented in lower-level positions, such as untenured and junior faculty positions. In academia, even after controlling for publication productivity and institutional affiliation, women's estimated ranks are still lower than those of comparable men in physical sciences, mathematics, and engineering (Sonnert, 1995). Women faculty members in STEM are also promoted more slowly and receive fewer honors and leadership positions (COSEPUP, 2007).

In industry in the U.S., women scientists and engineers also fare less well than their male peers. In engineering firms, women are less likely than men to be in high-status positions, such as R&D engineers, but more likely to be in lower-status positions, such as production and sales engineers. Women engineers often do well in the first few years of their careers, but over time, they are less likely to advance into high-status technical or managerial positions than their male colleagues (McIlwee and Robinson, 1992). Simard et al. (2008) report that men are 2.7 times as likely as women to be in high-level positions. At the mid-level, the most critical stage for women on the technical career path, women (primarily White and Asian in their study) face various barriers to advancement, including their being perceived as less technically competent than their male counterparts. Fassinger et al. (2007) report that women in chemical firms feel that they are often passed over for advancement opportunities. Nevertheless, their managers, mostly male, think that women receive sufficient support from the firm and their supervisors. Other studies find that women scientists' disadvantages are limited to only some groups of women. Xie and Shauman (2003) find that among women scientists, including unmarried women, married women without children, and married women with children, only the last group has statistically significant lower odds of promotion than their male counterparts. They are only 24% as likely to be promoted as their male counterparts, net of other factors.

The concentration of women scientists and engineers in lower-rank positions has implications for their access to important resources including earnings. Women scientists and engineers are paid less than their male counterparts. In a survey conducted by the American Association of University Professors in 2007–08, women faculty at bachelor's- and master's-granting institutions (in all fields and at all ranks) earned salaries that were close to those of men. At Ph.D.-granting institutions, the gender gap was larger, and on average women earned about 91% as much as men. In a recent American Chemistry Society survey of its members, among full professors at Ph.D.-granting universities in the U.S., women earned an average of $101,500 while men earned $111,400 (Heylin, 2008).

A landmark report from MIT (1999) found that women scientists and engineers with similar qualifications and achievements as their male peers were not rewarded in the same way, including salary, lab space, awards, funding, and outside offers. The follow-up report (MIT, 2002) finds that women faculty in the Schools of Science and Engineering still earn less than men with similar academic achievements. Xie and Shauman (2003) report that, after controlling for variables such as age; race; education; field; sector; and, weeks and hours worked, unmarried women, married women with no children, and married women with children, who were all working as full-time scientists and engineers, earn 7%, 14%, and 14% less, respectively, than their male counterparts. Lal et al. (1999) find that women engineers in all employment sectors are younger and earn 13% less than male engineers. Ten percent of the salary difference can be explained by years since receiving the bachelor's degrees. Yet, when other factors, *i.e.,* the field of education (engineering vs. non-engineering); the level of the highest degree; the employment sector; the geographic region; and, engineering specialty are controlled for, women still earn 2% less than men. Long (2001) finds that as a group, women doctoral scientists and engineers are younger and have shorter work experience than their male peers. This finding, consistent with that of other studies, can be explained by the fact that a large proportion of women entered the STEM fields only recently. After 20 years of work, the salaries of male scientists and engineers continue to rise, while those of women do not. In 1995, when factors such as year of Ph.D., field, sector of employment, and primary work activity are controlled for, women scientists and engineers earned 5% less than their male counterparts, down from 14% in 1973. Long also finds that the gender gap in salaries is larger in some fields such as engineering and mathematics, which also have a smaller proportion of women than other fields, such as the life, social, and behavioral sciences. More recent reports (COSEPUP, 2007) show that women academic scientists and engineers continue to earn less than their male peers.

Studies of cohorts reveal that the earning disadvantage of women engineers, compared with their male counterparts seems to be due to the cohort effect. Morgan (1998) reports that after human capital, family and marital status, race, work setting, and region are controlled for, only women engineers of the oldest cohort (receiving degrees in or before 1971) earned less than their male counterparts in 1982, 1984, 1986, and 1989. Women of the middle cohort (1972-1976) earned less in 1982 but not in other years. Women of the youngest cohort (1977-1981) did not earn less in any year. Morgan argues that the earning disadvantage of female engineers is not due to the glass ceiling effect, *i.e.* that women earn less than men within each cohort and that women's earning disadvantage will grow over time. Rather, it is due to the cohort effect—that older cohorts of women tend to earn less than comparable groups of men but younger cohorts do not. However, Morgan's study is criticized by Alessio and Andrzejewski (2000) in that she does not consider the increasing gender gap in response rates over the years. The fact that the gap in response rates between men and women widened over time could indicate a hidden glass ceiling, *i.e.,* that women were less likely than men to stay employed. Furthermore, the incomes of 1.7% of male respondents but only of 0.2% of the females are top coded (treating salaries over a certain amount as the same as that amount), which could mask the male advantage.

Another study that examines the earnings of women scientists and engineers reveals neither cohort nor glass ceiling effect, but consistent female earning disadvantages across all fields. Prokos and Padavic (2005) find that in the years 1993, 1995, 1997, and 1999, none of the six cohorts (*i.e.*, those receiving degrees in 1955-1964; 1965-1969; 1970-1974; 1975-1979; 1980-1984; and, 1985-1989) experienced statistically significant changes in gender gap in their earnings over time. Thus, their findings do not support the glass ceiling effect. Furthermore, the older cohorts did not always experience a larger gender gap in earnings than the younger cohorts in all four years examined, so the cohort effect is not supported. Yet, women regularly earned less than their male counterparts, and these results were consistently found among engineers, physical scientists, life scientists, and computer and mathematic scientists.

