Analyzing Wage Patterns of Engineers and Secretaries

Engineers traditionally earn much more than secretaries, and both groups' salaries can vary significantly depending on area of the country, level of work, size of firm, and other factors. This article identifies these factors and uses regression analysis to isolate their effect on earnings.

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Engineers averaged about $46,600 a year in 1994, and secretaries averaged about $26,700, according to the Bureau's *Occupational Outlook Handbook.* In both cases, wages of individuals varied widely within these occupations. This article examines earnings data obtained for these occupations in the Bureau's 1995 Occupational Compensation Survey (OCS) program, to determine how selected factors contribute to variation in earnings, and to determine whether these major professional and clerical occupations are affected in the same way.[1]

Level of work

Level of work was found to be the most important indicator of engineers' salaries. The OCS program studies eight levels of engineers, distinguished primarily by the difficulty of the work and its importance to the organization. About 75 percent of the engineers were found at levels 3 through 5 (the two journey levels and first advanced level). Workers in the eight levels averaged about $1,122 a week or $58,344 a year in 1995. Engineers at the entry level earned less than a third as much as the highest level of engineers studied, $664 a week versus $2,323. (See table 1.) Differences in average earnings between a level and the next higher level ranged from 18 to 22 percent.

The level of work had far less effect on earnings of secretaries than on engineers. The OCS program divided secretaries into five levels according to the position of the secretary's supervisor and the degree of responsibility of the secretary. As shown in table 2, the highest level secretaries averaged $793 a week, or about twice as much as the lowest level, $379 a week. About two-thirds of the secretaries were found at the second and third levels.

From 1960 to 1990, the Bureau conducted occupational wage surveys, studying the wages of professional occupations on a

Table 1. Average weekly earnings of engineers by selected characteristic, 1995

Characteristic	Level							
	1	2	3	4	5	6	7	8
All	$664	$790	$943	$1,149	$1,389	$1,634	$1,935	$2,323
Region								
Northeast	659	775	940	1,134	1,352	1,600	1,908	2,190
South	638	779	925	1,148	1,389	1,668	1,856	-
Midwest	681	794	934	1,140	1,387	1,574	1,917	-
West	694	813	981	1,169	1,420	1,657	2,006	2,300
Type of area								
Metropolitan	674	795	950	1,152	1,392	1,638	1,934	2,323
Nonmetropolitan	605	755	871	1,106	1,313	-	-	-
Industry								
Private industry	666	793	943	1,155	1,397	1,650	1,943	2,326
Goods producing	679	797	941	1,152	1,400	1,664	1,983	2,354
Manufacturing	677	796	940	1,147	1,392	1,653	1,972	2,348
Service producing	644	782	949	1,163	1,388	1,610	1,843	2,245
Transportation and utilities	712	843	1003	1,188	1,384	1,628	-	-
Services	638	763	926	1,150	1,388	1,610	1,838	-
State and local government	650	775	946	1,095	1,264	1,349	-	-
Establishment size								
Fewer than 500 workers	626	752	917	1,148	1,409	1,641	1,933	-
500 - 999 workers	662	792	950	1,134	1,376	1,619	1,887	-
1,000 - 2,499 workers	706	818	975	1,178	1,414	1,696	1,971	2,305
2,500 workers or more	707	817	949	1,140	1,371	1,606	1,923	2,365

NOTE: Dashes denote that data do not meet publication criteria.

Table 2. Average weekly earnings of secretaries by selected characteristic, 1995

Characteristic	Level				
	1	2	3	4	5
All	$379	$470	$547	$651	$793
Region					
Northeast	405	489	570	673	805
South	368	436	511	606	740
Midwest	394	465	546	633	809
West	380	523	574	671	800
Type of area					
Metropolitan	388	474	550	652	794
Nonmetropolitan	347	427	491	608	-
Industry					
Private industry	391	480	552	661	799
Goods producing	431	499	569	672	804
Manufacturing	430	497	567	670	800
Service producing	380	475	544	653	796
Transportation and utilities	416	506	571	682	833
Wholesale trade	389	480	554	638	829
Retail trade	379	468	524	632	-
Finance, insurance, and real estate	396	494	541	649	788
Services	369	459	541	655	789
State and local government	365	454	530	617	736
Establishment size					
Fewer than 500 workers	373	466	548	676	851
500 - 999 workers	373	454	545	650	789
1,000 - 2,499 workers	381	495	550	654	786
2,500 workers or more	391	465	545	635	778

NOTE: Dashes denote that data do not meet publication criteria.

national basis, while clerical jobs were studied on a local and national basis. The assumption that professional pay is determined on a national basis, while the labor market for clerical jobs is local, was a rationale for design of the study. Beginning in 1991, the Bureau began studying local wages for selected professional occupations, so it is now possible to compare wage patterns for professional and clerical workers on a national, regional, and local basis.

