Report from the Human Resources Committee

April 28, 2016

The Human Resources Committee met on April 27 at 1:30 in Room D of the Training & Development Bldg. Before I report on that, I want to briefly speak about a positive development for employees on campus.

Kiz Adams was hired in February of 2016 as UGA's "Work/Life Balance Coordinator," a position which grew out of the Women's Leadership Initiative. The position is part of the Training and Development Department in Human Resources. Kiz is charged with assessing the work/life balance needs of our diverse population and finding solutions to the daily challenges employees face involving work, personal, and family life. She will identify resources, both on campus and in the community, to help faculty and staff manage life events and corral all that information onto a Work/Life Balance Resource website. This website will be a "one-stop shop" where employees can connect with the resources and services available to help them be successful, healthy, productive members of our community.

Kiz will also be going out to campus departments to ensure faculty and staff are aware of these resources and help design, develop, and implement new work/life balance programs. In addition to the information on the web site, she will provide individual consultations, as needed, to connect faculty and staff with the resources they need to manage stressful life events.

I'd like to introduce you to Kiz Adams and give you the opportunity to ask her any questions you may have.

Yesterday's committee meeting was convened at the request of Dr. Michelle Cook, who had received additional information from Dr. Mary Dunn Baker, the consultant who conducted the faculty salary equity study. Dr. Cook sent the consultant's document (attached) for review before the meeting. The meeting lasted more than an hour, so I am giving an abbreviated report of the discussion. [Adam, please bring up Fig. 1.]

The committee agreed that the document presented did not meet tests of rigor and transparency of methods that would be acceptable in most scientific reports. Because of the sensitive and political nature of the conclusions, the committee felt that a higher degree of transparency and reproducibility was required.

Although the consultant submitted results based on the guidelines she had been given, the committee felt that she did not do a proper or thorough regression analysis. Specifically, she failed to include interaction terms that would ensure accurate results.

[Adam, please bring up Fig. 2.] The committee was concerned by issues such as uneven sample sizes and the small number of data points. No technical report was submitted by the consultant, so the methods used, the assumptions made, and the conclusions reached cannot be evaluated by readers. The report lacks substantiation of claims and conclusions through data presentation and transparency; results are not provided or reproducible. These characteristics render the report unsatisfactory to our committee and in meeting the goals outlined for such a study.

As a result, the committee voted to send a memo to Provost Whitten requesting that the existing data be examined by another group or individual who can provide a more comprehensive report, including data analysis methodology and a more thorough and substantiated evaluation of how interaction terms, rank, and other factors affect gender pay equity at UGA.

May 3, 2016

Dr. Pamela Whitten
Office of the Provost
University of Georgia
203 Administration Building
Athens, Georgia, 30602-1651

Dear Provost Whitten:

University Council's Human Resources Committee met on April 27 with Dr. Michelle Cook to discuss additional information requested about the faculty gender equity study. After analysis of the executive summary and the follow up comments by the consultant, we find that these documents do not meet scientific standards of rigor and lack of bias.

The report lacks substantiation of claims and conclusions through data presentation and transparency; results are not provided in appropriate detail nor are reproducible. There are also issues about the choice of statistical models used. These issues include the lack of inclusion of interaction terms in the model, how unequal sample sizes were dealt with, and how units were grouped, among other factors. Decisions about statistical methods potentially affect conclusions of the study. Specifically, when more sources of variation are accounted for by other factors, the ability to detect effects of gender in the model (if significant) are improved. The fact that the methods were not provided in a full report to the University erodes credibility of the findings.

University Council requested that the study follow AAUP guidelines, which indicate that the use of rank is controversial (see *Paychecks: A Guide to Conducting Salary-Equity Studies for Higher Education Faculty*). However, the purchase order issued to the consultant stipulated including rank in the study. The committee suggests that the role of rank in the statistical models at least be explored.

Because of the sensitive and political nature of the conclusions, the committee felt that a higher degree of transparency and reproducibility was required. Our committee respectfully requests analyses of salary data by another group or individual who can provide a more comprehensive report, including data analysis methodology, and a more thorough and substantiated evaluation of how interaction terms, rank, and other factors affect gender pay equity at UGA.

We appreciate the University's interest in and exploration of this matter, and would like to see a final report that will be regarded as accurate and trustworthy in its assessment. Because this is my last semester on the committee, please continue communication on this issue with next year's chair, Dr. Patricia Yager of the Franklin College of Arts and Sciences, School of Marine Programs.

