DOCUMENT RESUME

ED 287 344 HE 020 716

AUTHOR Williams, John Delane; And Others
TITLE A Ten Year Study of Salary Differential by Sex through a Regression Methodology.
PUB DATE Apr 87
NOTE 18p.; Paper presented at the Annual Meeting of the American Educational Research Association (Washington, DC, April 20-24, 1987).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *College Faculty; *Females; Higher Education; Longitudinal Studies; *Males; Multiple Regression Analysis; Predictor Variables; *Salary Wage Differentials; *Sex Differences; *Teacher Salaries
IDENTIFIERS *University of North Dakota

ABSTRACT

A 10-year study of salary differential by sex was undertaken at the University of North Dakota using a multiple regression methodology, with rank, discipline, degree, years in department, years in current rank, and sex as predictors. The sex variable evidenced lower salaries for women when controlling for the other variables throughout the study period for both proposed and actual salaries (from $341 in 1978-1979, proposed salary, to $1675 for 1981-1982, actual salary, to $504 for 1986-1987). This apparent drop in discrimination by sex in salary at each rank was accompanied by increasing differences in pay. The change is in the direction of market adjustments (i.e., paying lower salaries to those in disciplines with higher proportions of women). The actual amount of inequity by sex often exceeded the projected inequity by sex; also, the inequity by sex appeared to peak in the early 1980s (in terms of the regression coefficient for sex) and has appeared to drop to only about $141 higher than projected for 1977-1978. Variables included in the regression analysis are identified. Data are provided on mean salaries by sex and rank for projected and actual salaries, 1977-1987. (Author/SW)

A Ten Year Study of Salary Differential by Sex Through a Regression Methodology

John Delane Williams[1], Jole A. Williams[2], Virginia T. Anderson[1] and Stephen J. Roman[3]

Abstract

A ten year study of salary differential by sex was completed, using a multiple regression methodology, with rank, discipline, degree, years in department, years in current rank and sex as predictors, focusing on the change in the value of the sex variable. The sex variable evidenced lower salaries for women when controlling for the other variables throughout the study period for both proposed and actual salaries from $341 in 1978-79 (proposed salary) to $1675 for 1981-82 (actual salary) to $504 for 1986-87 (proposed salary). This apparent drop in discrimination by sex in salary at each rank was accompanied by increasing differences in pay. The change is in the direction of "market adjustments," i.e., paying lower salaries to those in disciplines wich higher proportions of women.

[1]The University of North Dakota
[2]Northwestern (Minnesota) Mental Health Center
[3]New Market (Iowa) Community School

In a study of 1977-78 faculty salaries at the University of North Dakota (UND), using a regression approach, Martin and Williams (1978) found that women were underpaid $361 (in terms of the regression coefficient), on the average, taking into account a large number of variables. In that the ensuing years were supposed to be a time for eroding away sex discrimination, it was quite surprising that Anderson (1986) showed that the discrepancy in 1985-86 actual salaries may have become as large as $4619 at the same institution.

Subsequently, all UND faculty salary data for all years from 1977-78 to 1986-87 have been secured; these data are from public access files and thus contain no confidential information. The actual data are for nine complete years wherein the previous salary is given and the proposed salary for the following year is listed. Since it would be highly unusual for obvious, direct discrimination to take place without detection, the possibility of a secondary impact of discrimination is examined. If, for a given year, sex differences increase from proposed to actual salaries, it is important to document this process. The advantage of a long term data set (actual salaries from 1977-78 to 1985-86 and proposed salaries from 1978-79 to 1986-87) is that changes in the composition of the faculty can be monitored as well. One possibility is that arrivals and departures from the faculty may have devastating effects on sex discrimination measures. Other possibilities could be examined as well. The particulars of either the data set and/or the variables used

could have a major impact on outcomes. One cannot count out *a priori* another period of sex inequity in salary structure, though such inequity would of necessity be more subtle. First however, the particulars of the data should be addressed.

