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SUPPLEMENT



## THE STRUCTURE OF ECONOMISTS' EMPLOYMENT AND SALARIES, 1964

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higher average numbers of years of experience than the men, and in four of the six cases the women's advantage in experience was substantial.<sup>84</sup> Thus the sex differential in salaries prevailed, even though the factor of experience worked in favor of the women's salaries—and in the Welfare field probably was influential in raising the women's median salary above that of the men. The age factor, however, reinforced the gross sex differential, with women more heavily represented in the low-salary, beginning age groups and in the plateau-salary and declining-salary groups from 50 years upwards.

Limitations of both the data and of space preclude a detailed treatment of the sex differential in salaries in relation to all combinations of each of the other factors which may be associated with salary differences between economists.<sup>85</sup> Even when all six of the other factors in salary differences are simultaneously taken into account, Section V of this report shows that the net salary differences associated with sex remain statistically significant. Lack of lifetime continuity of work, mentioned previously, may partially explain the lower average salaries of women than of men in the economics profession.

#### V. *The Net Influence on Economists' Salaries of Each of Seven Characteristics: A Regression Analysis*<sup>86</sup>

The analysis of Section III has demonstrated that the "true" net relationship between salaries and each of the other surveyed characteristics is often evident only after the effect of intercorrelation among the characteristics has been removed. In Section III, this problem was approached through cross-classification by the intercorrelated characteristics; here, resolution of the same problem is sought through least-squares multiple regression. Such regression analysis supplements the preceding work in the following ways: (1) all seven characteristics are considered simultaneously, so that all intercorrelations are taken into account; (2) the regression coefficients provide a concise quantification of the net relationships; and (3) measures are obtained of the relative importance and statistical significance of the net influences on salaries. In general, the regression results confirm the principal findings reported in Section III.

<sup>84</sup> Appendix Table Q shows the distribution of women in each of six of the twelve fields of specialization by years of experience.

<sup>85</sup> But see Appendix Tables R and S for some further detail.

<sup>86</sup> This chapter was written by Emanuel Melichar, Economist, Board of Governors of the Federal Reserve System, Washington, D. C. A more detailed report on the regression analysis, including a discussion of the techniques employed and of tests and limitations of the model, is available from the author on request.

### 1. *Relative Importance of the Characteristics*

Among the seven characteristics in the regression model, length of professional experience and type of employer together made the greatest contribution toward explanation of salary variation, followed closely by level of highest academic degree and the primary work activity. Age, sex, and economic specialty were found to exert relatively minor net influence. These rankings are based on coefficients of partial determination, shown in the first column of Table 14. The net contribution made by each characteristic was significant beyond the .01 probability level, according to the F-ratios also reported in Table 14.

TABLE 14—IMPORTANCE OF SELECTED CHARACTERISTICS IN EXPLAINING SALARY VARIATION

Characteristic	Net relationship		Gross relationship		Number of variables used
	Partial R <sup>2</sup>	F-ratio	R <sup>2</sup>	F-ratio	
Years of experience (separately for each of two employer groupings)	.085	65.50	.412	498.95	14
Level of highest degree	.081	218.45	.032	82.54	4
Primary work activity	.065	137.13	.235	612.82	5
Type of employer	.032	36.38	.169	224.70	9
Age of economist	.015	22.12	.226	415.42	7
Sex of economist	.015	154.59	.011	110.45	1
Specialty of greatest competence	.009	8.44	.040	37.40	11

Note: all relationships are significant at the .01 probability level.

In the regression analysis, each class of each of the seven characteristics was represented by a separate independent variable, with one exception introduced to take account of a major interaction between the influence of professional experience and type of employer. As was noted in Section III, the progression of salaries with additional professional experience was markedly greater in business than in educational institutions or in the Federal government. Further investigation showed that this effect persisted even after the other two important characteristics—primary work activity and level of highest academic degree—were both taken into account. In the regression model, therefore, two sets of variables were provided to measure the influence of professional experience: one for economists who worked for industrial, business, nonprofit, and other employers, or who were self-employed (Group I);

and the other for the economists employed by educational institutions and governments (Group II).

