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WESTERN WASHINGTON UNIVERSITY GENDER EQUITY SALARY STUDY

Research Notes Report Series

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Carl Simpson

April 16, 2001

WWU OFFICE OF INSTITUTIONAL RESEARCH & RESOURCE PLANNING
Research Notes Report Series Report 2001-02

INTRODUCTION

At the request of Provost Bodman and a faculty advisory group working with him on salary-related issues, the Office of Institutional Research and Resource Planning conducted the analysis of gender equity in salaries reported here. This analysis is based on available data; no new data were collected. Consequently, the range of data elements that can be brought to bear on the question is limited; in particular, no measures of merit or productivity can be included.

The central goal here is to estimate whether or not, and to what degree, there is a difference between average earnings of male and female faculty based primarily on their gender rather than on correlated factors such as year since the degree. There is no question as to whether women earn less than men in the faculty ranks. Among all 463 full-time 2000-2001 faculty, the average (mean) salary is \$55,493 for men and \$47,968 (\$7,527 less) for women. If we include only the 412 full-time faculty who are tenured or tenure-track, the averages become \$56,525 and \$50,467 (\$6,058 different).

The questions are: 1) what causes that difference (what is our best understanding of how to interpret the difference)? and 2) are the origins of the difference legitimate and appropriate, or do they represent bias?

Before even looking at the data for any one university, we know that much of the difference in earnings by gender is accounted for by macro-social phenomena that are out of Western's control, although steps can be taken to remediate some inequities. The two most significant societal level phenomena to consider in the present case are 1) historical changes that cluster women in newer positions, which pay less, and 2) differential pay levels by discipline, which have evolved such that higher pay accrues in disciplines that traditionally have few women in them, by choice, via "channeling" and via direct discrimination.

Western's full-time faculty in academic year 2000-2001 arrived here spread over the forty year period from 1961 to 2001. The availability of female Ph.D.s has increased dramatically over this period. Between 1960 and 1970, only 11% of all Ph.D.s were awarded to women. By 1975, the percent nearly doubled, to 20%. By 1980, the figure was just over 30%, and the increase has continued at a relatively constant rate until the present, when it approaches 45%. In short, across the age span included in our faculty, the availability of female Ph.Ds has changed from ten percent to 45%.

Exactly one-third of Western's full-time faculty are female (154 of 463). Almost inevitably, these faculty members will be concentrated in more recent, lower paying jobs because of the radical changes in Ph.D. production over the past 30 years.

In addition, those Ph.D.s and other terminal degrees are not concentrated equally in all fields, and the fields generating highest salaries tend to be dominated by men. To the extent that hiring at Western has been market-driven, those differentials will be replicated here. Whether market-driven hiring is necessary or appropriate is a matter for policy discussion at any university.

DATA AND METHOD

These issues--when faculty first finished a degree and what rank they have achieved, and what college or department they work in—form the core of the factors considered in this analysis, along with a handful of other factors. The analytic question is whether such factors can account for the observed average difference by gender, or whether some difference remains unexplained. Any unexplained difference stems either from factors not included in our analysis, such as productivity, or from biased behavior that rewards the two groups differentially, over and above differences generated by field, time of entry to Western, etc.

The same logic would apply to an analysis of equity by minority/non-minority status. While Western employs too few members of minority ethnic groups to allow a fully reliable analysis, findings are presented for two groups of minority faculty (Asian-American and all other persons of color).

Existing personnel records at Western provide a limited range of measures appropriate to this analysis. Included are:

- College and department
- Rank and tenure status
- Salary and step
- Gender, ethnicity, age and also handicapped, veteran, and citizen status
- Highest degree
- Date of first employment at Western
- Date when highest degree was earned
- Dates of tenure and current rank
- Step at first hire (or in 1979 when this record begins) for tenured and tenure-track faculty.