Geographic region

As expected, regional wage differences were much smaller for engineers than for secretaries. (See table 3.) Differences in average earnings between the highest and lowest paying regions ranged from 3 to 9 percent for the eight levels of engineers, while differences for secretaries ranged from 9 to 20 percent. Typically, earnings were highest in the West for both groups. Earnings of secretaries at all levels were lowest in the South, but the pattern was mixed for engineers. Each region but the West had the lowest earnings for at least one level of engineers.

Table 3. Relative pay levels for engineers and secretaries by region, 1995

Region	Engi-neers	Secre-taries
United States	100	100
Northeast	98	102
South	99	94
Midwest	99	100
West	103	106

NOTE: United States excludes Alaska and Hawaii.

Metropolitan area

In order to compare earnings among metropolitan areas, average earnings for all levels of an occupation in an area were combined, apportioning workers among levels in the same proportion as they were nationally. Because data collection occurred at different times of the year for localities, averages were then adjusted for differences in the

time areas were surveyed. The adjusted averages were then divided by the national average to produce relative pay levels. For example, the relative pay of 111 for engineers in Oakland, California shows engineers in that area earned 11 percent more than the national average. Likewise, the pay relative of 90 for St. Louis, Missouri-Illinois indicates earnings in that area were 10 percent below the national average.

Table 4 shows that regional averages are not good indicators of area averages. Three California areas—Oakland, San Francisco, and Anaheim—were among the areas with highest average earnings for engineers, while two California areas, Sacramento and San Diego, were among the lowest paying. Comparing tables 4 and 5 also shows that relative pay levels for one occupation are not necessarily good indicators of pay levels for another occupation. For example, New Orleans was among the highest paying areas for engineers and among the lowest paying for secretaries.

As expected, the difference between highest and lowest pay was larger for metropolitan areas, e.g., Oakland versus St. Louis, than for economic regions, e.g., West versus South. The percent difference between highest and lowest areas was greater for secretaries than for engineers.

Table 4. Relative pay levels for engineers in metropolitan areas with highest and lowest average pay, 1995

Highest		Lowest	
Oakland, CA	111	Kansas City, MO-KS	94
San Francisco, CA	108	Sacramento, CA	94
Houston, TX	107	San Diego, CA	94
Anaheim, CA	105	Atlanta, GA	93
New Orleans, LA	105	Milwaukee, WI	93
Philadelphia, PA-NJ	103	St. Louis, MO-IL	90

NOTE: United States, excluding Alaska and Hawaii, equals 100. Based on comparisons for 45 metropolitan areas.

Table 5. Relative pay levels for secretaries in metropolitan areas with highest and lowest average pay, 1995

Highest		Lowest	
New York, NY	119	New Orleans, LA	92
San Francisco, CA	119	Salt Lake City, UT	92
Los Angeles, CA	115	Phoenix, AZ	87
Oakland, CA	113	Corpus Christi, TX	86
Anaheim, CA	111		
Bergen-Passaic, NJ	111		
Detroit, MI	111		

NOTE: United States, excluding Alaska and Hawaii, equals 100. Based on comparisons for 58 metropolitan areas.

Type of Area

The number of engineers and secretaries at the highest levels was not sufficient to publish average earnings for these levels in nonmetropolitan areas. At the lower levels, earnings were consistently higher in metropolitan areas than in non-metropolitan areas—between 4 and 11 percent higher for engineers, and 7 to 12 percent higher for secretaries.

Industry

Both engineers and secretaries had higher average earnings in private industry than in State and local governments. The percentage differences between the major industry groups paying the highest and lowest wages were larger for secretaries than for the four lowest levels of engineers. Among private industries, engineers were primarily employed in manufacturing, transportation and utilities, and services, which includes engineering and architectural services. Within these groups, the transportation and utilities industry division was clearly highest paying, while the services division was the lowest paying for the three lowest levels. Above level 3, the pattern was not as distinct.

Secretaries were more evenly distributed among private industries. Their earnings were highest in transportation and utilities or manufacturing, and lowest in retail trade or services, similar to the pattern for engineers.

