NACME Technical Report: Salaries of Engineers[1]

Lisa M. Frehill, Ph.D., Director of Research, Evaluation and Policy

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Executive Summary

The gap in pay between full-time, year-round employed women and men in the U.S. active civilian labor force is currently 0.79: the average woman earned 79 cents for every dollar the average man earned. The situation for women is very different in engineering, possibly due to the high demand for engineering talent. First, among those who enter engineering management, women earn salaries similar to those of men, except for those aged 55-64. Second, the gap in pay is higher among those who are employed as engineering technicians starting at 0.82 for those in the youngest age group (25-34) narrowing and then widening again to 0.75 for the oldest age group (55-64 years of age). Finally, among engineers, the gap in pay is negligible for those aged 44 and less but widens to 0.89 and then 0.85 for engineers aged 45-54 and 55-64, respectively.

Overview

This brief looks at the monetary rewards that accrue to engineers and answers such questions as: What key factors play a role in engineers' salaries? To what extent do men and women in engineering have similar salaries? Do engineers of color experience similar salary outcomes as white males? We begin by looking at data collected by the Engineering Workforce Commission in its annual employer survey of engineers' salaries. These data focus on engineers in industry and government, the leading sectors for engineers and are useful for seeing how large-scale structural features impact engineers' salaries.

The second set of analyses use 2009 data from the American Community Survey (ACS), a large, national survey conducted by the U.S. Census Bureau. While the EWC study is based on information provided by employers, ACS data are based on reports of earnings by individuals. Therefore, these data are useful for answering questions about how individual characteristics, such as racial-ethnic category or sex, affect engineers' salaries.

Importantly, these studies employ different methodologies, different units of analysis, and different populations from which respondents have been drawn. As such, the results from the union of these studies will provide a more complete picture of engineers' salaries than analyses solely from one study or the other. If we are ultimately interested in further exploring why there are variations in engineers' salaries, both datasets provide useful—and different starting points—for generating research hypotheses. An important note: the analyses presented here are descriptive and do not attempt to replicate full-scale wage models that are used in the literature for the purposes of explaining wage differences. There are many other factors that are necessary to control for in those analyses and, as discussed in Morgan and Arthur (2005), the specific measurement of wages has an impact on a study's conclusions. We leave more complex analyses for a later time: here we present some initial analyses that are suggestive of future research directions.

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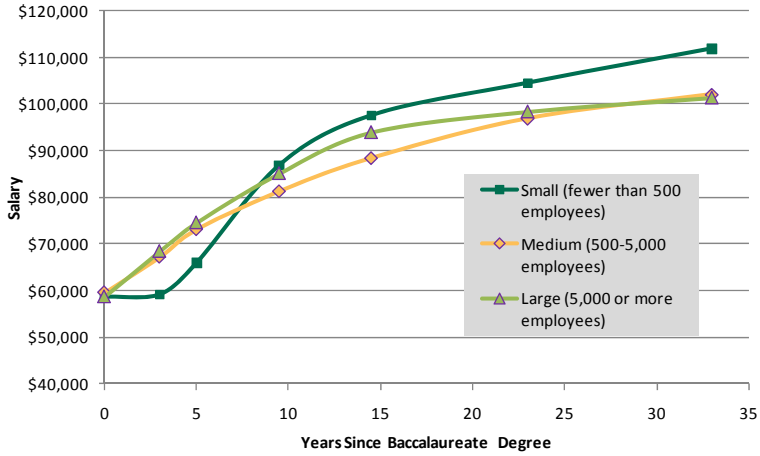
The Engineering Workforce Commission (EWC)

For more than 40 years, the EWC has collected data on engineers' salaries from the nation's leading engineering employers. Data are collected from employers rather than individual engineers, so they provide information on the ranges of pay that exist for engineers. Their data allow closer examination of engineers in specific, key industries (e.g., various types of manufacturing, research and development, etc.); for supervisors; and in several major metropolitan areas. EWC's analyses all show how time, measured in years since earning the bachelor's degree, relates to earnings. Engineers and engineering employers use the EWC data to benchmark salaries. Employers use the EWC report to ensure that they are offering competitive salaries to recruit new engineers and keep experienced ones. Engineers use the EWC data to see how well their present salary tracks for those in similar positions.