Sincerely,

Brenda Keen

Brenda Keen
Chair, 2015-16

ANALYSES OF 01/2015 UGA FEMALE/MALE FACULTY SALARY DIFFERENCES

Mary Dunn Baker, Ph.D.
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I. Purpose of UGA Faculty Salary Studies

Salary analyses were conducted to determine whether The University of Georgia's (UGA's) ***similarly situated*** female and male 2014/2015 faculty members were paid at statistically similar rates. Specifically, the studies measure gender differences between the nine-month base salaries[1] paid to the 566 female and 1,097 male Assistant, Associate and Full Professors.[2]

II. Methodology and Interpretation of Results

The statistical method used to conduct the UGA faculty salary studies is ordinary least squares multiple regression analysis.[3] This technique allows the analyst to quantify the female/male salary difference after filtering out pay rate differences that are attributable to gender differences in factors or characteristics that are typically considered in the salary-setting process. [Such factors/characteristics include variables that describe the level and type of work performed, education level and relevant work experience, as well as the institution's pay-setting policies and practices.]

Multiple regression analysis also allows the analyst to determine whether the characteristic-adjusted pay disparity revealed by the model is statistically significant, i.e., whether the salary difference is too large to have occurred by chance (or to be attributable to random variation) in a compensation system that is neutral with respect to gender. This is accomplished by computing the number of standard deviations[4] of the observed disparity and the probability that the difference would have occurred by chance in a gender-neutral setting.

Consistent with the conventional social science and legal interpretations of the results of statistical analyses, in these studies, at the 95% confidence level, the threshold for statistical

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[1] Salaries paid to professors with longer contract types were converted to the nine-month equivalent rate.
[2] Faculty in the Division of Academic Enhancement, Deans and Executive Administrators were excluded from the analyses.
[3] In her October 6, 2015 presentation materials, Dr. Billard quotes from Scott's (1979) "Higher Education Salary Evaluation Kit," an AAUP publication, that the "gold standard" for compensation analysis "is multiple regression modeling."
[4] The term "number of standard deviations" is used rather than the "number of standard errors" to be consistent with the manner in which courts tend to describe the results of statistical analyses.

significance is ±1.96 standard deviations or a two-tailed five percent probability of chance occurrence. Accordingly, differences that are equal to or greater than the absolute value of 1.96 standard deviations or two-tailed probabilities of chance occurrence that are five percent or less are considered statistically significant – i.e., differences that are not likely to have occurred by chance in a pay-setting process that is neutral with respect to gender.[5]

In order to filter out differences in female and male salaries that are attributable to factors that impact pay (and so that the pay rates of ***similarly situated*** professors are compared), the base model controls for the factors that are typically considered in faculty salary analyses[6] and for which data are readily available.

- To account for variation in pay across academic disciplines, the model controls for College or School and department.[7] Appendix A shows the number of professors in each College/School and department.

- To further account for the type of work that professors perform, the base model also controls for Administrator Status[8] and includes an indicator as to whether or not the professor has a Medical Partnership.

- Level of work and level of accomplishment are accounted for by Academic Rank (Assistant, Associate or Full Professor) and Tenure Status.[9]

- As pay tends to vary with education level, highest degree level indicators enter the base model. The degree level indicator variables include Bachelor's, Master's, Doctorate, DVM, MD, JD and PHARMD. Faculty who have a Doctorate as well as a professional degree, or who have multiple professional degrees, are so indicated in the model.

- Given that the amount of UGA experience influences salary levels, the base model controls for years at the current rank and other years of UGA service. To account for the general fact that the relationship between years of experience and salary is non-linear,

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[5] Statistically significant differences do not necessarily indicate pay discrimination against a demographic group. While discrimination is one potential explanation for such a disparity, the observed salary shortfall may be attributable to gender differences in other factors for which the regression model did not account.

[6] For example, in Paychecks, A Guide to Conducting Salary-Equity Studies for Higher Education Faculty (2002), ("Paychecks"), Haignere describes some of factors for which faculty salary studies often control. These variables include years of experience, highest degree attained, rank and discipline. (See page 18.)

