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

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Abstract

:n year study of salary differential by sex was completed,
 it a multiple regression methodology, with rank, discipline,
~nn, years in department, years in current rank and sex as
lictors, focusing on the change in the value of the sex
table. The sex variable evidenced lower salaries for women
i controlling for the other variables throughout the study
iod for both proposed and actual salaries from $341 in 1978-79
proposed salary) to $1675 for 1981-82 (actual salary) to $504
1986-87 (proposed salary). This apparent drop in
:rimination by sex in salary at each rank was accompanied by
~anging differences in pay. The change is in the direction of
rket adjustments," i.e., paying lower salaries to those in
:iplines with higher proportions of women.

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 Andersen (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, 1978), 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
383.03	1.57	.268	.913	.145	537.55	2.71	.267	.870	.158
341.07	.80	.275	.849	.163	731.11	4.80	.286	.886	.156
609.32	2.02	.338	.854	.185	530.45	2.09	.313	.894	.189
572.27	1.56	.273	.840	.175	1250.23	6.27	.276	.842	.159
1351.95	6.28	.317	.838	.183	1674.58	10.35	.329	.850	.178
1542.32	7.96	.341	.848	.186	1007.74	3.91	.334	.861	.185
1293.57	5.56	.340	.836	.185	1362.68	5.36	.320	.834	.174
1110.44	4.19	.328	.841	.188	739.51	1.42	.286	.865	.190
849.70	2.23	.368	.861	.195	747.11	1.60	.375	.862	.200
804.12	.74	.392	.861	.211					

rom 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	Tot
977-78*										
F		14606	17283	21389	16954	12883	15001	17143	21866	16!
M		15524	18151	22164	19040	13095	15518	18263	22277	19:
1978-79										
F	13395	15292	18002	23195	17008	13330	15180	18040	22786	17:
M	14200	16370	19259	23335	20045	14158	16189	19275	23567	20:
1979-80										
F	12813	15881	19422	24306	17286	13124	16109	18662	24393	18(
M	15027	17207	20594	24951	21461	14400	16964	20403	25510	21:
1980-81										
F	14648	16047	20148	25957	19420	16158	18560	22014	26219	21
M	15809	18512	21921	26868	23001	16683	20565	23316	28646	*25
1981-82										
F	18112	20790	24310	29064	22757	16686	20271	24084	28141	22
M	21860	22438	26243	31896	27581	21864	22727	26058	31608	27
1982-83										
F	17907	20535	24901	27901	22996	17997	20398	24923	28922	2:
M	21889	23243	27140	33153	28556	22172	23358	26710	32813	2€
1983-84										
F	19272	20098	25229	29325	23335	19194	20598	24490	27727	2:
M	21030	24190	27142	33000	28814	20294	23050	26650	32451	2(
1984-85										
F	18393	21051	24952	27945	23275	17858	24255	24683	27540	2:
M	21013	23245	26850	32568	28550	22943	23115	26341	32806	2(
1985-86										
F	21556	22887	28083	31934	25997	22603	23127	26091	32116	2(
M	23814	26848	29960	36743	32410	24380	26715	29677	36400	3:
1986-87										
F	21922	24147	28084	34132	26810					
M	25202	27882	31134	38046	33788					

*Taken from Martin and Williams (1978)

98

TABLE 4

Number of Persons at Each Rank by Sex

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

a 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)

e	Proposed 1978-79 Reg. Coeff.	F	Actual 1981-82 Reg. Coeff.	F	Proposed 1986-87 Reg. Coeff.	F
Held						
ate	802.08	6.18	1126.71	5.95	522.04	4.72
ors/Prof.	1377.13	2.11	1680.21	1.51	3001.00	1.16
in Dept.	-93.91	8.17	-106.51	5.93	-111.27	5.60
ile=1, Female=0)	341.07	.80	1674.50	10.35	504.12	.74
ssor	9999.24	134.02	8147.24	24.44	15884.11	64.54
iate Professor	5642.34	50.87	2883.28	3.27	9725.70	26.68
tant Professor	2188.97	7.62	241.56	.02	6045.03	10.28
in Current Rank						
ssor	197.58	17.17	374.05	32.63	433.98	39.67
iate Professor	159.98	7.93	332.66	19.53	313.60	15.54
tant Professor	266.46	12.73	277.91	5.70	192.64	2.54
uctor	157.60	.88	-949.04	2.32	874.97	1.51
line (HKGIS)						
ily	-869.94	1.42	38.13	.00	-392.59	.12
ions	1603.15	8.41	4059.71	21.31	6312.41	50.86
nications	533.33	.20	-633.56	.16		
iter Science	2410.42	3.77	3643.84	5.20	10927.30	38.99
ition	533.51	1.12	2469.74	9.06	1107.34	1.85
leering	392.07	.40	4773.05	21.38	6810.45	45.09
Arts	-1220.63	3.82	1162.12	1.41	-437.15	.20
th Prof.	-1794.86	3.26	3401.56	5.37	1417.81	1.10
and Hum.	-761.19	2.11	571.01	.45	-48.01	.00
ary Science	1850.55	1.80	3441.30	3.01	5352.24	3.37
omatics	392.85	.28	1360.86	1.36	104.04	.01
Sci. and Avtn.	-47.98	.01	3011.09	11.84	4032.67	21.87
hology	760.22	1.04	735.67	.45	533.17	.18
tical Science	261.69	.09	2007.16	3.37	2486.40	2.74
Economics	866.17	.56	2078.12	1.59	-176.89	01
	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 frought with personal meanings likely to differ for different individuals although consensus may