MINORITY WOMEN IN STEM IN THE U.S.: MULTIPLE DISADVANTAGES?

Women in the U.S. differ in race, nationality, culture, and social class. As a result, analyses of women workers based on aggregate data (treating women as one group) can obscure these differences. Increasingly, sociological studies are paying attention to the intersection of gender and race for the general U.S. workforce (e.g., Browne and Misra, 2003; Leicht, 2008) and in STEM in the U.S. (e.g., Pearson, 1985; Leggon, 2006). Many studies have found that minority women tend to suffer from double jeopardy, double penalty, double bind, or multiple disadvantages—all the terms refer to disadvantages in addition to gender. While white women may be disadvantaged solely due to their gender, minority women tend to be disadvantaged in their careers due to their race as well as gender.

The seminal study by Malcom et al. (1976) finds that the price of being a minority woman in science, engineering, and medical fields in the U.S. is extremely high due to her 'differentness'—she is very different from white men, on whom the practices and the evaluation criteria in science have been based. white men usually have adequate spousal support, and they can devote a considerable amount of time to scientific research. Minority women scientists and engineers have to adjust their life and work styles and devote more time, energy, and persistence to their work. Nevertheless, they experience discrimination in job assignments, salaries, and promotion. They feel isolated and lonely because few other minority women are to be found in their fields, and they have pressures to get married, choose more culturally acceptable occupations, and return to communities where they grew up. Over time, despite the steady increase in the participation of minority women in the U.S., such as in earning STEM degrees (NSB, 2010), research suggests that their experiences of feeling alone, excluded, and discriminated against have not improved to any significant extent (Whitaker, 2001; Taylor, 2002; Mahtani, 2004; Pearson, 2005; COSEPUP, 2007).

In terms of earnings, African American women scientists report lower earnings than white and African American male and than white female scientists (Pearson, 1985). However, other studies find that factors in addition to gender work differently for African American and Asian women in STEM. Tang (1997) compares the earnings of native- and foreign-born white, Asian, and African American female scientists and engineers with that of native-born white men.

She finds that after personal, geographic, and human capital variables are controlled for, among the U.S.-born, both African American and white women earn less than their white male counterparts, but Asian women do not. With regards to subject area differences, compared with their white male counterparts, white women earn less in computer science, social sciences, and engineering; Asian women earn less only in computer science; and African American women earn less only in social sciences. Among the foreign-born, Asian women (the number of foreign-born African American women is too small for comparison) fare similarly to comparable U.S.-born white women. Thus, both native- and foreign-born Asian women scientists and engineers do not suffer from the double hit due to both gender and race. Tang assigns the relative advantage of Asian women scientists and engineers over comparable white and African American women to the 'statistical discrimination', *i.e.,* that Asians are perceived as good at scientific and technical tasks. Yet, due to the limitations of the data, Tang does not examine the effect of degree origin.

Tang's findings are confirmed by studies of minority women workers in many fields, not just in STEM. Greenman and Xie (2008) compare the earnings of U.S.-born white women with a range of 18 groups of U.S.-born minority women workers, including Chinese; Asian Indian; Korean; Cuban; Asian-White; Black-Asian; Filipino; Vietnamese; Black-White; Native American-White; Hispanic; Puerto Rican; Mexican; Black; and, Native American. They find that the gender difference in earnings of every minority group is smaller than that of white Americans. In other words, the disadvantage of being a woman is smaller for minority women than for white women. Greenman and Xie argue that, instead of minority women earning more than expected, white women earn less than expected. A possible explanation is that white families are more specialized with respect to gender roles within the family, with white women being more economically dependent on men than other racial/ethnic groups. white women are more likely than other women to experience a linkage between gender inequality at work and gender inequality at home.

ASIAN AND IMMIGRANT SCIENTISTS AND ENGINEERS IN THE U.S.

A small number of studies of Asian and immigrant scientists and engineers in the U.S. consistently find that Asians experience a glass ceiling in their careers. Interview studies find that Asian scientists and engineers report that they tend to be passed over for promotion, despite their interest in managerial positions and their competitiveness (Wong and Nagasawa, 1991; Miller, 1992; Woo, 2000). In addition, Asians are virtually absent from leadership positions, such as being deans, advisory board members, and institute heads (Miller, 1992). In engineering, net of other personal, educational, and employment characteristics, Asians are more likely to be engineers and less likely to be managers than their white counterparts (Tang, 2000).

Varma (2006) reports that about 34% of the 120 Asian Indian immigrant scientists and engineers that she interviewed for a research study reported that they had to wait longer than their peers for promotion. Those who report the same length of time for promotion (33% of the interviewees) believe that it is because their organizations use standardized promotion intervals. Those who report less time for promotion (5%) believe that their organizations reward employees fairly. The rest, 28%, entered their current organizations for too short a period to be considered for promotion. According to the interviewees who reported waiting longer for promotion, the major reason they felt for this is that they have to prove themselves while such efforts do not apply to their colleagues, especially white colleagues. In addition, the interviewees report that their being less aggressive, knowing less about how the system works, and lack of mentoring contribute to their disadvantages in promotion. Other barriers to Asians scientists' and engineers' advancement that earlier studies report include the lack of clear promotion process and work valuation standards; stereotypes that Asians are not good at interpersonal communications or do not speak English well; and, their lack of access to important resources, such as management training or important career assignments that could lead to increased visibility and recognition in the organization (Wong and Nagasawa, 1991; Miller, 1992; Woo, 2000). Also, gender differences are reported in promotion. Across employment sectors, a higher percentage of Asian Indian female immigrant scientists and engineers report longer waiting times for promotion than do men. For instance, 54% of men and 75% of women in national laboratories in the U.S. reported longer waiting periods than their colleagues. For the women, further barriers come from gender and gender-related issues, such as having a family (Varma, 2006).