[7] The colleges include Agriculture & Environmental Science, Business, Education, Engineering, Environment & Design, Family & Consumer Services, Forestry & Natural Resources, Journalism & Mass Communications, Pharmacy, Public Health and Veterinary Medicine. The schools includes Ecology, Law, Public & International Affairs and Social Work. The departments in the College of Arts & Sciences were categorized by "school" – Biological Sciences, Fine Arts, Humanities, Physical & Mathematical Sciences and Social Sciences.

[8] The Administrative Status indicator variables are: Department Head; Associate Department Head; Sr. Associate Dean; Associate Dean; Assistant Dean; Division Director; Director; Associate Director and Assistant Director.

[9] The Tenure Status categorical variables are: Non-tenured, 1 Yr Prior Credit; Non-tenured, 2 Yr Prior Credit; Non-tenured, 3 Yr Prior Credit; Non-tenured, Non-tenured Position; Non-tenured, Not on Track; Non-tenured, On Track; and Tenured.

the model also includes years in the current rank squared and other years of UGA service squared.[10]

- Although no specific measures of years of relevant experience elsewhere are available, a second model was estimated that included a proxy for the amount of pre-UGA work experience – the number of years between the most recent UGA hire year and the year of the highest degree.[11]

In recognition of the fact that the impacts that factors have on pay may vary from one College/School (or discipline) to another, all of the explanatory factors except the gender and department variables were interacted with College/School.[12]

The percentage of variation in the salaries paid to the 1,663 professors that is explained by these models is substantial. Specifically, the explanatory power of the base model (the adjusted R^2 statistic) is 84.05%. The explanatory power of the model that also includes the proxy for pre-UGA prior experience is 84.48%. Accordingly, these models have considerable predictive power, which indicates that these sets of explanatory variables are highly correlated with pay.

III. Outcomes of Multiple Regression Analyses

Overall Female/Male Salary Difference. As Figure 1 shows, the base model reveals that, on average, across all of the UGA Colleges/Schools, female professors were paid nine-month salaries that were $1,380, or approximately 1.5%, less than the amounts paid to men who were like them in terms of the factors for which the model controls. As the number of standard deviations of this difference is -1.59 and the probability of chance occurrence is 11.31%, this salary disparity is not statistically significant, i.e., the magnitude of this difference is consistent with the outcome of a pay-setting process that is neutral with respect to gender. [In order to attain statistical significance, the female salary shortfall would have to have been at least $1,701, a 1.85% disparity.[13]]

In some instances, the observed female/male pay difference is substantially influenced by the salaries paid to a small percentage of professors who are, from the statistical perspective, extraordinarily high or low ("outliers"). Therefore, in order to determine whether outliers had a

[10] In Paychecks (pages 49-50), Haignere recommends the inclusion of squared experience terms in the regression model to account for the curvilinear relationships between pay and years of experience.
[11] In Paychecks (pages 32-33), Haignere suggests using years since highest degree at the time of hire to measure prior experience. However, as she notes, using years since degree prior to hire as a proxy for previous experience may credit women with too many years of relevant experience. In that event, the regression model would overstate the female/male salary difference.
[12] The department indicator variables do not need to be interacted with college/school as a given department is associated with one and only one college/school.
[13] The value of one standard error is approximately $868.

substantial impact on the observed female/male salary difference, professors with outlier salaries were identified and the base model was re-estimated excluding these observations.

The base model identified 76 professors whose actual salaries deviated from the amount predicted by the model by $\pm$1.96 or more standard deviations. As Figure 1 shows, when these faculty are excluded from the analysis, the female/male salary difference is reduced to -$728, or a -0.80% disparity. As this difference is not statistically significant (-1.21 standard deviations, 22.47% probability of chance occurrence), the data fail to produce a pattern of paying female faculty less than their similarly situated male counterparts.[14] Moreover, this analysis indicates that a substantial proportion of the statistically insignificant gender disparity observed in the model that includes all faculty is attributable to the salaries paid to a small proportion of professors.

When the proxy for pre-UGA experience also enters the model, the University-wide female/male salary difference is slightly diminished. As Figure 1 illustrates, this model indicates that female professors were paid $1,267 less than their male counterparts, a 1.37% difference. Again, given that the number of standard deviations of this disparity (-1.46) and the probability of observing this outcome by chance in a gender neutral compensation system (14.33%), this shortfall is not statistically significant. Accordingly, the conclusion is that a disparity of this magnitude is likely to be attributable to random or chance variation. [In order to attain statistical significance, this difference would have to be at least -$1,701, a -1.84% difference.]