The logarithm of salary was used as the dependent variable in the model reported here. By regressing the characteristics on logarithms rather than on the actual salaries, their net influences are measured in proportional rather than absolute terms, and their cumulative effect is considered to be multiplicative rather than additive. Experimentation with these alternative models confirmed the *a priori* belief that the logarithmic form would better reflect the salary structure. The seven characteristics, represented in the logarithmic equation by 51 independent variables, explained 55 percent of the total variation among the logarithms of salaries and 41 percent of the variation among actual salaries. These coefficients of multiple determination ( $R^2$ ) are statistically significant beyond the .01 probability level in an analysis based on 9,981 observations.

For comparison, Table 14 also presents the  $R^2$  and F-ratio calculated for the gross relationship exhibited between salaries and each characteristic. (The gross relationship is defined as that found for a single characteristic when no other characteristics are taken into account.) For most of the characteristics, the net influence was less important than one would have assumed from study of the gross relationship only, as part of the latter was generally found to be attributable to other influences. This was particularly true of age, which was found to have only minor net effect after the length of experience was taken into account. On the other hand, the full influence of the level of academic degree emerged only in the net relationship, having previously been obscured by intercorrelations with type of employer and primary work activity. The strength of the salary difference between men and women also persisted unabated into the net relationship. This relationship was statistically highly significant, but not of much importance in explaining total salary variation because the women economists were few in number.

## 2. *The Nature of the Net Relationships*

The regression coefficients that quantify the net relationships are the heart of the regression results. Each coefficient is the net percentage salary difference from the geometric mean that was associated with membership of an economist in the class to which the coefficient applies. The results are charted in Figure 1 (pp. 66-67), over which shows the gross and net salary differences associated with each class of each characteristic. The chart also shows the proportion of the registered economists that fell into that class, to help one assess the relative