Measures that were constructed from the above include:

- College grouping including the division of Arts and Sciences into Humanities, Math and Natural Sciences and Social Sciences.
- Years since highest degree was awarded
- Years since arriving at Western
- Having been hired during particular periods, especially 1975-85, a period of especially low demand in many fields.
- Interaction effects involving years at Western: years as an Associate professor and as a Full professor, years in each college
- Interaction effects involving gender: being female in each college group and in each rank.
- Number of years between receiving the degree and tenure, and between tenure and promotion to full (as the only indicators of merit or productivity available).

The analytic strategy used in this analysis is Ordinary least Squares Regression. The dependent variables, salary and step, are continuous and essentially normally distributed, making regression a robust and unbiased tool for estimating the unique effects of each factor tested. Independent variables in this analysis are typically structured as dummy variables (either/or dichotomies indicating membership in some category such as full professors). Most variables in the analysis are nominal and require this approach. Others, such as rank, are unlikely to have linear effects and are therefore best tested as dummy variables.

The impact of each factor estimated by this method is unique and additive. That is, each effect is estimated over and above the effects of other factors; overlap among explanatory variables such as rank and years since degree has been assessed and eliminated by ascribing the appropriate separate effect to each factor. Also, each estimated effect can be added to others to generate a total estimate for particular statuses. For example, full professors in CBE who have the Ph.D. are estimated to have salaries higher than others for all three reasons—the amounts shown in Table 1 for each of these factors would be added together to estimate the salary advantage of this particular group.

The approach adopted here is to test the full range of variables listed above and to identify reduced models including only statistically reliable effects. These are reported in a series of tables. Any factor tested but not included in these tables was found to have no reliable effect on salary. Final reduced models include a considerable number of reliable effects. Attention was given to potential problems of covariance and suppression, which could emerge with such large models. The models reported here proved to be highly robust, as suggested by the near equivalence between R^2 and adjusted R^2 .

FINDINGS

The final models in these analyses include many explanatory variables. Each is therefore presented as a full-page table that lists each factor and describes its estimated impact on salary (or, in one case, step). Since only statistically reliable effects are included in the model, no statistical tests are reported. Each factor listed satisfies the conventional 95% confidence test. The one exception to that rule is that gender is presented in every model, regardless of statistical reliability, since it is the “bottom line” factor for all analyses.

Testing Possible Effects of Gender on 2000-2001 Salary Among all Full-time Faculty

The first test examines factors that explain salary among all full-time faculty during the 2000-2001 academic year, including limited term faculty as well as tenure-track and tenured faculty. Findings are displayed as Table 1. Highlights include (see Table 1):

- Rank explains a great deal of the variation in salary. Assistant professor was the category chosen as a comparison group; the effects of other ranks are estimated in comparison to Assistant Professors. Full Professors average over fifteen thousand dollars more, after adjustments for other factors in the model, than Assistant Professors. In fact, the concrete difference is typically greater than that, but the effect ascribed to professor rank in itself is fifteen thousand dollars. Associate Professor status generates seven thousand and lecturers/Instructors receive nearly six thousand less than Assistants.