For immigrants in STEM in the U.S. in general, their gender difference in career advancement could be larger than those among their white American colleagues. Xie and Shauman (2003) find that after age, race, education, field, sector, family status, and English proficiency are controlled for, native-born women scientists are not disadvantaged relative to their male counterparts. However, foreign-born women scientists and engineers have odds of employment 59% as high as those of comparable men, and 32% as high odds of promotion as comparable men.

In terms of finances, studies have reported mixed findings regarding Asian and immigrant scientists and engineers compared with their white and/or native-born counterparts in the U.S. Lee (1993) reports that Asian immigrant scientists and engineers, either U.S.- or foreign-educated, do not earn lower wages than their native-born white or Asian counterparts in the U.S. This result is obtained after controlling for education, experience, English skills, and labor market segments (monopoly, regional, or local enterprises). Lee argues from these data that Asian immigrant scientists and engineers are well integrated into the U.S. labor market.

However, Varma (2006) reports that 15% of the 120 Asian Indian immigrant scientists and engineers that she interviewed believe that they are paid less than their mostly white colleagues, yet they have never taken action to get their salaries adjusted. Only 4% of the interviewees believed they were underpaid and have had their salaries corrected. One way or another, virtually all interviewees believed that they have to work harder and outperform their colleagues to be paid the same. Among this group, gender differences exist. In all the four settings studied (*i.e.,* industry, academia, national laboratories in the U.S. and positions in India), and especially in academia in the U.S., a higher proportion of women than men believe that they are paid less than their colleagues—14% of men believe they are paid less, but 50% of women do so. In all settings, no women reports being paid more than her peers.

Varma's findings are consistent with studies of the earning disadvantages of immigrant scientists and engineers relative to their U.S.-born counterparts. Espenshade et al. (2001) report that when education, locations, field, age, marital status, class, race/ethnicity, and industry are controlled for, foreign-born scientists and engineers earned less than their native counterparts by 4.4% in 1989 and 9.3% in 1996. Furthermore, Xie and Shauman (2003) find that when age; race; education; field; sector; family status; English proficiency; and, weeks and hours worked are controlled for, immigrant women scientists and engineers earn 12% less than their male counterparts.

In addition, degree origin can influence some Asian worker's earnings. Zeng and Xie (2004) find that among Asian workers, only those who finished their education before migrating to the U.S. experience earning disadvantages due to the place of their education. Tao (2009) finds that among Asian-born Asian computer scientists who were educated in the U.S. or Asia, net of personal, educational, and employment characteristics, the Asian-educated earned less than their U.S.-educated counterparts in 1993, but not in 2003. The disappearance of the degree origin effect could be explained by the improvement in the quality of education in Asia and an increase in the demand for computer scientists in the U.S. between 1993 and 2003.

HYPOTHESES

The literature shows that women scientists and engineers in the U.S. tend to be disadvantaged in their careers, including earning less than their male counterparts. Minority women may suffer from disadvantages associated with both their gender and race, but the disadvantages vary from one minority group to another. This paper disaggregates data about Asian women in the U.S. by birthplace (U.S.- or Asian-born) and degree origin (U.S.- or Asian-educated) to test whether being Asian-born and Asian-educated leads to disadvantages in addition to gender and race. Based on the literature, this paper tests the following hypothesis while controlling for relevant variables: *1. Asian women from different groups (U.S.-born, U.S -educated; Asian-born, U.S -educated; and Asian-born, Asian-educated) earn less than their white male counterparts.*

However, some studies have pointed out that Asian women scientists and engineers or minority women workers do not necessarily experience earning disadvantages due to a combination of gender and race because of the low earnings of white women (Tang, 1997; Greenman and Xie, 2008). Thus, this paper tests a second hypothesis: *2. Asian women from different groups do not suffer from multiple disadvantages. In other words, the earning differences between these Asian women and their white male counterparts, if any, are not due to factors in addition to their gender.*

DATA AND METHODS

This paper uses the National Survey of College Graduates (NSCG) conducted by the National Science Foundation (NSF) in the U.S. The NSCG data sets have nationally representative samples of individuals with at least a bachelor's degree in STEM, or in non-STEM fields but working in STEM, in the U.S. The samples of the surveys include professionals who were born and earned their degrees in or outside the U.S, and who were less than 76 years of age when surveyed.

The 2003 NSCG used samples from the 2000 U.S. census and the 2001 National Survey of Recent College Graduates (another NSF dataset). The 2003 NSCG sample included individuals who received their bachelor's degrees by April 1, 2000, but some received a higher degree between 2000 (when the 2000 census was conducted) and 2003 (when the NSCG survey was conducted). The reader needs to note that the sample does not completely cover foreign-educated individuals.[3] Therefore, the reader should be somewhat careful in interpreting the full representativeness of this group. However, the limited attention paid to the effect of degree origin on the earnings of U.S. scientists and engineers in previous studies makes it more than worthwhile to examine this effect in this paper.