Obstacles to Salary Discrimination Research

Obtaining the data sets for analysis was a major obstacle in this study. Originally, Anderson's (1986) data was to be reanalyzed. She was agreeable to this, and the UND Vice President for Academic Affairs provided strong encouragement. However, because the Anderson data set was generated under the auspices of the university's Office of Institutional Research, the opinion of the university legal counsel was that her data should not be made available to outside researchers (despite the first author's being at that institution and having served on Anderson's doctoral committee!). Thus, the investigation was possible only through the use of public documents; all UND salary data (since at least 1926) are available at the university library. These data were secured for the academic years 1978-87 (the years following the studies by Martin and Williams, 1978, 1979). The quality of these salary data was shocking to these researchers. For some years several pages were missing, though these omissions were to some degree rectifiable. More important were obvious mistakes--mistakes that became apparent only as the data set was constructed. In several cases (perhaps 2-5%)

subsequent salary data suggested that earlier salary data were incorrect. For example, a person's salary history might read:

	Proposed Salary	Last Year Salary	Increase
1978 79	22000	21000	1000
1979 80	11500	22000	1000
1980 81	24000	23000	1000

This kind of "mistake" occurred when someone was on leave, the last year's salary for 1979-80 was actually a hypothetical salary, but was entered into salary history. The "mistake" shown here was a logical one; less logical or actual errors (perhaps due to the faculty member's negotiating a higher salary) also occurred, but became known only in the next year's budget. Thus, the proposed salary figures include persons who negotiated higher salaries than were budgeted, and also include those who resigned and didn't actually receive a salary. New faculty members usually don't show up at all in the proposed salary figures for their first year. In that sense, actual salary data is known (insofar as the public documents are concerned) only a year later.

Choice of Variables

The choice of variables in salary equity studies is particularly important; some variables such as academic rank have been viewed as biased themselves (Scott, 1977). She preferred a smaller set of variables that, from a practical point of view, tend to show more discrimination. The choice of variables is somewhat (if not wholly) political and the choice of variables

surely influences the interpretation. For example, using a different selection of variables (including Scott's) Anderson (1986) found coefficients for sex favoring males from $1883 to $4619 for the 1985-86 actual salaries.

The original point of view for the present study was to incorporate variables similar to those used in Martin and Williams (1978), but deleting variables that had "suspect" outcomes. By "suspect" outcome is meant that the direction of the outcome for that variable is counter-intuitive; for example, that study found that serving on committees had a negative partial effect on salaries. Though different interpretations are possible, these sorts of variables may also incorporate sex inequity differences--in fact, women did have a higher tendency to serve on committees (Williams, 1978)--and including these variables helped cover over sex differences. Hence, committee membership was not included in the present analysis. Also, teaching in a graduate program had a negative impact on salary (Martin & Williams, 1973), an outcome that was counter-intuitive as well as counter-productive from a university's point of view. Publication information and teacher rating information are no longer available due to privacy considerations, and teacher rating information is no longer uniform as well. The variables finally selected are found in Table 1.

TABLE 1

Variables Included in the Regression Analysis Regarding Equity Adjustments to Salaries at the University of North Dakota

Degree Held
- Doctorate
- Bachelors/Professional
- (Masters, zero coded)

Years in Department

Sex
- Male = 1
- Female = 0

Rank
- Professor
- Associate Professor
- Assistant Professor
- (Instructor, zero coded)

Years in Current Rank
- Years in rank Professor
- Years in rank Associate Professor
- Years in rank Assistant Professor
- Years in rank Instructor

Discipline
(HEGIS Taxonomy)
- Biology
- Business
- Communication
- Computer Science
- Education
- Engineering
- Fine Arts
- Health Professions
- Languages and Humanities
- Library Science
- Mathematics
- Physical Sciences and Aviation
- Psychology
- Political Science
- Home Economics
- Law
- (Social Sciences, zero coded)

For the years 1978-79 through 1986-87 both proposed and actual previous salaries were used as criteria, using year appropriate data. In the case of promotion the rank would be one rank lower for proposed salary but is correct for actual salary. Table 2 gives results for the regression coefficient, F value, and biserial correlation for sex (with salary) along with R and the proportion of women for each year, in both the proposed and actual budget.

TABLE 2

Regression Coefficients, F Values, Biserial Correlations, R and Proportion of Women with Proposed and Actual Salaries

	Proposed					Actual				
	Reg. Coeff.	F	Point Bisl. Corr.	R	Prop. Women	Reg Coeff.	F	Point Bisl. Corr.	R	Prop. Women
1977-78*	361.03	1.57	.268	.913	.145	537.55	2.71	.267	.870	.158
1978-79	341.07	.80	.275	.849	.163	731.11	4.80	.286	.886	.156
1979-80	689.32	2.62	.338	.854	.185	530.45	2.09	.313	.894	.189
1980-81	572.27	1.56	.273	.840	.175	1250.23	6.27	.276	.842	.159
1981-82	1351.95	6.28	.317	.838	.183	1674.58	10.35	.329	.850	.179
1982-83	1542.32	7.96	.341	.848	.186	1007.74	3.91	.334	.861	.185
1983-84	1293.57	5.56	.340	.836	.185	1362.68	5.36	.320	.834	.174
1984-85	1110.44	4.19	.328	.841	.188	739.51	1.42	.286	.865	.190
1985-86	849.79	2.23	.368	.861	.195	747.11	1.60	.375	.862	.200
1986-87	504.12	.74	.392	.861	.211					