Establishment size

In general, large firms pay higher salaries than small firms. This was not self-evident in examining wages of establishments of different sizes. For the most part, engineers at level 4 and above, and secretaries at all levels, generally earned more in establishments employing fewer than 500 workers than those in establishments with 500 to 999 workers. Those in establishments employing 1,000 to 2,499 workers earned more than those in establishments employing 2,500 workers or more.

The relationships between earnings and establishment size do not necessarily show that the establishment size determines pay. Other factors, such as industry, may influence both pay and establishment size. For example, aircraft manufacturing is an above-average paying industry and is usually carried out in large establishments. Conversely, most of retail trade is relatively low paying and includes many very small establishments. Regression analysis is useful in distinguishing between causal relationships and incidental correlations in cases such as these.

Regression analysis

Comparing averages of workers with varying characteristics gives an indication of the effect of the characteristics but does not isolate the effect. To better isolate the effect of these characteristics on earnings, weekly earnings of engineers and secretaries were regressed against the level of work in the occupation, geographic region, metropolitan characteristic, industry, and establishment size. The constant related to workers employed in the lowest level of the occupation (level 1), the South, a nonmetropolitan area, retail trade, and an establishment with fewer than 500 workers. The R^2 of 0.7337 for engineers and 0.5313 for secretaries indicates that the variables accounted for about 73 percent of the variability in wages of engineers, and 53 percent for secretaries. (See table 6.)

The regressions based on employment characteristics of individual workers generally confirmed the observations about occupational averages for workers grouped by characteristic. For both engineers and secretaries, wages consistently increased as level of work became more complex and demanded more responsibility; the change by level was much greater for engineers than for secretaries.

Among regions, working in the Northeast, as compared with the South, was a decided advantage for secretaries but a disadvantage for engineers. Engineers earned more in the West than in the other regions. Engineers working in metropolitan areas earned about $63 a week more than those in nonmetropolitan areas, and secretaries in metropolitan areas earned about $35 a week more than their nonmetropolitan counterparts.

Industry had a much larger effect on earnings of engineers than on secretaries. Engineers employed in mining had an earnings advantage of $346 a week over engineers in retail trade; in finance, insurance and real estate, the engineers'

earnings advantage was $241; and in transportation and public utilities, it was $137. In contrast, for secretaries, variation among industries was less than $51 a week except for mining. Salaries in mining were $125 higher than in retail trade.

As with simple cross tabulations, in the regression analysis, earnings did not rise consistently with establishment size. Engineers received less of a premium in establishments with 2,500 workers or more than in establishments with 1,000 to 2,499 workers. Earnings of secretaries were more inconsistent. Secretaries in establishments employing fewer than 500 workers earned more than secretaries in establishments employing 500 to 999 workers and those employing 2,500 workers or more.

Regression studies of earning levels were also done using the natural logarithms of earnings, rather than the earnings themselves. This was done in the belief that explanatory variables are related to earnings in a multiplicative, rather than additive fashion. That is, it was hypothesized that a factor such as industry increases earnings by a given percent rather than by a set dollar amount. In this article, the R^2 was almost identical for the multiplicative and additive relationship approaches, so neither approach was clearly superior.

Logarithmic analysis can be more useful when comparing the effect of variables on occupations with widely differing earnings. For example, table 7 shows that engineers working at level 2 earn 18.7 percent more than those at level 1, all else being equal.

—*ENDNOTES*—

[1] For comprehensive information on the 1995 survey, see *Occupational Compensation Survey, National Summary, 1995*, or individual area bulletins. Bulletins can be purchased from the Bureau of Labor Statistics, Publications Sales Center, P.O. Box 2415, Chicago, IL 60690-2145. Electronic files are available on the Internet's World Wide Web through the Bureau of Labor Statistics' site: stats.bls.gov/ocshome.htm

[2] For a more detailed analysis of earnings by region, see: John E. Buckley, "Occupational Pay Across Regions in 1994," *Compensation and Working Conditions*, June 1996, pp. 35-38.

[3] For a more detailed analysis of earnings in metropolitan and nonmetropolitan areas, see: Elizabeth Dietz and Jordan Pfuntner, "Do Urban Workers Earn More Than Their Country Cousins?", *Compensation and Working Conditions*, June 1996, pp. 39-40.

[4] In goods-producing industries, an establishment is defined as a single physical location where industrial operations are performed. In service-producing industries, an establishment is defined as all locations of a company in the same area within the same industry division. In government, an establishment typically comprises all locations of a government entity.

Information was not available on differences in earnings by firm size.

[5] Regressions done separately for each occupational level, and thus not having level as a variable, accounted for less than a quarter of the variability for all levels of engineers and secretaries, and 11 percent or less for 8 of the 13 occupations/levels.