Figure 1. EWC Salary Data

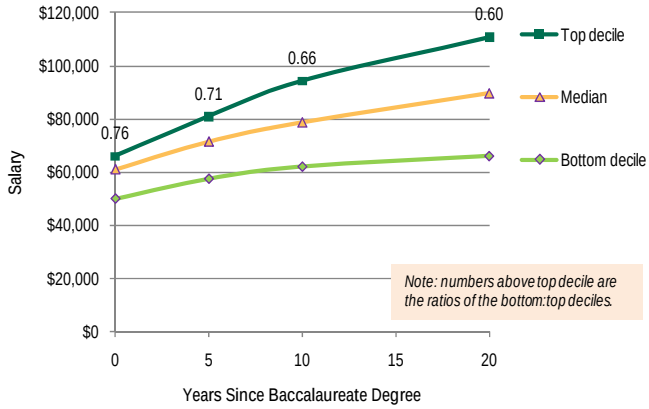
Engineers' Median Salaries by Employer Size, All Degree Levels, 2010
(Source: NACME Research, Evaluation and Policy analysis of Engineering Workforce Commission (2010) . *Engineers' Salaries: Special Industry Report.*)



Here, we present just two examples of the many analyses that are possible using the rich EWC data. The first graph in Figure 1 provides a glimpse of the median, top decile and bottom decile salaries earned by engineers at all levels and all engineering positions in industry and government at four points in engineers' careers: 1) initial hiring (0 years since the baccalaureate), 2) early career at five years 3) 10 years past the baccalaureate and mid-career, and 4) 20 years since the bachelor's degree. The numbers above the top decile earnings represent the ratio of earnings for engineers in the bottom 10 percent compared to those in the top 10 percent. These show that while at the time engineers are initially hired, the earnings gap can be as large as 0.75 for those, by the time engineers have put in 20 years in the field, that gap has widened so that the top-earning engineers earn quite a bit more than those at the bottom.

Figure 2 EWC Salary Data for Engineers by Employer Size

Salaries of Engineers, Non-Supervisory, Bachelor's Degreed by Years Since Baccalaureate Degree, 2010
(Source: NACME Research, Evaluation and Policy analysis of Engineering Workforce Commission (2010) *Engineers' Salaries: Special Industry Report*)



The second analysis shows the impact of employer size on the wages for engineers. Unlike the previous graph, in which salaries of only non-supervisory, bachelor's-degreed engineers were presented, in this chart, the salaries represent all engineers at all degree levels. There is an interesting relationship between the size of employers, median earnings and the time since bachelor's degree. Regardless of employer size, the median starting salary for new engineers at all degree levels

was around $58,500-$59,500. Within the first few years of employment, engineers' salaries at small employers remain virtually unchanged versus those at medium and large employers immediately start to grow. But the trajectory for those who work at small employers steepens and eventually those who have more than 30 years of post-baccalaureate experience at small companies have salaries that exceed those of their peers at large and medium ones. Salary trajectories for small and medium firms are similar, with only slight differences around 10-17 years post-bachelor's degree.

While the EWC data do not provide us with insight on the gender gap in pay, they are instructive in demonstrating how the range of engineers' salaries, even for those who possess just a bachelor's degree and hold non-supervisory positions, widens greatly over time, reflecting increasing inequality within the field. The bases of this inequality are a matter for subsequent research. Second, firm size seems to matter most when looking at the fairly "predictable" wage trajectories of those employed in firms of 500 or more people versus engineers working in firms with fewer than 500 employees. Hence, if it is the case that women prefer to work in smaller companies, as has been suggested in literature on biotech firms, for example, then early wages inequality in favor of men would, over time, yield in favor of women.