All subjects included in this study were employed as full-time computer scientists working in the U.S. when surveyed in 2003, and they reported their highest degrees as bachelor's, master's, or doctorates from U.S. or Asian institutions. All white computer scientists in this study were self-reported as non-Hispanic White born in the U.S. and were U.S. citizens in 2003. They all received their degrees in the U.S. Asians were self-reported, non-Hispanic Asians born in the U.S. or in Asia and were U.S. citizens, permanent residents, or temporary residents in 2003.[4] Asians are classified into three major groups based on their birthplace and the origin of the highest degree: 1) U.S.-born, U.S.-educated Asian Americans (referred to as Asian Americans); 2) Asian-born, U.S.-educated Asian immigrants (referred to as U.S.-educated immigrants); and 3) Asian-born, Asian-educated Asian immigrants (referred to as Asian-educated immigrants). No U.S.-born, Asian-educated individuals are included in the paper. Since Asians are grouped based on their birthplace and degree origin, U.S.- or Asian-educated immigrants could be naturalized U.S. citizens, permanent residents, or temporary residents. Thus, the findings of this paper may have been different if Asians had been classified based on their citizenship status.

This paper includes both U.S.- and Asian-born Asians but only U.S.-born White computer scientists because these groups can best test the effects of race, birthplace, and degree origin. Other factors being equal, the only difference between White and Asian Americans is race (White vs. Asian); that between Asian Americans and U.S.-educated immigrants is birthplace (born in the U.S. vs. Asia), and that between U.S.- and Asian-educated immigrants is degree origin (received the highest degree in the U.S. vs. Asia). Ten individuals of Asian race were born of American parents in Asia and received their highest degrees in the U.S., and they are recoded as Asian Americans. Similarly, 44 white subjects born of American parents in Europe and received their highest degrees in the U.S. are recoded as White Americans and included in this study.

In total, the 2003 sample contains 6,933 White and Asian computer scientists (Table 1). Across genders, White computer scientists are the largest group: the sample contains 3,725 White men and 1,310 White women, representing 72.5% of all men and 73% of all women. The second largest group is U.S.-educated immigrants (856 men and 334 women, accounting for 16.7% of men and 18.6% of women), followed by Asian-educated immigrants (428 men and 109 women, representing 8.3% of men and 6.1% of women). The smallest group is Asian Americans (129 men and 42 women, accounting for 2.5% of men and 2.3% of women). The small size of this Asian American group limits the ability to detect significant results. Thus, we should be careful in interpreting and generalizing the regression results regarding Asian American women.

Table 1. The Composition of the Sample

	White Americans	Asian Americans	U.S.-ed. Immigrants	Asian-ed. Immigrants	Total
Male	3,725	129	856	428	5,138
	(72.5%)	(2.5%)	(16.7%)	(8.3%)	
Female	1,310	42	334	109	1,795
	(73.0%)	(2.3%)	(18.6%)	(6.1%)	
Subtotal	5,035	171	1,190	537	6,933
	(72.6%)	(2.5%)	(17.2%)	(7.7%)	

Source: National Survey of College Graduates, 2003

To understand whether the three groups of Asian women as well as White women had statistically significant earning differences from comparable White men, this paper uses multivariate regression or ordinary least square (OLS) regression, controlling for relevant variables. OLS regressions can show whether the effects of race, birthplace, and degree origin are statistically significant, meaning not due to chance, while other variables are held constant. OLS results serve as the first-step analysis. The second step is to test whether the earning differences, if any, exist at different percentiles. To achieve this latter goal, this paper uses quantile regressions. The percentiles examined include the 10^{th}, 25^{th}, 50^{th} (or median), and 75^{th} percentiles (or the 0.10, 0.25, 0.5, and 0.75 quantiles). The 90^{th} percentile is not included because of the small size of some groups, particularly Asian American women. Quantile regressions can additionally test the statistical significance of the effects at various percentiles and show whether the effects exist differently for better-paid than for lower-paid workers. The first and second steps can test Hypothesis 1. The third step is to test Hypothesis 2, to understand whether the effect of multiple disadvantages exists; in other words, to test whether any earning disadvantages for the Asian women's groups relative to their White male counterparts, are due to factors in addition to gender. To achieve this goal, this paper uses Interaction terms of gender and each of the three Asian groups (i.e., male*Asian American; male*U.S.-educated immigrants; and male*Asian- educated immigrants). Interaction terms indicate the difference of a difference. For instance, the interaction term male*Asian Americans indicates how the gender difference in earnings (or more specifically, the male earning advantage) between Asian American men and women differ from that between White men and women. If it is statistically significant and positive, then the male advantage is larger for Asian Americans than that for White groups. In other words, if this is the case then Asian American women may suffer from the double hit of gender and race.

In this study, the dependent variable is the natural logarithm of the annual salary. The independent variables include the White women and Asian men's and women's groups for the first and second steps, and the interaction terms of gender and the three Asian women's groups for the third step. Control variables include personal, educational, and employment characteristics. Personal characteristics include gender; marital status; having at least one child; the interaction terms of gender and being married and gender and having children; age; age-squared; and, citizenship status. Previous studies report that scientists' and engineers' status, whether married and whether they have children can influence their performance and earnings. Since earlier studies show that marriage and children have different impacts on the career advancement of women than on that of male scientists, the interaction terms between these two variables and gender can test whether the effects of marriage and children differ for men and for women. Age is often correlated to earnings, but the relation may not be linear, and the age-square variable is used to determine the linearity of the relationship. Citizenship status can be a proxy for the level of assimilation (Tang, 1997) and may influence earnings.