The model that incorporates the proxy for previous work experience indicates that 73 faculty have statistically outlying salaries. As Figure 1 shows, when the data for these individuals are excluded from the model, the female/male salary difference is -$316, a -0.35% disparity. As the number of standard deviations of this difference is -0.52 and the probability of chance occurrence is 60.24%, this female salary shortfall is not statistically significant.[15] Again, this analysis indicates that a substantial proportion of the statistically insignificant female/male salary difference observed in the model that includes all faculty is attributable to the salaries paid to a small proportion of professors.

Female/Male Salary Differences by Academic Rank. In addition to measuring the UGA-wide female/male faculty salary difference, other analyses were conducted to quantify the gender difference in pay on a by-rank basis. To quantify the by-rank salary differences, the model includes variables that interact female and rank.[16]

Assistant Professors. UGA employed 371 Assistant Professors in January 2015, 203 men and 168 women. Figure 2 shows that the base model reveals that, on average, the female Assistant Professors had base salaries that were $1,892, or 2.39%, less than the amounts paid to their similarly situated male counterparts. This difference is not statistically significant as the number of standard deviations is -1.11 and the probability of chance occurrence is 26.79%. [In order to

[14] The percentage of variation in salaries explained by this model is 91.51%.
[15] The percentage of variation in salaries explained by this model is 91.48%.
[16] As indicated above, the percentage of variation in salaries explained by the model without the prior experience variable is 84.05%. The adjusted R^2 statistic for the model that incorporates the pre-UGA experience variable is 84.48%.

attain statistical significance, this disparity would have to be at least approximately -$3,341, a -4.22% difference.[17]]

Figure 2 reveals that when the proxy for pre-UGA experience is included in the model, the Assistant Professor female/male salary difference is -$2,010, a -2.54% disparity. As the number of standard deviation of this difference is -1.18 and the probability of chance occurrence is 23.68%, this disparity is not statistically significant. [In order to attain statistical significance, this difference would have to be at least approximately -$3,339, a -4.22% disparity.[18]]

Figure 2 also shows that when professors with statistical outlying salaries are excluded from the regression analysis, the base model reveals that the female/male Assistant Professor salary difference shrinks from -$1,892 to -$1,586, or from a -2.39% to a -2.00%, difference. When the model that includes the proxy for pre-UGA experience is estimated without the outliers, the female/male Assistant Professor salary difference drops from -$2,010 to -$1,704, or from a -2.54% to a -2.15% difference. These disparities are not statistically significant and are, therefore, consistent with the outcome of a gender-neutral compensation system.[19]

Associate Professors. As of January 2015, UGA employed 536 Associate Professors – 323 men and 213 women. As Figure 2 illustrates, the base model shows that, on average, across The University, the female/male Associate Professor salary difference is $141, a 0.17% disparity. As this miniscule difference favors women and is not statistically significant (0.10 standard deviations, 91.98% probability of chance occurrence), this result is consistent with the outcome of a gender-neutral compensation system. [In order to produce a statistically significant outcome that is adverse to women, the female/male Associate Professor pay difference would have to be at least approximately -$2,764, a -3.33% disparity.[20]]

When the proxy for pre-UGA experience is included in the model, Figure 2 shows that female Associate Professors were paid $156, or 0.19%, more than their male counterparts. Again, as this miniscule difference favors women and is not statistically significant (0.11 standard deviations, 91.12% probability of chance occurrence), this result is consistent with the outcome of a compensation-setting system that is neutral with respect to gender. [In order to produce a statistically significant outcome that is adverse to women, the female/male Associate Professor pay difference would have to be at least approximately -$2,780, a -3.39% disparity.[21]]

When faculty with outlier salaries are excluded from the base model, the female/male Associate Professor salary difference changes from $141 to -$125, or from a 0.17% to a -0.15% difference. When outliers are not included in the estimation of the model with the pre-UGA

[17] The value of one standard error is approximately $1,705.
[18] The value of one standard error is approximately $1,703.
[19] When outliers are excluded from the base model, the number of standard deviations of the female/male Assistant Professor salary difference is -1.37 and the probability of chance occurrence is 17.15%. When outliers are excluded from the model that includes the proxy for pre-UGA work experience, the number of standard deviations of the female/male pay disparity is -1.44 and the probability of chance occurrence is 14.88%.
The adjusted R^2 statistic for the base model excluding outliers is 91.50%. The percentage of the variation in salaries explained by the model that incorporates the prior experience proxy and excludes outliers is 91.48%.
[20] The value of one standard error is approximately $1,410.
[21] The value of one standard error is approximately $1,418.