FIGURE 1. GROSS AND NET RELATIONSHIPS BETWEEN ECONOMISTS' SALARIES AND SPECIFIED CHARACTERISTICS

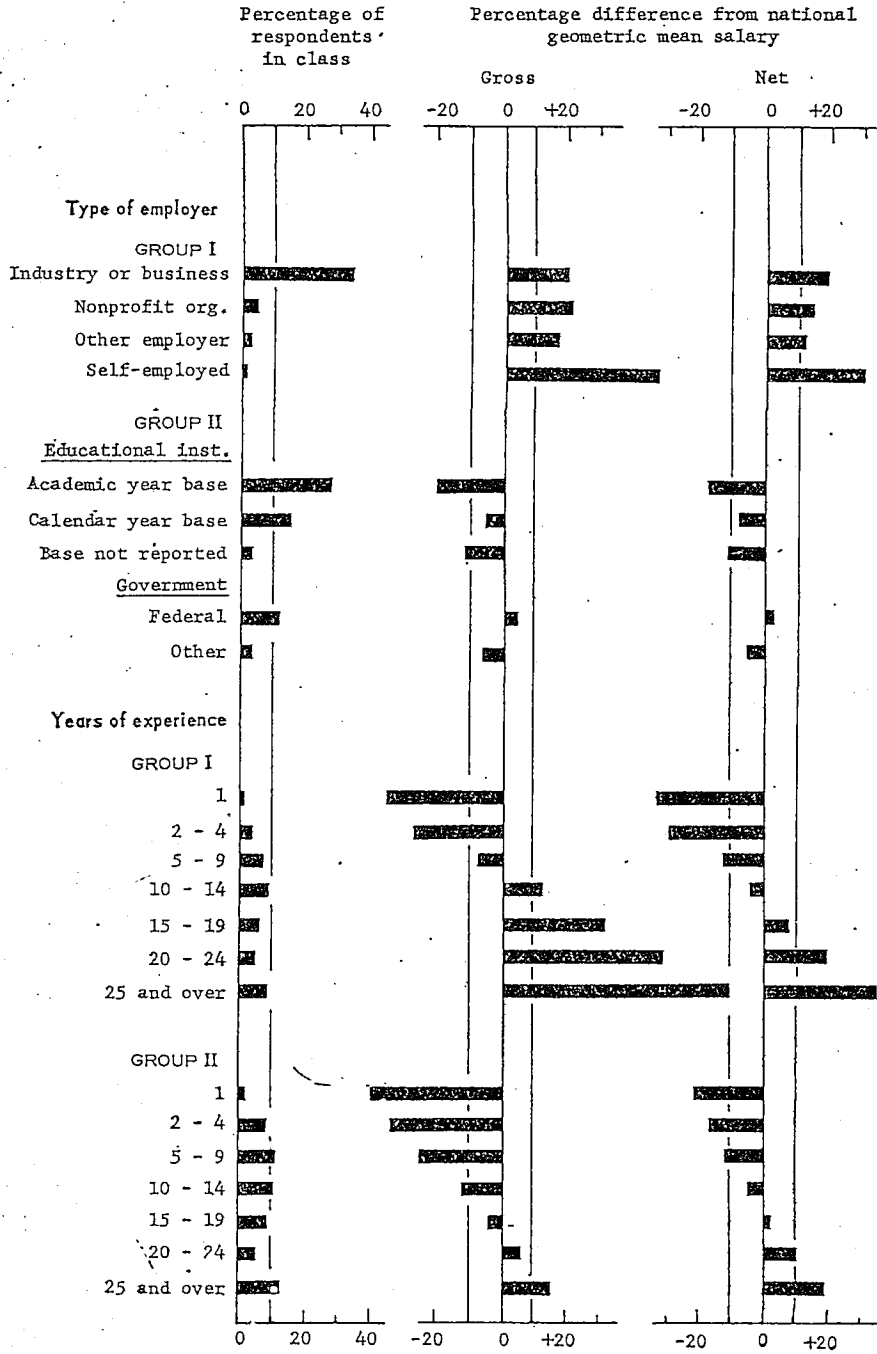
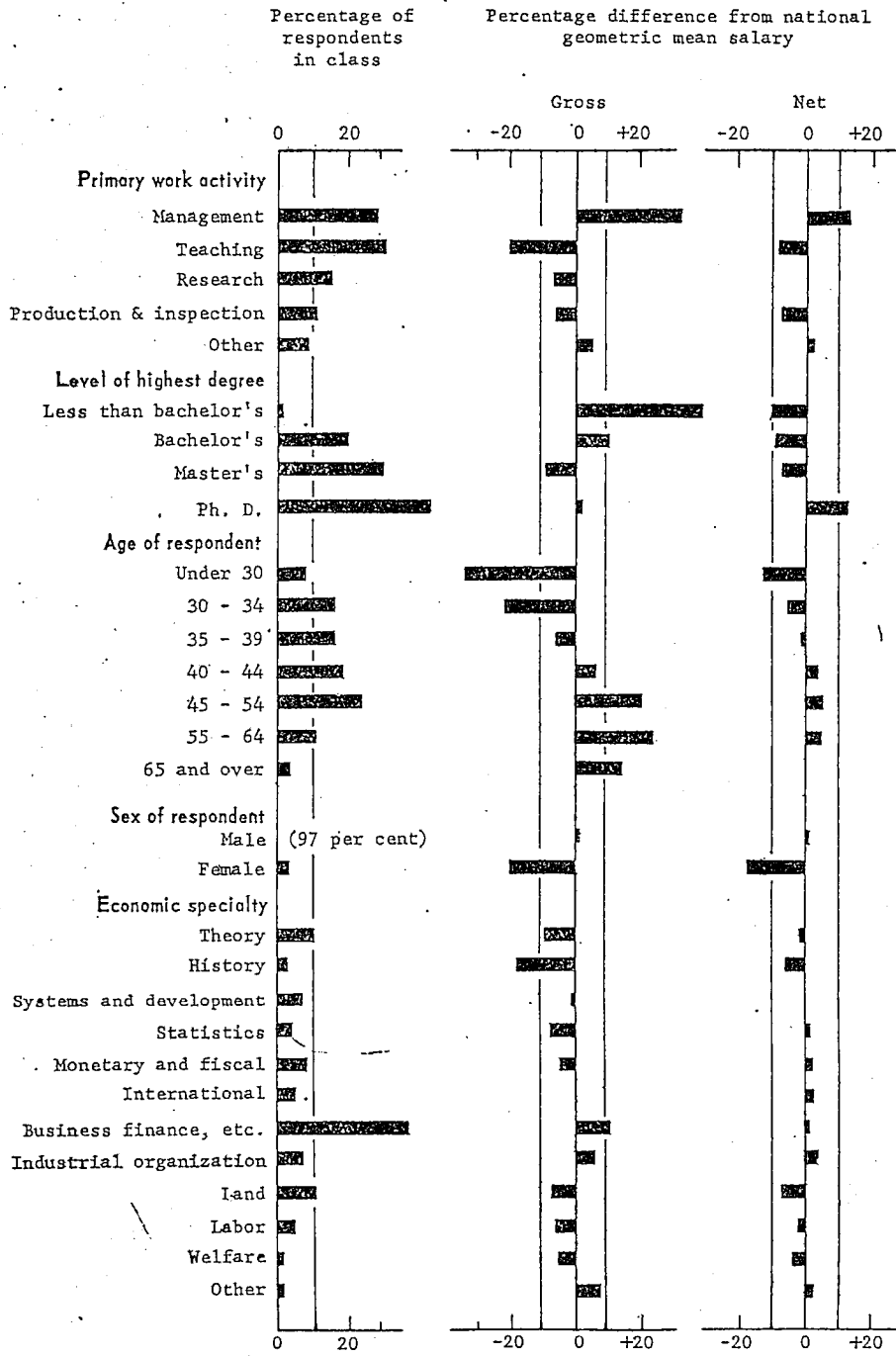