Educational characteristics include the level of the highest degree (*i.e.,* bachelor's, master's, or doctoral) and the field of the highest degree (*i.e*., computer science, engineering, physical sciences, biological sciences, social sciences, or other fields). The former is important because human capital theory argues that the higher the level of education, the higher the earnings (Schultz, 1961; Becker, 1993; Becker, 2002). Engineers trained in non-engineering fields may have different qualifications from those trained in engineering programs, and their salaries may differ.

Employment characteristics include individual and employer characteristics. Individual characteristics include years since obtaining the highest degree; years-squared; supervisor status; principal work activities; subfield; and, hours worked per week. In addition to age, more years accrued since the highest degree leads to an increase in salary, and its square term can test whether the increase is linear or curvilinear. Supervisors often differ from non-supervisor workers in earnings, and different work activities and subfields of computer science will also lead to different earnings. Employer characteristics include the employment sector and location. In terms of the sector, industry may pay workers differently from educational institutions and government. Location also matters because some areas, such as New England and the Pacific Coast, have higher costs of living than other regions, and employees expect to earn more in these areas. In addition, different subfields of computer sciences may pay workers differently.[5] Furthermore, the number of hours worked per week can influence earnings.

DEMOGRAPHIC CHARACTERISTICS AND EARNINGS

Table 2 shows that among the four groups, White Americans are on average the oldest among both men and women. Asian-educated immigrants are the youngest for women, and both Asian-educated immigrants and Asian American men are younger than other men. Asian-educated immigrants have the largest proportions who are married and with children for both men and women. On the other hand, Asian Americans who are married and have children for both genders. Among immigrants, the largest share of U.S.-educated men and women are naturalized U.S. citizens, but the largest share of Asian-educated men and women are permanent residents. In terms of educational achievement, compared with other groups of the same gender, Asian American men and women have the largest majority with a bachelor's qualification as the highest degree. Across the genders, U.S.-educated immigrants have the smallest proportion with a bachelor's degree as the highest degree and the largest proportion with graduate degrees, especially master's degrees, of all four groups.

Table 2 also indicates that White men and women have the longest time period since their highest degrees, and U.S.-educated immigrants have the shortest. These findings may be explained by the facts that White men and women in the sample are in general older than other groups and a majority of them have a bachelor's degree as their highest degree. However, a majority of U.S.-educated immigrants have graduate degrees. In terms of the proportion of the group working in supervisory positions, White computer scientists have the highest share among women, and U.S.-educated immigrants have the highest share among men. For all the four groups, a majority of men and women work in for-profit firms. Not surprisingly, the most common primary work activity for all the groups is in computer applications. A larger proportion of White Americans and a smaller share of Asian-educated immigrants, however, work in management and administration than other groups. This is the case for both men and women. The two occupations with the largest proportions of workers are computer software engineers and computer systems analysts. Asian-born computer scientists are more concentrated in computer software engineering than the native-born. In terms of the place of employment there is a striking difference between White and Asian computer scientists with a much larger proportion of Asians, especially Asian Americans, working in the Pacific region. In addition to the Pacific region, the Asian-born tend to reside in Middle Atlantic, South Atlantic, and East North Central regions. The native-born are also concentrated in the three regions. The above results also show that although men and women of a group differ in some aspects, such as being married, having children, and their employment sector, their other personal, educational, and employment characteristics are in general closer to each other than to the same gender of other groups.

Table 2. Mean Characteristics of White and Asian Male and Female Computer Scientists in the U.S. Note: The percentages of some categories, such as degree level, may not add up to 100 due to rounding. Source: National Survey of College Graduates, 2003

Variable	**White American**		**Asian Americans**		**U.S.-educated Immigrants**		**Asian-educated Immigrants**	
	F	M	F	M	F	M	F	M
Mean age	42.9	42.7	39.2	36.8	39.5	39.2	36.9	36.8
% Married	60.3	77.3	42.9	57.4	82.3	83.8	89.0	91.1
% Having children	43.1	54.8	33.3	34.1	64.7	63.6	69.7	68.5
Citizenship Status								
% native-born U.S. citizens	100	100	100	100	--	--	--	--
% naturalized U.S. citizens	--	--	--	--	67.4	62.7	33.0	18.7
% Permanent residents	--	--	--	--	24.3	25.8	56.9	50.0
% Temporary residents	--	--	--	--	8.4	11.5	10.1	31.3
Highest Degree								
% Bachelor's	72.9	71.7	73.8	74.4	28.1	25.5	64.2	60.1
% Master's	25.3	25.2	21.4	22.5	67.4	60.8	32.1	36.5
% Doctorate	1.8	3.1	4.8	3.1	4.5	13.8	3.7	3.5
Years since highest degree	15.7	15.7	14.5	12.0	10.6	10.4	13.6	13.4
% Supervisor	34.7	36.1	21.4	29.5	21.6	36.9	18.4	34.6
Employment Sector								
% Educational institutions	11.6	6.6	9.5	7.8	6.9	5.4	3.7	1.6
% For-profit firms	68.6	79.6	59.5	83.7	82.6	86.2	83.5	91.8
% Self-employment	1.3	2.9	7.1	--	1.2	1.8	1.8	0.9
% Non-profit organizations	6.0	3.3	11.9	3.9	2.7	1.8	1.8	3.3
% Federal government	5.7	3.7	4.8	1.6	1.5	2.6	2.8	0.5
% State/local government	6.9	4.0	7.1	3.1	5.1	2.3	6.4	1.9
Primary work activities								
% R&D	15.4	18.9	23.8	20.9	15.6	21.7	12.8	15.2
% Teaching	3.3	1.9	--	--	1.2	1.6	--	0.2
% Management and admin.	25.0	17.6	19.1	17.1	12.6	10.8	8.3	8.6
% Computer application	52.1	56.4	50.0	56.6	68.0	61.7	74.3	73.4
% Other work activities	4.1	5.3	7.1	5.4	2.7	4.2	4.6	2.6
Subfield of Computer Science								
% Comp. support specialist	13.6	10.6	4.8	9.3	4.5	6.1	6.4	4.2
% Comp. systems analyst	29.4	22.8	31.0	20.9	27.0	17.9	22.0	26.9
% Database administrators	6.5	4.5	9.5	3.9	9.3	3.7	4.6	7.7
% Netwk & comp sys admin	8.2	11.3	14.3	17.8	2.1	5.5	2.8	4.9
% Netwk sys & data commu	6.1	6.4	7.1	5.4	4.5	3.5	6.4	4.0
% Computer software eng.	20.4	34.3	23.8	36.4	47.0	54.6	52.3	47.2
% Others	15.8	10.1	9.5	6.3	5.6	8.7	5.5	5.1
Employer Region								
% New England	8.4	8.1	4.8	9.3	3.3	5.4	5.5	6.5
% Middle Atlantic	15.2	12.6	11.9	11.6	15.9	17.6	19.3	21.7
% East North Central	15.5	15.1	4.8	7.0	12.3	12.2	12.8	13.8
% West North Central	9.1	8.7	2.4	3.1	3.9	3.5	3.7	3.5
% South Atlantic	20.3	19.6	9.5	7.0	15.9	13.9	14.7	15.4
% East South Central	3.4	3.3	--	--	0.6	2.0	5.5	1.6
% West South Central	9.2	9.1	2.4	8.5	12.0	9.1	6.4	6.1
% Mountain	6.0	8.9	--	7.0	1.5	2.5	1.8	3.7
% Pacific	12.9	14.7	64.3	46.5	34.7	33.9	30.3	27.6