experience proxy, the female/male Associate Professor salary difference changes from $156 to -$78. These trivial disparities are not statistically significant and are, therefore, reflective of the outcome of a gender-neutral salary-setting process.[22]

Full Professors. In January 2015, UGA employed 756 Full Professors, 571 men and 185 women. As Figure 2 shows, the base model indicates that, on average, across the Colleges/Schools, the female Full Professors had base salaries that were $2,609, or 2.29%, less than the rates at which the men who were like them in terms of the factors for which the model accounts were compensated. As the number of standard deviations of this difference is -1.81 and the probability of chance occurrence is 7.01%, this difference is not statistically significant and is likely to be attributable to random variation in a salary-setting process that is gender-neutral. [In order to produce a statistically significant outcome that is adverse to female Full Professors, the female/male pay difference would have to be at least approximately -$2,825, a -2.48% disparity.[23]]

When the proxy for prior experience is included in the model, the Full Professor female/male salary difference is -$2,219, a -1.95% difference. Given that the number of standard deviations of this disparity is -1.56 and the probability of chance occurrence is 11.98%, this difference is not statistically significant and is consistent with random variation in a gender-neutral pay-setting process. [In order to produce a statistically significant outcome that is adverse to female Full Professors, the female/male pay difference would have to be at least approximately -$2,788, a -2.45% disparity.[24]]

When outliers are excluded from the base model analysis, Figure 2 reveals that the female/male Full Professor salary difference shrinks from -$2,609 to -$743, or from a -2.29% to a -0.67% disparity. When outliers are not included in the estimation of the model that incorporates the prior experience proxy, the female/male pay difference changes from -$2,219 to $459, or from a -1.95% to a 0.41% disparity. As these salary differences that the models excluding outliers yield are not statistically significant, these salary differences are reflective of the outcome of a gender-neutral compensation system.[25]

IV. Responses to Criticisms of the Faculty Salary Regression Model

Rank and Tenure Status Variables. As stated above, the specific purpose of these salary analyses is to determine whether ***similarly situated*** female and male professors are paid at statistically similar rates. That is, the analyses must compare the rates paid to male and female

[22] When outliers are excluded from the base model, the number of standard deviations of the female/male Associate Professor salary difference is -0.13 and the probability of chance occurrence is 89.62%. When outliers are excluded from the model that includes the pre-UGA experience proxy, the number of standard deviations of the female/male pay disparity is -0.08 and the probability of chance occurrence is 93.60%.

[23] The value of one standard error is approximately $1,441.

[24] The value of one standard error is approximately $1,422.

[25] The number of standard deviations of the -$743 female/male Full Professor salary difference is -0.73 and the probability of chance occurrence is 46.42%. The number of standard deviations of the $459 female/male Full Professor salary difference is 0.45 and the probability of chance occurrence is 65.26%.

faculty who are alike in terms of factors that legitimately influence the establishment of base salaries. Clearly, rank and tenure status are factors that impact the amounts paid to faculty.[26] Therefore, in order to make ***"apples to apples"*** salary comparisons, these characteristics must be included in the model. This position is consistent with publications endorsed by the AAUP. Specifically, according to Paychecks (page 38), most faculty salary studies include rank as an explanatory variable, usually without apology or justification.

My understanding is that some critics of the model contend that rank and tenure status should not enter the model because they *may be* or are simply *assumed to be* "tainted" variables, the inclusion of which masks female shortfalls in pay because of discrimination against women in selection for promotion and tenure (i.e., women are promoted at lower and/or slower rates than their male counterparts).[27] In my view, allegations of compensation and promotion discrimination should be analyzed ***separately***.[28] If an appropriately modeled analysis of promotions produces statistical evidence that female professors are promoted and are granted tenure at lower or slower rates than similarly situated men, then such disparities should be directly remedied and pay rates adjusted accordingly.