*Taken from Martin and Williams (1978)

Table 2 yields some interesting outcomes. The actual amount of inequity by sex often exceeded the projected inequity by sex; also, the inequity by sex appeared to peak in the early 1980's (in terms of the regression coefficient for sex), and has appeared to drop to only about $140 higher than projected for

1977-78. However, the point biserial correlation has gone up considerably, indicating that real differences in mean salaries have sharply increased. It is useful to address salary differences by rank as shown in Table 3. The number of persons at each rank by sex are shown in Table 4.

TABLE 3

Mean Salaries by Sex and Rank for Projected and Actual Salaries, 1977-1987

	Proposed					Actual				
	Inst	AsstP	AscP	Prof	Total	Inst	AsstP	AscP	Prof	Total
1977-78*										
F		14606	17283	21389	16954	12883	15001	17143	21866	16559
M		15524	18151	22164	19040	13085	15518	18263	22277	19236
1978 79										
F	13395	15292	18002	23195	17008	13330	15180	18040	22786	17247
M	14200	16370	19259	23335	20045	14158	16189	19275	23567	20342
1979-80										
F	12813	15881	19422	24306	17286	13124	16109	18662	24393	18021
M	15027	17207	20594	24951	21461	14400	16964	20403	25510	21843
1980-81										
F	14648	16947	20148	25957	19420	16158	18560	22014	26219	21199
M	15809	18512	21921	26868	23001	16683	20565	23316	28646	25041
1981-82										
F	18112	20790	24318	29064	22757	16686	20271	24084	28141	22740
M	21860	22438	26243	31896	27581	21864	22727	26058	31608	27684
1982-83										
F	17997	20535	24901	27901	22996	17997	20398	24923	28922	23349
M	21889	23243	27140	33153	28556	22172	23358	26710	32813	28641
1983-84										
F	19272	20098	25229	29325	23335	19194	20598	24490	27727	23411
M	21030	24190	27142	33000	28814	20294	23050	26650	32451	28660
1984-85										
F	18393	21051	24952	27945	23275	17658	24255	24663	27540	23045
M	21013	23245	26850	32568	28550	22943	23115	26341	32806	28959
1985-86										
F	21556	22887	28083	31934	25997	22603	23127	26891	32116	26163
M	23814	26848	29960	36743	32410	24380	26715	29677	36400	32541
1986 87										
F	21922	24147	28084	34132	26819					
M	25202	27832	31134	38046	33788					

Taken from Martin and Williams (1978)

TABLE 4

Number of Persons at Each Rank by Sex

	Proposed					Actual			
	Inst	AsstP	AssoP	Prof	Total	Inst	AsstP	AssoP	Prof	Total
1977-78*										
F		14	20	6	40	9	15	24	8	56
M		64	107	98	269	2	57	126	114	299
1978-79										
F	10	18	24	7	59	5	20	21	8	54
M	8	59	125	110	302	7	47	124	115	293
1979-80										
F	13	27	22	7	69	9	22	25	11	67
M	6	59	125	114	304	3	45	125	115	288
1980 81										
F	8	21	25	11	65	1	22	22	9	54
M	5	61	125	115	306	5	43	117	121	286
1981-82										
F	8	29	24	9	70	5	21	29	8	63
M	11	57	124	121	313	8	50	111	121	290
1982-83										
F	6	27	30	8	71	6	24	30	10	70
M	9	65	113	123	310	9	52	115	133	309
1983-84										
F	8	26	30	10	74	7	17	28	11	63
M	9	62	122	134	327	5	46	111	138	300
1984-85										
F	10	23	29	11	73	11	18	29	10	68
M	7	58	114	138	317	3	40	108	139	290
1985-86										
F	11	24	30	10	75	6	19	35	9	69
M	4	54	111	140	309	1	39	101	136	277
1986-87										
F	8	27	36	9	80					
M	3	48	108	140	299					

*Taken from Martin and Williams (1978)

While there are some difficulties due to probable missing information (that is, information gone from the public documents), it seems clear that if women were "underranked" for the earlier years in the study, they are far more so for the most recent available year. Using projected data for 1977 78, 6 of 40

women or 15% are professors, as compared to 98 of 269 men, or 36.43%. For 1986-87, 9 of 80 women or 11.24% are professors, as compared to 140 of 299 men or 46.82%. For those who might have hoped that these sorts of differences would dissipate during a period of supposed redressing of inequity, these outcomes confirm the dashing of those hopes. Further, salary differences by sex within ranks favored men by approximately $800 at each rank for projected 1977-78, compared to 1986-87 projected data where differences are in the range of $3000 $4000 at each rank, while salaries increased by only about $10000 for women and $13700 for men during the interim. This latter finding is particularly anomalous, considering the changes in the coefficient for sex (gender) shown in Table 2; it can be recalled that discrimination costs to women appeared to have reduced almost back to 1977-78 levels, after going much higher in the early 1980's.