American Community Survey (ACS) Findings

We turn now to the findings based on an analysis of the ACS. Unlike the company-provided data from EWC, ACS data are on individuals. While a certain level of selection bias exists in the EWC data—that is, specific kinds of companies are likely to report data to EWC, it is a non-random sample—the ACS data are more broadly generalizable but complement those from EWC. These analyses look at salary outcomes for engineers in four age groups:

- 25 – 34
- 35 – 44
- 45 – 54
- 55 - 64.

These age groups provide information about early labor market experiences (i.e., 25-34 year olds), mid-career professionals at early (i.e., 35-44 year olds) and late mid-career stages (i.e., 45-54 year olds), and senior practitioners (i.e., 55-64 year olds). The ACS data allow us to look at salaries for three broad types of engineering professionals: engineers, engineering technicians, and engineering managers. Median salaries for year-round (those who worked at least 48 weeks in the past year), full-time (those who reported working at least 35 or more hours per week) were computed. We first examine the sex gap in earnings for engineering professionals within each of these three groups of workers and within each of the four age groups. As a basis for comparison, the overall gap in pay between women and men for full-time, year-round civilian employed workers in the United States was 0.79: the average woman earned 79 cents for every dollar the average man earned.

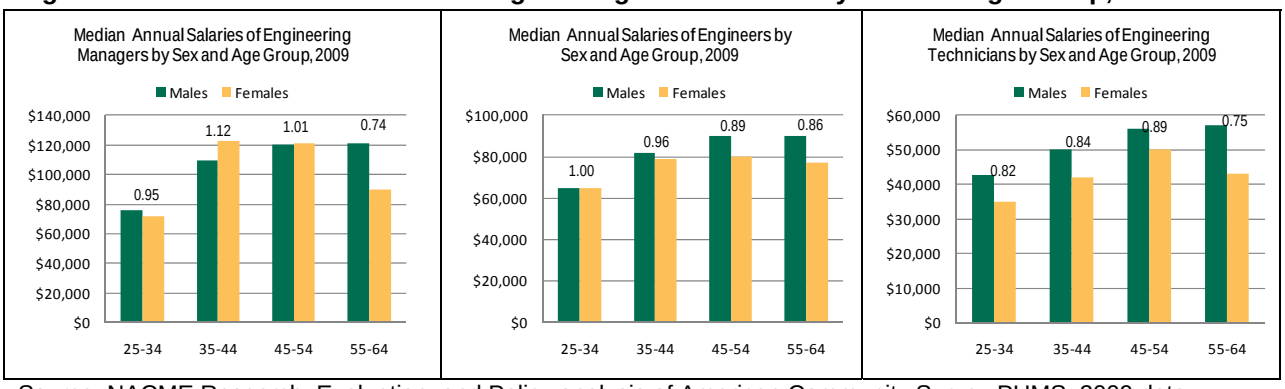
Then, we turn attention to measuring the gap in earnings for engineers of color. Data were sufficient to enable comparisons of four racial-ethnic categories: whites, African Americans, Asian-Pacific Islanders and Hispanics. As is common in wage and salary analyses, white males were taken as the category to which all seven other racial-ethnic by sex categories were compared. Some subsample sizes were quite small, so to some extent, results in these cases should be viewed with caution. An appendix table reports the cell frequencies in the race/ethnicity by sex by engineering occupation matrix.

Figure 2 reports the median salaries for three types of engineering professionals, engineers, engineering managers and engineering technicians by sex for each of the four 10-year age groups. The center panel,

showing results for "engineers" represents the job category into which most newly-degreed engineers from colleges and universities locate employment. The left-most panel shows results for engineering managers who often hold advanced training, generally engineering master's degrees, but also in business administration. Finally, engineering technicians' salaries are shown in the final panel: engineers in this group often hold education credentials below the bachelor's degree level and do work that is more technical. The numbers above the bars in each of the three charts provide the computed sex ratio, which is the females' median annual salaries divided by those of males.