- In addition, having completed the terminal degree adds \$2,009, and each year since the degree was awarded adds \$309. Thus, a Ph.D. of 20 years receives, on average, \$7880 more than an M.A. of one year ago.
- Once the model includes the time since the highest degree was awarded, another indicator of time—how long each faculty member has been at Western—has no further reliable effect except in one case. Among Associate Professors, each additional year at Western represents a loss of a small amount--\$134. That is, long-term Associates have gained less compared to Assistants than have more recent Associates. Each year since the degree and at Western adds \$309 for all except Associates, who add \$234 less, or \$175.
- Belonging to one of two colleges or one of four departments adds earnings above and beyond those predicted by degree, time since degree, and rank. Four other departments produce a net reduction in salary above and beyond other factors. These are shown in Table 1.
- The most complex case of college and department effects is CBE. Four separate effects in Table 1 must be combined to understand the estimated impact of employment in CBE on salary. The initial estimated effect for CBE is a \$22,676 addition to salary. However, there are two types of provisos. First, two departments within CBE share in only part of that addition. The CBE addition is \$5,498 less for Management and \$7,012 less for Economics than for the other departments, which enjoy the entire \$22,504. In addition, the increment for employment in CBE has grown over time. Each year at Western in CBE represents a reduction of \$495 against the \$22,504. Thus, a veteran of 20 years is estimated to enjoy a CBE increment of \$12,776 rather than \$22,676. If that 20 year veteran is in Management, for example, the increment is \$7,278.
- All other interactions between unit or rank and time at Western were found to have no effect on salary.
- When all of the effects described above are included in the model, the entire difference between men's and women's earnings disappears university-wide. The best estimate is no difference at all.
- One of the interactions tested between gender and unit or rank proved to be almost, but not quite statistically reliable and to favor women: women in Humanities may earn about two thousand dollars more than men, after adjustments are made for rank, specific department, degree, and time since degree. However, there is a 12% probability that this finding could have occurred by random chance.
- Taken together, these factors account for 84% of the variation in annual salary among full-time faculty during the 2000-2001 academic year. That means that a significant amount of variation is not explained by this model, but that is always the case in human systems. The more remarkable finding is that Western's salary structure is orderly enough that we can explain 84% of all the variation in salary levels for all full-time faculty.

Table 1. Final Model Estimating the Influence of Various Factors, Including Gender, on Salaries of Full-Time Faculty at Western Washington University as of Fall, 2000.

<u>Factor</u>	<u>Estimated Effect On Salary</u>
Being a Full Professor (compared to Assistant)	adds \$15,584
Being an Associate Prof (compared to Assistant)	adds \$7,062
Being a lecturer or Instructor (most non-tenure-track (compared to Assistant Prof)	subtracts \$5,956
Having the terminal degree in the field (PhD or JD vs. MA or BA)	adds \$2,009
Years since the current degree was earned	each year adds \$309 (thus, 10 years adds \$3,090)
Years as an Associate Professor at Western	each year subtracts \$134. (That is, for this group each year at Western since the degree has added only \$175, rather than \$309.)
College: College of Business and Economics	adds \$22,676
Years in the College of Business and Econ	each year subtracts \$495. (That is, the amount added for employment in CBE is smaller for those hired longer ago. For a twenty-year veteran, the amount added is \$12,776 rather than 22,676 for the most recent hires.)
College: Woodring College of Education	adds \$4,309
Department: Computer Science	adds \$14,396
Department: Engineering Technology	adds \$8,909
Department: Mathematics	adds \$5,224
Department: Psychology	adds \$3,471
Department: Modern and Classical Languages	subtracts \$3,060
Department: Management	subtracts \$5,498 (that is, the additional \$22,676 for being in CBE is reduced to \$15,629 in the Management Department.
Department: Anthropology	subtracts \$4,618
Department: Economics	subtracts \$7,012 (that is, the additional \$22,676 for being in CBE is reduced to \$15,664 in the Economics Department.
Gender	No difference (estimate: women earn \$541 less than men and that difference has a 30% probability of occurring by chance.

TOTAL proportion of variance in salaries explained by the above model: 84.0 (adjusted = 83.4).

N=462. Intercept=\$37,302.

Sources of the Observed Pay Differential Between Male and Female Faculty

The observed difference between average salary for male and female faculty members is just over \$7,500. That entire difference is accounted for by the list of factors shown in table 1. To understand more clearly which of these factors contributes most to the observed gender difference, we can examine the proportion of women in the higher paid and less well paid categories. If full professors earn more, the question is what proportion of full professors are female.