Table 6. Regression results on weekly salaries of engineers and secretaries, 1995

Independent variable	Engineer		Secretary	
	Parameter estimate	Standard error	Parameter estimate	Standard error
Constant	495.63	14.661	353.70	3.334
Level of work				
2	122.58[1]	2.207	67.64[1]	1.015
3	272.77[1]	2.045	132.40[1]	.988
4	470.85[1]	2.033	225.50[1]	1.115
5	706.99[1]	2.111	357.57[1]	1.663
6	946.24[1]	2.438		
7	1239.71[1]	3.733		
8	1623.41[1]	9.202		
Geographic region				
Northeast	-4.43[1]	1.211	43.84[1]	.847
Midwest	12.05[1]	1.111	17.15[1]	.812
West	48.98[1]	1.091	23.71[1]	.889
Metropolitan character				
Metropolitan area	63.46[1]	1.633	35.01[1]	2.594
Industry				
Mining	345.76[1]	14.975	125.27[1]	3.374
Construction	98.75[1]	15.160	25.13[1]	5.312
Manufacturing	96.40[1]	14.508	38.83[1]	2.034
Transportation and utilities	136.91[1]	14.609	41.71[1]	2.252
Wholesale trade	77.67[1]	15.342	9.20[1]	2.737
Finance, insurance and real estate	240.96[1]	18.244	-1.642	.046
Services	84.86[1]	14.533	-4.95[2]	2.014
State and local government	43.31[1]	14.550	-19.42[1]	2.039
Establishment size				
500-999 workers	9.74[1]	1.270	-10.27[1]	1.006
1,000-2,499 workers	41.51[1]	1.091	.73	.781
2,500 workers or more	27.90[1]	1.337	-1.71[2]	.799
R^2	0.7337		0.5313	
Adjusted R^2	0.7337		0.5312	
Sample size	176,211		98,043	

[1]Significant at the 1 percent level.
[2]Significant at the 5 percent level.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics

Table 7. Regression results on natural logarithms of weekly salaries of engineers and secretaries, 1995

Independent variable	Engineer			Secretary		
	Parameter estimate	Standard error	Effect (in percent)	Parameter estimate	Standard error	Effect (in percent)
Constant	6.315	0.013		5.873	0.006	
Level of work						
2..	0.171[1]	0.002	18.7	0.160[1]	0.002	17.3
3..	0.345[1]	0.002	41.2	0.287[1]	0.002	33.3
4..	0.536[1]	0.002	70.9	0.444[1]	0.002	55.9
5..	0.722[1]	0.002	105.9	0.625[1]	0.003	86.7
6..	0.878[1]	0.002	140.7			
7..	1.039[1]	0.003	182.8			
8..	1.213[1]	0.008	236.3			
Geographic region .						
Northeast	0.000	0.001	.0	0.081[1]	0.002	8.5
Midwest..	0.014[1]	0.001	1.4	0.035[1]	0.002	3.6
West...	0.046[1]	0.001	4.7	0.046[1]	0.002	4.7
Metropolitan character						
Metropolitan area	0.068[1]	0.001	7.0	0.077[1]	0.005	8.0
Industry						
Mining	0.281[1]	0.013	32.5	0.223[1]	0.006	25.0
Construction	0.089[1]	0.013	9.3	0.048[1]	0.010	4.9
Manufacturing	0.096[1]	0.012	10.0	0.073[1]	0.004	7.6
Transportation and utilities	0.140[1]	0.013	15.1	0.075[1]	0.004	7.8
Wholesale trade	0.078[1]	0.013	8.1	0.021	0.005	2.1
Finance, insurance and real estate	0.216[1]	0.016	24.1	-0.001	0.004	-.1
Services...	0.083[1]	0.012	8.7	-0.009[2]	0.004	-.9
State and local government.....................................	0.049[1]	0.012	5.0	-0.044[1]	0.004	-4.3
Establishment size						
500-999 workers	0.012[1]	0.001	1.2	-0.018[1]	0.002	-1.7
1,000-2,499 workers	0.038[1]	0.001	3.9	0.005[1]	0.001	.5
2,500 workers or more	0.028[1]	0.001	2.8	0.001	0.001	.1
R²	0.7422			0.5298		
Adjusted R²	0.7422			0.5297		
Sample size	176,211			98,043		

[1] Significant at the 1 percent level.
[2] Significant at the 5 percent level.

SOURCE: U.S. Department of Labor, Bureau of Labor Statistics