Among engineers in the 25-34 and 35-44 year old age groups females' and males' median earnings were almost equal, shown by the ratios close to 1.0. Similarly, there was almost no sex gap in earnings for engineering managers in these same two age groups as well as those in the 45-54 year old age group. Indeed, women who were engineering managers in the 35-44 year old age group reported salaries that were a bit higher than those of their male peers. For both engineers and engineering managers, the 55-64 year old age group (and, for engineers, the 45-54 year old group) shows a more sizable sex gap in earnings. These findings are consistent with those found by Morgan (1998) whose analysis of data from the Society of Women Engineers documented a cohort effect related to the gap in salaries between women and men engineers.

Figure 3. Median Annual Salaries of Engineering Professionals by Sex and Age Group, 2009



Source: NACME Research, Evaluation, and Policy analysis of American Community Survey PUMS, 2009 data.

The earnings gap for engineering technicians followed a very different pattern than that for engineering managers and engineers. This group has greater variability of workers' reported educational levels (see NACME Research Brief, V1, No. 3, 2010) than that for the other two sets of engineering professionals. Figure 4 shows that whereas 8 in 10 engineers and engineering managers held a bachelor's degree or better, just over 20 percent of engineering technicians had completed this level of education. Further, about 40 percent of engineering managers and 30 percent of engineers had completed an educational credential above the bachelor's degree.

Figure 4. Educational Attainment of Engineering Professionals, 2009

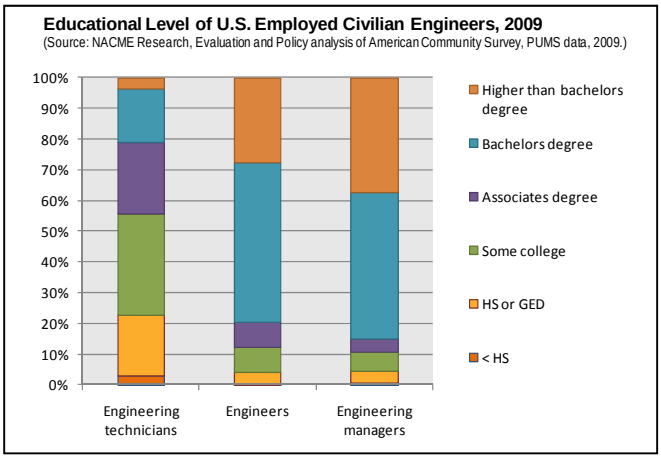


Table 1 shows the median annual salaries of the comparator category, white males, highlighted in yellow and the ratios of median salaries of men of color and of women in the four racial-ethnic categories to those of white males. Just as in the previous analyses, there is a clear cohort effect in that engineering professionals in the most senior age category, 55-64 years of age, generally had higher gaps for men of color and all women as compared to white males than those in the younger cohorts.

First, looking at the highlighted median salaries, there is a clear relationship between age group and salary in the expected direction for all three groups of engineering professionals: as age group increases so too do annual median earnings. Second, engineering managers' median salaries are higher than those of engineers, with engineering technicians posting the lowest median annual earnings.

Table 1. Engineers' Wage Ratios

Wage Ratios Comparing Earnings of White Males within Each Age Group to Those of Males of Color and Females, 2009

	Engineers		Engineering Technicians		Engineering Managers	
Age & Ethnic Category	Males	Females	Males	Females	Males	Females
25-34						
White	$65,000	0.985	$42,000	0.810	$75,000	0.960
African American	0.969	0.985	1.024	0.571	N/A	0.533
Asian/Pacific Islander	1.077	1.138	1.071	1.000	1.413	1.467
Latino	0.923	1.031	1.071	0.714	1.187	0.000
35-44						
White	$80,000	0.950	$50,000	0.832	$110,000	1.073
African American	0.938	0.875	1.020	0.840	0.691	N/A
Asian/Pacific Islander	1.125	1.063	0.900	0.860	1.091	1.318
Latino	0.938	0.813	1.000	0.880	0.909	1.055
45-54						
White	$90,000	0.833	$58,000	0.862	$120,000	1.008
African American	0.833	1.000	0.897	0.862	0.975	1.667
Asian/Pacific Islander	1.111	1.000	0.966	0.983	0.917	1.167
Latino	0.944	0.722	0.862	0.845	0.950	0.667
55-64						
White	$91,000	0.857	$59,000	0.729	$122,000	0.820
African American	0.813	0.593	1.017	0.847	0.820	0.492
Asian/Pacific Islander	1.055	0.923	0.847	0.661	1.279	0.492
Latino	0.879	0.648	0.814	0.658	1.434	N/A