Overall, the full-time faculty is 33.3% female. Table 2 shows the percentage in the various categories that have been shown to earn more or less than average. The table lists the category, the salary difference uniquely attributed by the regression analysis to that category, and the percent of female faculty in that category. Some highlights (see Table 2):

- The groups that are most highly paid are male dominated. Full professors hired before 1980, who earn an average of \$22,400 more than Assistant Professors, are 85% male, 15% female. CBE, which generates a pay advantage of between \$10,000 and \$22,000, is 17% female, and Computer Science, Engineering Technology and Math, where faculty are paid \$14,400, \$8,900 and \$5,200 more, are 8%, 15% and 15% female, respectively. The fact that few females enjoy the benefits of membership in these groups explains a large portion of the observed difference in salary.
- The opposite is also true: the two groups lowest in pay are dominated by women. 53% of lecturer/instructors, who earn \$6,000 less than Assistant Professors, are women, and Anthropology, paid \$4,600 less is 55% female.
- On the other hand, there are some exceptions. These help explain why the observed salary differential is not even greater than it is. Twenty-eight percent of recent full professors are female—nearly at the overall rate of 31% at Western—and 40% of associate Professors are female. Also, Woodring College of Education, 50% female, generates salaries \$4,300 above the level expected on the basis of its mix of rank, time since degree, etc.

In short, the observed difference in earnings by gender is entirely explained in terms of rank, especially long-term Full Professors versus Instructors/Lecturers, degree and time from degree, and differential membership in a handful of college and departmental units where salaries are higher or lower than expected, presumably because of the play of market forces on Western's hiring decisions.

A question that this analysis cannot address directly is whether the units that pay the most tend to actively exclude women faculty, or whether appropriate faculty are simply less often available in those fields because of gender effects on choice of Ph.D. field.

However, we know that the fields in question—business, computer science, technology and math—are all dominated by males nationwide. Further, tests of interaction effects make clear that once women are hired in these areas, they are paid equally.

Table 2. Proportion of Women in Various Categories of Full-Time Faculty at Western Washington University as of Fall, 2000*

<u>Category</u>	<u>Effect on Salary (Table 1)</u>	<u>Percent of Women</u>
RANKS AND DEGREES:		
Full Professors hired before 1980	+ 22.4 k	15%
Full Professors hired after 1980	+ 18.5 k	28%
Associate Professors	+ 7.1 k	40%
Assistant Professors	0 (comparison group)	36%
Lecturers or Instructors	- 6.0 k	53%
Terminal degree holders (Ph.D. or J.D.)	+ 2.0 k	31%
COLLEGES AND DEPARTMENTS:		
College: College of Business and Economics	+ 22.7 k**	17%
College: Woodring College of Education	+ 4.3 k	50%
Department: Computer Science	+ 14.4 k	8%
Department: Engineering Technology	+ 8.9 k	15%
Department: Mathematics	+ 5.2 k	15%
Department: Psychology	+ 3.4 k	38%
Department: Modern and Classical Languages	- 3.1 k	54%
Department: Anthropology	- 5.5 k	55%

* The categories shown here are those identified in Table 1 as having a unique and reliable impact on salary at Western.

** Economics and Management enjoy only part of this amount. The proportion of women in these two fields is 13%, while it is 18% in the remainder of CBE.

Testing Possible Effects of Gender on 2000-2001 Salary Among Tenured and Tenure-Track Faculty Hired on a “Step”

Looking only at tenured and tenure-track full-time faculty in the 2000-2001 academic year, we can add one element to our analysis. All these individuals were hired into Western’s “step” salary system, and records include the step of their original hire. We can therefore add original salary to the analysis of current salary. The question becomes, then, after taking into account the step level at which one was hired, does gender affect current salary (i.e., the changes in salary that have occurred since hire)?

Most of the changes in salary level subsequent to hire represent the advantage, expressed in dollar amounts, of having a higher initial salary on which to base the percentage increases set by the step system. In addition, promotion includes a merit increase in Western’s pay system and there are a limited number of other merit or pay adjustment possibilities for faculty. The question is whether gender enters the picture.

Table 3 displays findings, structured in the same way as Table 1. Some highlights (see Table 3):

- Once we can include initial salary at hire, then years at Western replaces years since the degree in the model. Initial salary reflects years since degree to that point relatively well, so that adding years since degree adds little.
- With a few exceptions, the college and departmental units that influence salary beyond initial hire are the same as those in Table 1, although fewer units show any statistically reliable difference. This presumably occurs partially because higher initial salaries generate larger step increases. In some cases, the differential is large enough that it also indicates some greater-than-average salary adjustments since hire. Computer Science seems to be a case in point. One department, Theater, enters this model without having been included in the earlier model.
- Our best estimate is that gender has zero impact on salary increases since the initial hire, university-wide. In one college units, the Social Sciences, we estimate a larger increase for women.
- The total variation in current earnings explained by this model is very high: 90.0%. That unusual level is reached at least in part because Western’s step-based salary system is based predominantly on routine annual increments rather than on merit.