If rank and tenure status are removed from the salary model and the analysis produces a significant shortfall in the average female pay rate, then the interpreter of the analysis cannot determine whether the observed disparity is (1) attributable to some aspect of the compensation-setting process that impacts men and women differently or (2) the result of men and women being assigned to different ranks for *legitimate* reasons or (3) the result of men and women being assigned to different ranks for *discriminatory* reasons. Consequently, if the model produces a statistically significant shortfall in female pay, the analysis does not provide any guidance as to the reason for the disparity.[29] Such guidance is necessary in order to determine if any remedial action should be taken and, if so, to determine the appropriate remedy. Accordingly, the preparation of **separate** analyses of salaries (which control for rank and tenure status) and promotion/tenure selection rates is the only way to properly make this determination. Therefore, to simply assert that rank and tenure status are tainted variables without any relevant statistical evidence and, on that unscientific basis, to exclude these important factors from the compensation model, is inappropriate.

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[26] "Current rank is widely seen as related to job level and as a legitimate determinant of salary." Haignere (2002), Paychecks, page 46.

[27] Dr. Billard's presentation materials suggest that, when studying pay, under no circumstances should rank and tenure be used as predictor variables. This is incorrect. Absent a proper statistical showing that, among similarly situated faculty members, women have been promoted at lower or slower rates than men, no conclusions about rank and tenure being "tainted" variables can be drawn. To my knowledge, neither Dr. Billard nor anyone else has presented any properly modeled statistical analysis that demonstrates that women have lower or slower promotion rates than similarly situated men.

[28] At Chapter 4 in Paychecks, Haignere and Eisenberg describe one method of analyzing gender differences in rank after controlling for factors that influence a professor's current rank.

[29] The reader should recognize that the model may produce a significant pay difference adverse to females even when the compensation and promotion/tenure systems do not negatively affect women. Such a disparity may be attributable to gender differences in other legitimate, non-discriminatory factors for which the analysis did not account.

Another reason to include rank and tenure status variables in the salary model is that no specific measures of productivity (e.g., scholarly research record and quality of teaching) are readily available for inclusion in the model. The author of Paychecks (pages 19 and 38) specifically states that rank and tenure status may act as proxies for research and publication records. Consequently, without the rank and tenure status predictor variables, the model would not account in any way for this important factor.

Interaction of Explanatory Variables with the Female Indicator. Critics of the 2015 UGA faculty salary study complain that the estimated regression model is deficient because some or all of the predictor variables are not interacted with the female indicator variable.[30] The primary reason for incorporating such interaction terms is to determine whether the number of dollars associated with a given characteristic is similar for men and women. Apparently, this issue is raised under the assumption that the number of dollars associated with pay-enhancing characteristics is smaller for women than for men (e.g., women get less monetary credit than men for possessing a Ph.D., occupying a given rank and/or having an additional year of service, etc.)

The chosen model was not fully interacted with the female variable for two primary reasons. First, given that the model was already interacted with college/school, the interaction of the female indicator with every predictor in the model would add a large number of variables to the equation and result in many cells with small numbers of observations. Paychecks (page 55) cautions against the inclusion of myriad interaction terms for this reason.

Second, one cannot readily determine from such a female-interacted equation whether, across all of the predictor variables, on net, female and male faculty are compensated at similar rates. That is, the model does not produce any summary statistics that directly measure the female/male salary difference and that allow for the determination of whether or not the observed disparity is statistically significant.

Nevertheless, a statistical test was conducted to determine whether an estimated modified regression equation without female interaction terms is statistically significantly different from the modified model that does include such interactions.[31] A comparison of the estimated equations without and with the female interaction variables reveals that these models are statistically similar. Therefore, the conclusion is that the interactions of female with the other

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[30] In her presentation materials, Dr. Billard also indicates that, in addition to interacting the explanatory variables with the female indicator variable, the predictor variables should also be interacted with discipline. The purpose of such interaction terms is to account for the possibility that the impact that a given factor has on pay may vary from one discipline to another.

The faculty salary model estimated using the 2015 data is, in fact, fully interacted with college/school indicators, which are reflective of academic disciplines (e.g., Agriculture & Environmental Sciences, Engineering, Family and Consumer Services, Fine Arts, Pharmacy, Physical & Mathematical Sciences). Therefore, the model does account for the fact that the pay-off for given characteristics may not be similar across disciplines.