Yet a different interpretation would be obtained from viewing the two-way ANOVA outcomes, suggesting it would be worthwhile to inspect changes in other variables in the regression analysis. Rather than attempt to give the entirety of the sets of regression analyses shown in Table 2, three analyses investigated are discussed. Table 5 records these analyses: the proposed salaries for 1978-79 and 1986-87 and the actual salaries from 1981 82. These years were chosen because they show the minimum effect for sex (proposed, 1978-79), maximum effect for sex (actual, 1981 82) and most recent outcome (proposed, 1986 87).

TABLE 5

Regression Analyses for Three Selected Years
(Proposed 1978-79, Actual 1981-82 and Proposed 1986-87)

Variable	Proposed 1978 79 Reg. Coeff.	F	Actual 1.81-82 Reg. Coeff.	F	Proposed 1986 87 Reg. Coeff.	F
Degree Held						
Doctorate	802.08	6.18	1126.71	5.95	522.04	4.72
Bachelors/Prof.	1377.13	2.11	1680.21	1.51	3001.00	1.16
Years in Dept.	-93.91	8.17	-106.51	5.93	-111.27	5.60
Sex (Male=1, Female=0)	341.07	.80	1674.50	10.35	504.12	.74
Rank						
Professor	9999.24	134.02	8147.24	24 44	15884.11	64.54
Associate Professor	5642.34	50.87	2883.28	3.27	9725.70	26.68
Assistant Professor	2188.97	7.62	241.56	.02	6045.03	10.28
Years in Current Rank						
Professor	197.58	17.17	374.05	32.63	433.98	39.67
Associate Professor	159.98	7.93	332.66	19.53	313.60	15.54
Assistant Professor	266.46	12.73	277.91	5.70	192.64	2.54
Instructor	157.60	.88	-949.04	2.32	874.97	1.51
Discipline (HEGIS)						
Biology	-869.94	1.42	38.13	.00	-392.59	.12
Business	1603.15	8.41	4059.71	21.31	6312.41	50.86
Communications	533.33	.20	-633.56	.16		
Computer Science	2410.42	3.77	3643.84	5.20	10927.30	38.99
Education	533.51	1.12	2469.74	9.06	1107.34	1.85
Engineering	392.07	.40	4773.05	21.36	6810.45	45.09
Fine Arts	1220.63	3.82	1162.12	1.41	-437.15	.20
Health Prof.	1794.86	3.26	3401.56	5.37	1417.81	1.10
Lang. and Hum.	761.19	2.11	571.01	.45	-48.01	.00
Library Science	1350.55	1.80	3441.30	3.01	5352.24	3.37
Mathematics	392.85	.28	1360.66	1.36	104.04	.01
Phy. Sci. and Avtn	47.98	.01	3011.09	11.84	4032.67	21.87
Psychology	760.22	1.04	735.67	.45	533.17	.18
Political Science	261.69	.09	2007.16	3.37	2486.40	2.74
Home Economics	866.17	.56	2078.12	1.59	176.89	.01
Law	8205.57	97.43	16325.76	150.00	15109.78	153.88

Table 5 is clearly complex; simplistic interpretations would violate that complexity. Some interpretations, however, can be

made. The importance of discipline (HEGIS category) in salary becomes quite clear. Recent major gainers are computer science (up almost $7300, compared to social sciences, since 1981-82), business (with large comparative increases for the last two reported years), engineering (up more than $4000 from 1978-79 to 1981-82, and an additional $2000 for 1986-87), library science (up $1600 for 1981-82, and an additional $1900 for 1986-87) and political science (up $1750 for 1981-82 and an additional $500 for 1986-87). What is not apparent in the data is that these disciplines have higher proportions of males than do those whose climbs (vis a vis the social sciences which have a higher proportion of females) are not as marked. In the year 1985-86 in particular, an internal study allowed large individual deviations in salary based on "market" considerations. Those market considerations were achieved by comparing salaries in various categories to a regional average. Departments were compared to the mean of similar departments within that regional study with the intent of raising salaries to near the regional averages. This study, though of considerable importance in determining salaries, was not generally disseminated, within a college, results for affected departments might be known, but the overall texture for the university was not known. One case in point was the "statistics" department. Since the University of North Dakota has the only such grouping in the region, this department was exactly at the norm and thus needed no adjustment. The fallibility of the other data can only be conjectured- the data