The demographic characteristics of computer scientists in this study, including the difference in educational attainment between U.S.- and foreign-born individuals as well as residential location, are mostly consistent with the characteristics of U.S.- and foreign-born information technology (IT) workers in the U.S. In general, in the U.S., compared with their native-born counterparts, foreign-born IT workers are more likely to be Asians or Hispanics than White or African Americans. The foreign-born in the IT workforce tend to be more highly educated than their native-born counterparts. They concentrate in a few states, including California (in the Pacific region), New York and New Jersey (in Middle Atlantic), and Illinois (in East North Central). However, the native-born are concentrated in California, Texas (in West South Central), and New York (in Middle Atlantic) (Ellis and Lowell, 1999; Lowell, 2004).

Table 3 shows the earnings of each group of computer scientists in 2003 (in dollars). Among men the mean earnings of U.S.-educated immigrants is the highest at $86,023, and Asian Americans earn the lowest ($79,210), followed closely by White Americans ($79,237). Since the means may mask uneven distributions of earnings, the table also presents the earnings of each group at four percentiles. At all the four percentiles, U.S.-educated immigrants have the highest earnings: $53,000; $67,500; $83,000; and $100,000 at the 10th (the same as Asian-educated immigrants), 25th, 50th, and 75th percentiles, respectively. This finding is not surprising considering U.S.-educated immigrants' overall higher educational achievement (see Table 2). White Americans have the lowest earnings at the 10th, 25th, and 75th percentiles ($45,000; $60,000; and $94,000, respectively). Asian Americans have the lowest earnings at the median or 50th percentile ($75,000). Asian-educated immigrants' earnings were the highest and the same as U.S.-educated immigrants at the 10th percentile.

Table 3. Earnings of White and Asian Male and Female Computer Scientists in the U.S., Mean Value and Values at Selected Percentiles

	Mean	**10th**	**25th**	**50th (median)**	**75th**
Male					
White Americans	79,237	45,000	60,000	76,900	94,000
Asian Americans	79,210	47,000	62,000	75,000	95,000
U.S.-ed. immigrants	86,023	53,000	67,500	83,000	100,000
Asian-ed. immigrants	82,125	53,000	66,000	80,000	95,000
Female					
White Americans	68,597	39,000	51,000	67,638	83,000
Asian Americans	68,546	40,000	55,000	66,000	81,000
U.S.-ed. immigrants	77,716	50,000	60,000	74,013	90,000
Asian-ed. immigrants	70,865	42,000	59,000	70,000	80,000

Source: National Survey of College Graduates, 2003

Table 3 also indicates that among women, similar to the men, U.S.-educated immigrants have the highest earnings on average ($77,716), and Asian Americans ($68,546) earn the lowest on average, with White Americans following closely ($68,597). At all the percentiles, U.S.-educated immigrants earn the highest: $50,000; $60,000; $74,013; and $90,000, respectively. White women have the lowest earnings at the 10th ($39,000) and 25th percentiles ($51,000). At the 50th and 75th percentiles, Asian American ($66,000) and Asian-educated immigrant

(80,000) women, respectively, earn the lowest. In addition, Table 3 shows that men earn more than women in the same group at every percentile. The values in the table show the overall earning differences of the four groups and gender differences at different percentiles. But these values are obtained when factors that can influence earnings, such as education and work experience, are not considered.