Table 3. Final Model Estimating the Influence of Various Factors, Including Gender and Salary at time of Hire, on Salaries of Full-Time Tenured or Tenure-track Faculty at Western Washington University as of Fall, 2000.

<u>Factor</u>	<u>Estimated Effect On Salary</u>
Step at which hired.	Each step adds an average of \$867 to current salary.
Years since hired at Western	each year adds \$797. (Ten years at Western adds \$7,970.
Years as an Associate Professor at Western	each year subtracts \$117. (That is, for this group each year since hire has added \$680, rather than \$797.)
Being a Full Professor (compared to Assistant)	adds \$11,972
Being an Associate Prof (compared to Assistant)	adds \$5,234
College: College of Business and Economics	adds \$7,481
College: Woodring College of Education	adds \$1,948
Department: Computer Science	adds \$9,201
Department: Theater	adds \$3,936
Department: Engineering Technology	adds \$3,708
Department: Mathematics	adds \$2,857
Gender	No difference (estimate: women earn \$305 more than men and that difference has a 46% probability of occurring by chance.
Gender: being a woman in the Social Sci. faculty	adds \$1,546

TOTAL proportion of variance in salaries explained by the above model: 90.0 (adjusted = 89.7).

N=410. Intercept=22,290

Testing for Possible Effects of Gender on Salary Step at Hire

The final angle from which to view salaries at Western is salary at hire. Although the analysis thus far makes it unlikely that we will find gender effects on salary at hire, it nevertheless seems reasonable to perform and report the analysis, both to ensure the correctness of that assumption and also to further explicate the nature of Western's salary system.

Table 4 displays findings from the analysis of factors that explain the step level (as a proxy for salary that is less distorted by inflation) at time of hire. Some highlights from Table 4:

- Inflation has been adjusted for in part by increases in initial step, with each of the past 25 years or so adding an average of .49 step, except in the case of Humanities faculty, where the change over time has been smaller.
- One ten-year period stands out as particularly low in demand and high in supply. Hires during that period, 1975-85, were offered an average of 2.62 steps lower salary than at other periods, after adjusting for other factors in the model.
- The terminal degree adds 3.66 steps at hire (about 10%), and each year between receipt of the degree and hire at Western adds an average of .45 steps.
- A series of college and departmental groups produce differences in hiring salary that parallel the difference we have seen in previous tables. However, some departments are represented here but not in Table 1, and the reverse. Such differences in inclusion may stem from unique histories of particular units, or they may stem from differences in the hiring vs. later adjustments to pay.
- Once again, our best estimate is that gender has no impact on salary at hire. Our best estimate is that women are hired at .5 step lower than men, but that estimate is subject to enough statistical error that to report a likely difference in salary at hire would not be prudent. In addition, one statistically reliable interaction term emerges in this analysis, that women in CBE receive somewhat lower salary at hire. Since that difference is not present in Table 1, reporting on current salary, it may be eliminated with later adjustments or this finding may result from a unique history of hiring.
- Our total ability to explain variation in salary at hire is lower than our ability to explain current salary. That is, based on the modest data available to us, Western's salary structure is more orderly and predictable after hire than at hire.

Table 4. Final Model Estimating the Influence of Various Factors, Including Gender, on Salary Step at Time of Hire Among Full-Time Tenured or Tenure-track Faculty at Western Washington University as of Fall, 2000.