were never made available for analysis. Nevertheless, on the basis of these data, one department in particular was the recipient of a windfall--political science (in the college of business). This department's salary changes from 1984-85 to 1985 86 included one individual going from $25975 to $37000 (a $11025 or 42.44% increase), while another went from $26450 to $37200 (a $10750 or 40.64% increase). The remaining five faculty received increases of $2120 to $6390 (8.37% to 20.52%); the mean increase within the university overall was 11.4%. These changes were a major source of internal departmental disagreement that eventually saw one faculty member moving to another department in the university, and newspaper articles on these increases in both the local and student newspapers. Last in all of this is that these so-called "market adjustments" helped validate even larger differences in pay between men and women, though additional losers were both men and women in the disciplines that had larger proportions of women than the university average. Roads to the redressing of inequity had been circumvented in two ways--the market adjustments favored male dominated departments, and those faculty in departments receiving less favorable treatment could blame their treatment at least partially on their higher proportion of women.

Redressing inequity due to any cause (including gender based inequity) would seem not to be part of the immediate future at the University of North Dakota. Preliminary budgets for the 1987 89 biennium include pay increases totaling 2% for the entire

period, with that raise to come in 1988-89. Even this modest increase might still be eliminated; even worse, cutbacks in faculty and/or salaries are possible due to the financial woes of the state, which is largely dependent on two industries, agriculture and fossil fuels, both suffering in the present financial arena.

Comments on Choosing Variables Investigating Gender Bias in Salary

Scott (1977) suggested using a small number of variables, not including rank, in addressing possible sex bias. Her choice of not including rank was based upon rank's being a "contaminated" variable, that is, rank itself is accorded in a gender non-neutral way. The present study has used rank as a variable; perhaps to some degree, even to a large degree, Scott is correct in her assertion that rank is gender inequitable - surely the data on rank by sex in Table 4 would be more supportive than contradictive of her view. However, rank does have credence within a university setting, and its exclusion from consideration might render studies less acceptable in terms of redressing inequity.

The process of choosing variables is a political act; outcomes will be at least partially determined by the inclusion or exclusion of given variables. Generally speaking, the inclusion of more variables will tend to reduce the impact of a given variable (such as sex). Though not shown here, each

analysis shown in Table 2 was duplicated for each rank using a second degree term incorporating a quadratic regression for years in rank. Initially it was felt that a quadratic trend might possibly be occurring at the associate professor level and lower, the thinking being that those who failed to be promoted to the next rank might experience negative effects in regard to their salaries. While some second degree trends did exist for the data, almost without exception there were corresponding drops in the sizes of the coefficients for sex; one interpretation of this outcome is that for the lower ranks, women stay in a rank longer than men (this could be another result of possible discrimination), whereas at the professor rank men are in rank longer than women (obviously, if they get there sooner, they'll be there longer). Addressing inequity, whether due to gender related reasons or to some other cause, is a subtle process; different persons (whether researchers or not) will not often agree on the meaning of inequity or discrimination. The limits of regression as a technique for determining inequity should be apparent. If the researcher/activist is diligent in the choice of variables, he/she will be able to better show "what is." However, regression tells us nothing about "what should be." Too often, we misinterpret "what is" for "what should be." The former (what is) can be, to some degree, determined, depending on the ingenuity of the researcher in choosing variables. The latter (what should be) is fraught with personal meanings likely to differ for different individuals although consensus may

sometimes be achieved, at least for subgroups of people. This process would seem to pit those who have against those who have not; unfortunately, those who have do not often want to give up very many of their prerogatives.

References

Anderson, S (1986) A comparison of three methodologies reflecting wage disparity for faculty of equal appointment in higher education. Doctoral Dissertation, University of North Dakota.

Martin, M. P., & Williams, J. D. (1978). Effects of state-wide salary equity provisions on institutional salary policies. Multiple Linear Regression Viewpoints, 8(3), 51-65.

Martin, M. P., & Williams, J. D. (1979). Effects of state-wide salary equity provisions on institutional salary policies. In T. R. Pezzullo & P. E. Brittingham, Salary equity: Detecting sex bias in salaries among college and university professors. Boston: Lexington Press.

Scott, E. L. (1977). Higher education salary evaluation kit. Washington: American Association of University Professors.

Williams, J. D. (1978) Localism in faculty governance and participation in the reward system. Research in Higher Education, 9, 243-259.