Source: NACME Research, Evaluation, and Policy analysis of American Community Survey PUMS, 2009 data.

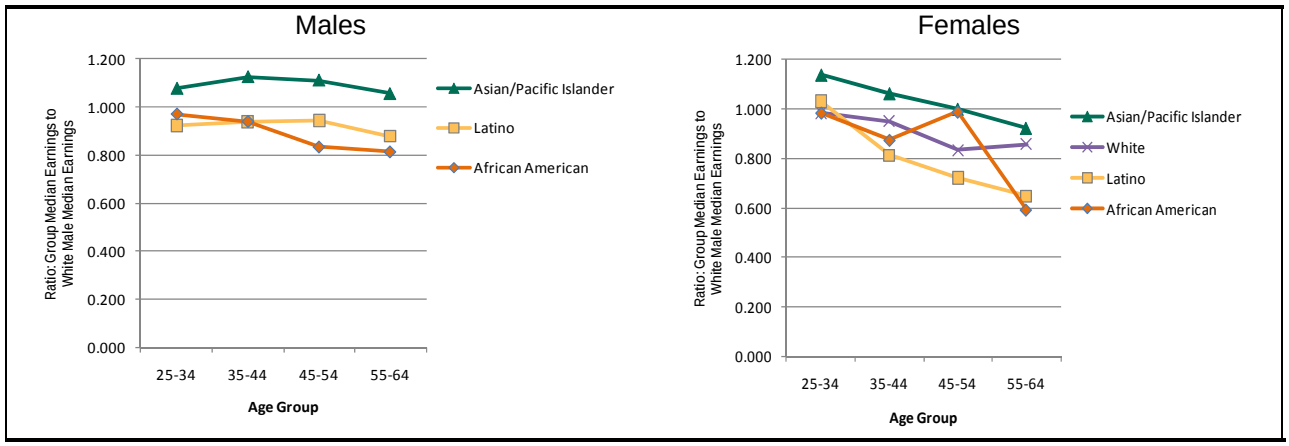
The relationship between the median earnings gap and racial-ethnic category and sex is complicated. Among engineers, those in the earliest stages of their careers show little differences regardless of racial-ethnic group and sex with salary ratios ranging from 0.92 when Latino males' earnings are compared to those of white males to 1.14 when Asian females' earnings are compared to white males. African American and Latina women's earnings for the 35-44 year old age group were lower than those of the six other racial-ethnic categories.

The two graphs in Figure 5 better illustrate the relationship between age group and the wage ratios for men and women who are employed, specifically, as engineers. For males, regardless of age, Asian/Pacific Islanders' salaries as engineers were consistently slightly higher than those of white males and those of Latino males were lower, with little variation associated with age group. African American males' salaries were also, on average, lower than those of white males, but were more so for older African American male engineers than for younger ones. Likewise, while the gap between Latino and

white males' earnings was fairly consistent among the younger three age groups, the gap notably widened for Latino males aged 55-64.

For women, there is a consistent pattern whereby the gap in average earnings compared to those of white males increased as age increased. The wage ratio at the early career stage, for 25-34 year olds, shows that regardless of ethnic background, female's wages were on par (or better in the case of Asian/Pacific Islander females) with those of white males. The only exception to this was that the wage ratio for African American females aged 45-54 was the same as that for Asian/Pacific Islander females, which was at parity with white males' average earnings for the same age group.