<u>Factor</u>	<u>Estimated Effect On Salary Step at Hire</u>
Years since hired at Western	each year subtracts .49 steps (that is, earlier hires were hired at lower steps; inflation has been dealt with primarily through step level at hire)
Years since hired among Humanities faculty only	each year adds .17 steps (combining this finding with the one above indicates that in Humanities, each year since hire subtracts only .32 steps rather than .49.)
Hired between 1975 and 1985	subtracts 2.62 steps (that is, in addition to the reduction of step by year since hire, reflecting inflation, hire during this period of especially low demand reduced salary at hire by an additional 2.62 steps).
Having the terminal degree in the field (PhD or JD vs. MA or BA)	adds 3.66 steps
Years between degree award and hire at Western	each year adds .45 steps (a hire 10 years out of the Ph.D. receives 4.5 steps more than a new Ph.D.)
College: College of Business and Economics	adds 11.45 steps
College: Woodring College of Education	adds 3.04 steps
Department: Computer Science	adds 6.30 steps
Department: Engineering Technology	adds 6.34 steps
Department: Anthropology	subtracts 3.50 steps
Department: Communication	subtracts 3.56 steps
Department: Modern and Classical Languages	subtracts 4.51 steps
Department: History	subtracts 4.65 steps
Department: Theater	subtracts 4.83 steps
Department: Philosophy	subtracts 4.89 steps
Department: Economics	subtracts 5.36 steps (that is, the addition for being in CBE is 6.09 steps in Econ. rather than 11.45 steps)
Department: Liberal Studies	subtracts 6.68 steps
Gender	No reliable difference (estimate: women earn .50 steps less than men, but that difference has a 22% probability of occurring by chance.
Gender: being a woman in CBE	subtracts 2.83 steps

TOTAL proportion of variance in salaries explained by the above model: 71.0 (adjusted = 69.6). N=410

Testing Possible Effects of Minority Ethnicity on 2000-2001 Salary Among Full-time Faculty

Western's full-time faculty in 2000-2001 includes 41 members of minority ethnic groups. While this number is too small to allow analysis by specific group membership, tests were performed for Asian-American faculty (19 individuals, 4.1% of the faculty) and for all other persons of color on the faculty (22 individuals, 4.8% of the faculty). Membership in these categories was included in each of the three regression models reported as Tables 1, 3, and 4 above.

Observed average salaries, before any analysis, are much closer across ethnicity than across gender. Asian-American faculty earn, on average, \$154 more than others, and other faculty of color earn \$1,847 less. These observed similarities may indicate no true difference by ethnicity, or they could mask differences that could emerge during analysis.

The findings for the all persons of color except Asian-American faculty are consistently "no difference." Initial step, changes since hire, and current salary are estimated at equal for this group and for all others. The probability that the two groups are in fact no different is above 90%.

In the case of Asian-American faculty, findings are similar, but one finding raises questions. Step at initial hire is estimated at no different (with 93% probability). Change to salary since hire is estimated at \$1,006 lower for Asian-American faculty than for others, although with the small numbers involved that difference could easily have occurred by chance (42% likely).

Total current salary, however, is estimated at \$2,014 lower for Asian-American faculty than for others, a finding that is marginally reliable statistically. (If this is treated as a sampling situation, the "true" effect being estimated is 90% likely to be that Asian-American faculty salaries are lower than others' salaries, to at least some degree, and the best estimate is about \$2,000.) However, the small numbers of faculty involved mean that any conclusions drawn from statistical analysis must be treated with caution.

The most accurate way to view these findings is probably that there is equity or very nearly equity across ethnicity. The policy question for Western is whether that should be the case. Western has been formally committed to diversifying the faculty for well over a decade. That goal introduces significant market considerations because recent years have seen colleges competing for limited numbers of minority Ph.D.s and, in some fields, female Ph.D.s. However, there is no indication that Western has used salary as an inducement to overcome market-driven forces that make it difficult to hire persons of minority descent. Western uses salary to overcome market forces to attract faculty to CBE, Computer Science, etc., but there is no evidence of the same commitment in the case of ethnic minority faculty. Nor is there great evidence of such in the case of female faculty, although the pay differential in some college units does favor women slightly.