[31] To increase the likelihood that a regression equation with female interaction terms would estimate, the equation described in Section II was modified. The modified model differs from the initial model in that it accounts for tenure status with three variables (not tenured, not tenure track; not tenured, tenure track; and tenured) rather than the seven tenure status indicator variables described at footnote 9. As with the model set forth in Section II, in the modified regression equation college/school is interacted with all of the explanatory variables except the female and the department indicators.

explanatory variables are unnecessary. Moreover, this outcome shows that, on net, men and women receive similar payoffs for the characteristics for which the model accounts. Accordingly, the criticism that the regression model is "all messed up"[32] because the predictor variables were not interacted with the female indicator is without merit.

Mary Dunn Baker

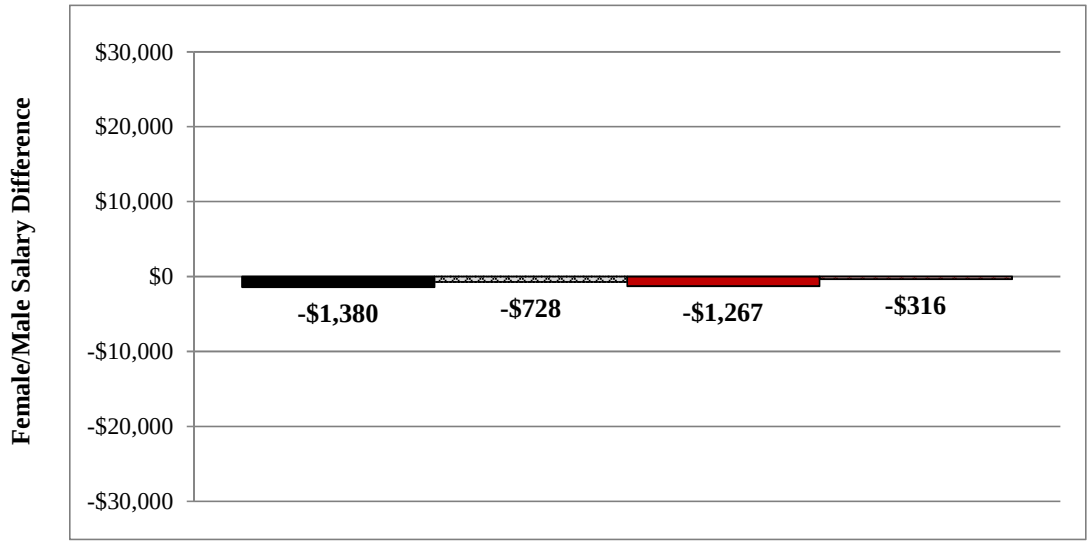
Mary Dunn Baker, Ph.D.

April 26, 2016

Date

[32] See the slides in Dr. Billard's presentation materials that are labeled "Without Interaction, With Interaction."

Figure 1
Female/Male UGA Faculty Salary Difference
With and Without Outliers
University-Wide
All Assistant, Associate and Full Professors
January 7, 2015