FIGURE 1. (CONTINUED)



aggregate importance of the salary differences shown. In each case that the difference between any two classes was large enough to be of much interest (5 percent or more), it is statistically significant at the .01 probability level.

As has been noted, separate net relationships between salary and years of experience were estimated for economists in each of two type-of-employer groups. In Group I, dominated by economists employed by business, the possession of 25 or more years of experience was associated with a net salary gain of 98 percent over those with only one year of experience. For Group II, comprised of the economists employed by educational institutions and governments, the comparable net gain was only 46 percent. The gain estimated for Group I represented an average annual net salary progression of about 2.25 percent over the period of approximately 30 years, while the net annual progression for Group II was about 1.25 percent. For both groups, however, the net annual rate of salary progression associated with experience was much higher in the early years and decreased steadily with more experience. For Group I, the net annual progression during the first seven years of experience averaged about 4.5 percent, but at about 25 years of experience the net annual progression was reduced to about 1.2 percent. In Group II, the comparable net annual gains were estimated at about 2 percent and 0.75 percent, respectively.<sup>87</sup>

For any two employer types who are either both in Group I or both in Group II, net salary differences may be cited without reference to years of experience. For instance, salaries in business tended to be 5 percent above salaries in nonprofit organizations. In educational institutions, salaries on a calendar year base tended to be 12 percent higher than those on an academic year base. Federal government salaries tended to be 10 percent above calendar-year salaries at educational institutions, and 24 percent above academic-year salaries.<sup>88</sup>

Salary comparisons between an employer type in Group I and one in

<sup>87</sup> In evaluating these net progressions of salary with additional years of professional experience, it should particularly be noted that the net influence of advancing age (to be discussed later) has been excluded as a result of its inclusion in the model as a separate characteristic.