REGRESSION RESULTS

To understand how Asian groups compare with their white male counterparts, net of other factors, a three step analysis is used. First, an ordinary least square (OLS) regression was run with White men as the reference group while controlling for personal, educational, and employment characteristics. Since the dependent or response variable is the natural logarithm of salaries, the coefficient (d_k) from the OLS or the quantile regression of a specific group indicates the natural logarithm of the earning ratio of this group to the reference group, i.e., White men. In other words, the exponentiated form of the coefficient ($\exp(d_k)$) indicates the earning ratio of this group to White men. Table 4 presents the exponentiated form of coefficients. A value that is statistically significant and larger than 1 indicates an earning advantage of the group relative to their white male counterparts, and a value that is statistically significant and smaller than 1 indicates an earning disadvantage. Compared with their white male counterparts, two women's groups earn less—White women earn 92.4% as much or 7.6% (1-0.924) less, and Asian educated immigrant women earn 88.1% as much or 11.9% (1-0.881) less (Column 1, Table 4). No group of Asian men earns less in a way that is statistically significant at the mean level than comparable White men (Column 1, Table 4). Since this paper focuses on these groups, the coefficients of the control variables (such as educational level and work experience) in the table or the analysis are not included.

The second step is to understand how these groups' earnings compare with White men's at different earning percentiles. To achieve this goal, quantile regressions at the 10^{th}, 25^{th}, 50^{th}, and 75^{th} percentiles were run. Three women's groups earn less than their white male counterparts at a certain percentile (Columns 2-5, Table 4). White women earn less than their male counterparts at the median and upper levels—they earn 5.1% and 7.1% less at the 50^{th} and 75^{th} percentiles, respectively (Columns 2-5, Table 4). U.S.-educated immigrant women earn less at the 75^{th} percentile (7.6% less), and Asian-educated immigrant women earn less at the 10^{th} (18.9% less), 50^{th} (7.5% less), and 75^{th} (9.6% less) percentiles. Asian American women do not earn less at the mean or any percentile levels. Among men, no group earns less than their white counterparts at the mean level or at any percentile.

Table 4. Exponentiated Coefficients of OLS and Quantile Regressions Regarding Earnings Relative to White Men in the U.S.

	OLS	**10th**	**25th**	**50th**	**75th**
White women	0.924**	0.982	0.974	0.949**	0.929***
	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)
Asian American women	0.855	1.036	0.925	0.920	0.929
	(0.11)	(0.10)	(0.06)	(0.05)	(0.05)
U.S.-ed immigrant women	0.937	1.009	1.002	0.956	0.924**
	(0.04)	(0.05)	(0.03)	(0.03)	(0.03)
Asian-ed immigrant women	0.881**	0.811**	0.957	0.925*	0.904*
	(0.05)	(0.07)	(0.05)	(0.04)	(0.04)
Asian American men	1.013	1.052	1.007	0.991	1.012
	(0.03)	(0.06)	(0.04)	(0.03)	(0.03)
U.S.-ed immigrant men	0.980	0.968	1.011	0.998	0.994
	(0.02)	(0.03)	(0.02)	(0.01)	(0.02)
Asian-ed immigrant men	0.956	0.912	0.955	0.992	0.990
	(0.03)	(0.05)	(0.03)	(0.02)	(0.02)

Notes: 1. All the control variables discussed in the Data and Methods section are included in the models but not reported in the above table.
2. Robust standard errors (OLS) and standard errors (quantile regressions) in parentheses
3. * $p<0.05$; ** $p<0.01$; *** $p<0.001$

The above table shows whether each female group earns less than their white male counterparts at each percentile. But the table does not indicate whether their earning disadvantages are due to only gender or a combination of gender, race, birthplace, and/or degree origin. To better answer this question, as a third step, regressions were run with interaction terms between gender and each of the three Asian groups. As discussed above in the Data and Methods section, the interaction term indicates the difference (such as the difference between two groups) of a difference (such as the gender difference in earnings). Table 5 presents the results of the interaction terms. None of the coefficients from OLS or quantile regressions is statistically significant, meaning that the effect of gender on earnings is not larger or smaller in a statistically significant way for any Asian group than for White Americans. To confirm this finding, OLS and quantile regressions were carried out exclusively for women, controlling for the same control variables, and no statistically significant earning differences were found between White women and any of the three Asian women's groups at the mean or at any percentile. In other words, Asian women do not suffer from earning disadvantages due to any factor in addition to gender, and, as a result, they do not suffer from multiple disadvantages. Rather, their earning disadvantages are solely due to their gender.

Table 5. The Exponentiated Coefficients of the Interaction of Gender and Race: Differences in the Gender Earning Gap among White and Asian Groups in the U.S.

	OLS	10th	25th	50th	75th
Male*Asian American	1.089	0.984	1.049	1.003	1.010
	(0.11)	(0.11)	(0.07)	(0.05)	(0.06)
Male*U.S.-ed immigrant	0.975	0.944	0.995	0.998	0.999
	(0.03)	(0.04)	(0.03)	(0.02)	(0.03)
Male*Asian-ed immigrant	1.014	1.132	0.984	1.042	1.020
	(0.04)	(0.07)	(0.05)	(0.03)	(0.04)

Notes: 1. All the control variables used for Table 4 are included in the models and the three Asian groups but not reported in the above table.
2. Robust standard errors (OLS) and standard errors (quantile regressions) in parentheses.
3. * $p<0.05$; ** $p<0.01$; *** $p<0.001$

DISCUSSION AND CONCLUSIONS

The results partially support Hypothesis 1 in that U.S.- and Asian-educated immigrant women in the U.S. earn less than their white male counterparts. This finding confirms those of many earlier studies that reveal the disadvantages of women scientists and engineers, especially female immigrants, in earnings and other aspects of their careers, such as promotion. However, Asian American women do not earn less than their white male counterparts. This finding is inconsistent with earlier studies, such as Tang (1997), that native-born Asian women earn less than their white male counterparts in computer science (but not in other fields). Asian American women in the sample may benefit from the 'statistical discrimination' that Asians are supposedly good at scientific and technical work and are thus paid more overall as a result. Yet, the 'statistical discrimination' does not apply to the Asian-born women in the sample. However, the result may be also due to the small number of Asian American women in my sample. As a result, the reader needs to be careful in generalizing the finding regarding Asian American women.