Figure 5. Wage Ratios for Workers Employed as Engineers by Age Group, Comparator Group: White Males, 2009



Source: NACME Research, Evaluation, and Policy analysis of American Community Survey PUMS, 2009 data.

Conclusions

These exploratory analyses show that engineers' salaries tend to be higher than those of most U.S. workers, that these salaries differ little early in engineers' careers regardless of race/ethnic category, sex, and employer size, but gaps between engineers' salaries increase with older cohorts. These increases are seen most notably in terms of the range of salaries reported by employers, shown in Figure 1 with EWC data, in which the gap between non-supervisory, bachelor's-degreed engineers' top and bottom earners' salaries was 0.60, far wider than the current overall sex gap in pay in the U.S. civilian labor force of 0.79. This is also shown in Figure 5, with especially pronounced deterioration of wages for females as compared to white males at each career stage. That is, the wage gap widened for each age-group of women, regardless of race/ethnicity for each older age group we examined.

The analyses from the ACS data show that within the younger cohorts—especially those who are within 10 years of college graduation (i.e., the 25-34 year olds)—there are few gaps in pay based on sex or ethnic category. With older cohorts, however, the gap in pay becomes all too apparent. But if we take the U.S. labor force sex gap of 0.79 as a benchmark, then only 11 of the 84 ratios presented in Table 1 are at or below this level, implying that most engineers' salaries tend to track better to white males than do those of women and of men of color in the labor market as a whole.

Finally, the descriptive analyses presented here have hinted at issues that are relevant in the determination of engineers' salaries, but in none of these analyses have the full range of factors been

considered. Additional research is necessary to understand the importance of education, how the combination of specific types of education (e.g., a bachelor's in engineering and a Master's of Business Administration (MBA), relatively common for engineering managers), industry, region, engineering discipline, and family status, together account for differences in engineers' salaries.

Appendix Table. Weighted Number of Cases in Each Cell Associated with Table 1.

	Engineers		Engineering Technicians		Engineering Managers	
Age & Ethnic Category	Males	Females	Males	Females	Males	Females
25-34						
White	235,930	44,086	89,489	16,713	9,906	1,416
African American	15,947	3,578	6,533	2,191	0	105
Asian/Pacific Islander	44,478	13,237	7,908	2,249	1,860	256
Latino	25,310	4,161	13,777	3,356	827	156
35-44						
White	86,687	37,848	93,640	19,020	29,579	2,659
African American	79,433	3,556	12,561	2,493	1,022	0
Asian/Pacific Islander	93,452	13,243	8,492	3,190	3,752	972
Latino	75,147	3,063	11,683	3,491	1,629	307
45-54						
White	342,429	37,412	118,902	24,159	46,943	4,535
African American	17,464	2,596	7,869	3,106	1,079	133
Asian/Pacific Islander	45,035	7,311	7,917	2,236	4,748	331
Latino	18,866	2,304	1,542	2,455	1,527	89
55-64						
White	202,180	9,504	77,561	12,566	19,995	1,072
African American	7,115	660	4,870	1,820	1,153	54
Asian/Pacific Islander	19,973	1,253	5,703	1,455	1,193	145
Latino	8,314	168	5,566	636	189	0

About the National Action Council for Minorities in Engineering, Inc. (NACME)
Since its founding in 1974, NACME has stayed true to its mission: To insure American resilience in a flat world by leading the national effort to expand U.S. capability via better engagement of African American, American Indian and Latino women and men in science, technology, engineering and mathematics (STEM) education and careers. NACME alumni hold leadership positions in industry, medicine, law, education and government. With funding from corporate and individual donors, NACME has supported over 22,000 students with more than $124 million in scholarships and other support. Currently, NACME provides scholarship support to more than 1,300 college engineering students through a national network of 50 partner universities. NACME is also implementing a middle school through community college strategy to increase the proportion of underrepresented minority students in STEM disciplines. http://www.nacme.org.