<sup>88</sup> Tests of the model indicate the presence of a complex interaction that requires this finding to be qualified. Within the two primary work activities, management and research, to which comparisons between educational institutions and the federal government must be restricted, the differences cited appear to be overstated for economists with the Ph.D. degree and understated for those with a Master's degree. For example, for economists with the Ph.D. who are working primarily in research, there appears to be no significant difference between federal government salaries and calendar-year salaries at educational institutions. By the same token, the differences between federal government and business salaries for Ph.D. economists were actually wider than the over-all differences indicated in the next paragraph of the text.

TABLE 15—NET RELATIONSHIPS BETWEEN ECONOMISTS' SALARIES AND YEARS OF EXPERIENCE, BY SPECIFIED TYPE OF EMPLOYER

Years of professional experience	Type of employer			
	Educational institution		Federal government	Industry or business
	Academic year base	Calendar year base		
Percentage difference from national geometric mean				
1	-35	-27	-19	-20
2-4	-31	-23	-15	-13
5-9	-27	-18	-9	+4
10-14	-20	-11	-2	+14
15-19	-16	-6	+4	+28
20-24	-10	+1	+11	+43
25 and over	-3	+8	+20	+59

Group II must be couched in terms of a specific length of professional experience. The process of combining the results for the two characteristics has been performed in Table 15 for the major employer types. Thus salaries for economists with one year of experience tended to be 10 percent higher in business than in educational institutions on a calendar year basis; but for economists with 25 or more years of experience, business salaries tended to be 47 percent higher. Similarly, for economists with one year of experience there was no net salary difference between employment by business and employment by the federal government, whereas economists with 25 or more years of experience tended to receive salaries 33 percent higher in business than in the federal government.

Fairly substantial net salary differences were also associated with differences in primary work activity, although the differences were much reduced by the simultaneous consideration of other characteristics. Economists with primary work activity of management tended to have salaries 14 percent above those in research and 24 percent above those in either teaching or production and inspection.<sup>89</sup> Economists in research, in turn, tended to have salaries 8 percent above those in the latter groups.

<sup>89</sup> An interaction found between primary work activity and years of experience, and which was not provided for in the model, requires that this finding be qualified. Among economists with little experience, those with primary work activity of management had about the same salaries as economists in other activities. On the other hand, for business-



The level of academic degree exerted a large net influence on salaries, as holders of the Ph.D. tended to receive salaries 22 percent above economists with the Master's degree and 24 percent above those with the Bachelor's. As this finding also indicates, there was no significant net salary difference between the latter two degrees. The net relationship thus indicated between salaries and level of degree differs markedly from the gross relationship, as the average salary of economists with the Bachelor's degree was higher than the average salaries of those with the advanced degrees. The analysis indicates, however, that this gross salary difference was attributable to characteristics other than the level of degree itself.

The net influence that age had on salaries after professional experience was taken into account was found to be rather small. Its major effect was among the young economists: given two economists similar in all characteristics except age, the salary of one in his late thirties tended to be 14 percent higher than the salary of one in his late twenties. The positive net progression of salary with age continued to approximately the age of 50, though at a much slower rate. Thereafter, a small net decline was associated with advancing age.

Given the same values for the other surveyed characteristics, men tended to have salaries 22 percent higher than those of the women economists.

Net salary differences between economists in the various specialty groups were much smaller than the gross differences, thus showing that most of the latter were attributable to correlated differences in the other characteristics. Only in two specialty groups—land economics and economic history—were there significant negative net salary differences. Between the low and high extremes—land economics and industrial organization—there was a net difference of about 11 percent.

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employed economists with many years of experience, the actual net salary difference associated with a primary work activity of management was apparently about 10 to 15 percentage points greater than that shown by the regression results reported.