Furthermore, Hypothesis 2 is supported in that this study does not find multiple disadvantages for any of the Asian women's groups of computer scientists in the U.S. This finding is consistent with those of earlier studies regarding Asian women scientists and engineers (Tang, 1997) and minority women workers in general (Greenman and Xie, 2008) in the U.S. While Asian American women are not disadvantaged due to either gender or race, U.S.- and Asian-educated immigrants as well as white women earn less than their white male counterparts. The earning disadvantages of the immigrant women's groups are due to their gender, rather than both their gender and race. Other additional personal characteristics, such as birthplace (U.S.- or Asian-born) or degree origin (U.S.- or Asian-educated), do not necessarily further disadvantage them. The reason that this paper does not find multiple disadvantages is most likely because white women computer scientists earn less than expected, and not that Asian women in computer science, especially immigrants, earn more than expected. In fact, as Table 4 shows, among the four women's groups, three earn less than comparable White men at certain percentiles, with the earning disadvantages ranging from 5.1% to 18.9%. The lack of statistically significant earning differences among groups of white and Asian immigrant women computer scientists in this study further confirms that white women scientists and engineers in the U.S. are likely underpaid to the same extent as some Asian women's groups. Again, the findings are confined to the U.S. context and may not be generalized to other countries or cultures.

While this study focuses on computer scientists working full-time, future research may investigate the choice of the employment type (full-time, part-time, or not working) of women of different races/ethnicities and how differently the choice of the employment type may influence their earnings. The Commission on Professionals in Science and Technology (CPST) (2004) reports that women are more likely than men to work part-time or be out of work. This finding may or may not hold true for all minority women. Furthermore, future studies can examine whether Asian women scientists and engineers are disadvantaged in other aspects of their careers in addition to earnings, such as being awarded tenure, getting promoted, receiving funding, and assuming leadership positions. Also, not all minority women are the same, and earlier studies have shown that different groups of minority women do not fare the same. Future studies can examine whether other minority women are disadvantaged in earnings and other aspects of their careers due to multiple disadvantages or factors in addition to their gender in the U.S.

This study suggests the importance of more research on minority groups in different cultures. Future research could investigate whether personal characteristics, such as gender, race, birthplace, and degree origin, influence the career outcomes of Asian and other minority scientists and engineers in other regions of the world, such as Europe and Australasia. In other words, are some minority groups, such as Asians, perceived as being good at STEM globally (outside Asia)? Or do their career outcomes vary from one world region or nation to another? Research addressing these issues may further improve our understanding of the career outcomes of minorities in STEM in various cultures.

ENDNOTES

[1] Many NSB publications group Asians and Pacific Islanders together due to the relative small numbers of the latter. In this paper, unless otherwise indicated, the term 'Asians' refers to Asians only and does not include Pacific Islanders.

[2] In studies of scientists and engineers in the U.S., in most, if not all, cases, the term 'Whit' refers to non-Hispanic White Americans. White Americans who are Hispanics are often differentiated as Hispanics. In this study, unless otherwise specified, the category, White, refers to non-Hispanic White.

[3] Those who were not or poorly covered in 2003 include "(a) individuals eligible for the SESTAT integrated database who lived abroad as of the 2000 decennial census who later came to live in the United States and who did not earn a bachelor's or higher SET degree from a U.S. institution after April 2000 and (b) individuals with only non-SET degrees obtained after April 2000 who held SET occupations in the survey reference period." For more details, please refer to http://www.nsf.gov/statistics/srs07201/content.cfm?pub_id=1716&id=3 .

[4] Asians refer to individuals with Asian origins born in or outside the U.S. In the sample that this paper uses, the Asian countries, from which immigrants

originally came, include India (41.2%), China (including Hong Kong and Macau) (25.7%), Taiwan (10.8%), Vietnam (6.3%), the Philippines (4.8%), Korea (3.5%), Pakistan (1.5%), Malaysia (1.1%), Japan (1.0%), and other countries representing less than 1% of the sample (in descending order): Bangladesh, Cambodia, Thailand, Sri Lanka, Iran, Laos, Singapore, Myanmar [formerly Burma], Indonesia, Nepal, Kuwait, Saudi Arabia, and Yemen. There is no indication about the ethnic origins in the NSF data of U.S.-born individuals who are self-identified as Asians since ethnicity was not identified when the data were collected. Most studies do not include individuals of Middle Eastern origins in the Asian group. However, it is likely that some U.S.-born, self-identified Asians are of Middle Eastern origins. To make U.S.-born and Asian-born computer scientists of Asian origins comparable, this study includes those of Middle Eastern origins among both U.S.- and Asian-born computer scientists. Nevertheless, the percentage of individuals of Middle Eastern origins makes up a very small proportion of the sample used in this study.

[5] The subfields defined by NSF and used in this study include computer and information scientists, computer support specialists, computer systems analysts, database administrators, network and computer systems administrators, network systems and data communications, computer engineers–software, and other computer scientists (including a small number of postsecondary teachers in computer science). Secondary teachers in computer sciences, computer programmers, and technicians are not included in this category.

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