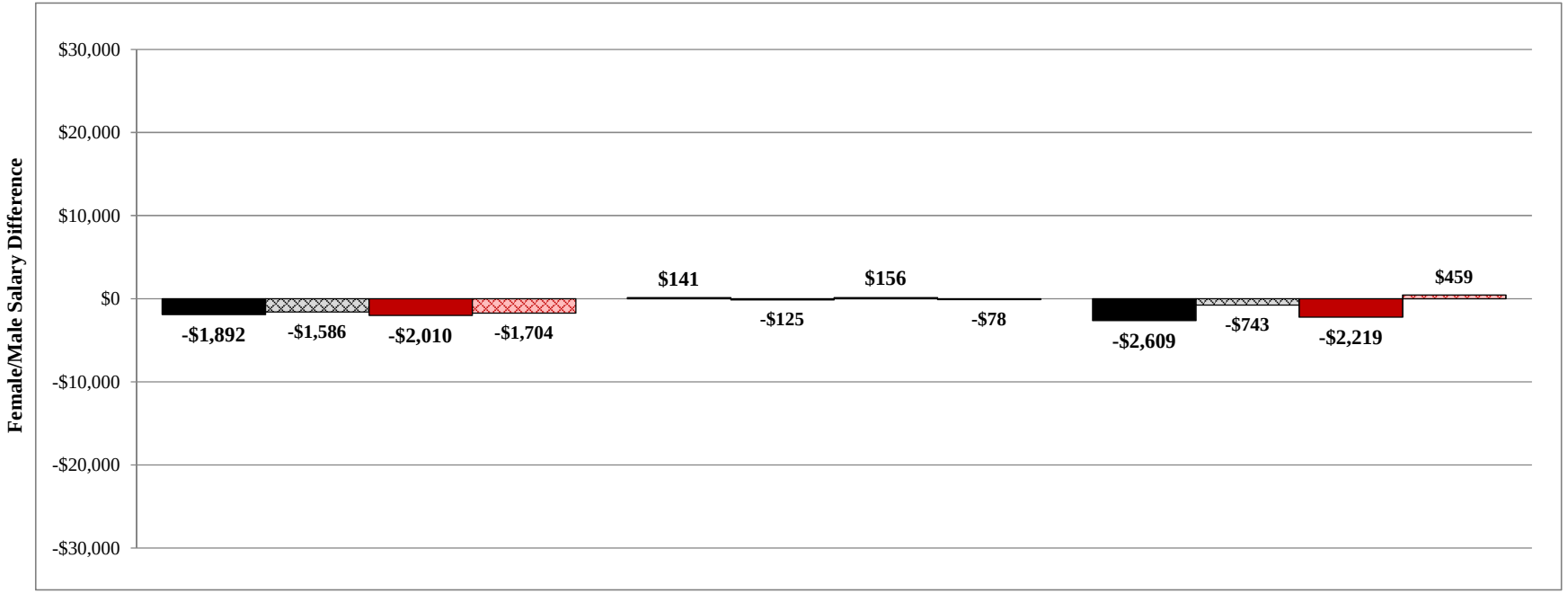
	Without Prior Experience		*With Prior Experience*	
	Base Model	Excluding Outliers	Base Model	Excluding Outliers
Number of Professors	1,663	1,587	1,663	1,590
Number of Females	566	554	566	555
% Pay Difference	-1.50%	-0.80%	-1.37%	-0.35%
Number of Std. Devs.	-1.59	-1.21	-1.46	-0.52
Probability	11.31%	22.47%	14.33%	60.34%
% of Difference Explained	84.05%	91.51%	84.48%	91.48%

Source: Data provided by the University of Georgia.

*Statistically Significant

Note: The dependent variable is the nine-month salary. The models control for College/School, Department, Current Rank, Tenure Status, Highest Terminal Degree or Professional Certification, Administrator Status, Medical Partnership Status, Years in Current Rank (including the squared term), Other Years of Service (including the squared term). All independent variables, except the demographic indicator are interacted with College/School. Prior experience is measured by the number of years between the UGA hire date and the year of the highest degree.

Figure 2
Female/Male UGA Faculty Salary Differences by Rank
With and Without Outliers
All Assistant, Associate and Full Professors
January 7, 2015



	Assistant Professor				Associate Professor				Full Professor			
	Without Prior Experience		*With Prior Experience*		*Without Prior Experience*		*With Prior Experience*		*Without Prior Experience*		*With Prior Experience*	
	Base Model	Excluding Outliers	Base Model	Excluding Outliers	Base Model	Excluding Outliers	Base Model	Excluding Outliers	Base Model	Excluding Outliers	Base Model	Excluding Outliers
Number of Professors	371	371	371	371	536	528	536	530	756	688	756	689
Number of Females	168	168	168	168	213	213	213	212	185	173	185	175
% Pay Difference	-2.39%	-2.00%	-2.54%	-2.15%	0.17%	-0.15%	0.19%	-0.09%	-2.29%	-0.67%	-1.95%	0.41%
Number of Std. Devs.	-1.11	-1.37	-1.18	-1.44	0.10	-0.13	0.11	-0.08	-1.81	-0.73	-1.56	0.45
Probability	26.79%	17.15%	23.68%	14.88%	91.98%	89.62%	91.12%	93.60%	7.01%	46.42%	11.98%	65.36%
% of Difference Explained	84.05%	91.50%	84.48%	91.48%	84.05%	91.50%	84.48%	91.48%	84.05%	91.50%	84.48%	91.48%

Source: Data provided by the University of Georgia.

*Statistically Significant

Note: The dependent variable is the nine-month salary. The models control for College/School, Department, Current Rank, Tenure Status, Highest Terminal Degree or Professional Certification, Administrator Status, Medical Partnership Status, Years in Current Rank (including the squared term), Other Years of Service (including the squared term). All independent variables are interacted with College/School. The demographic indicator is only interacted with Current Rank. Prior experience is measured by the number of years between the UGA hire date and the year of the highest degree.

Appendix A

Number of UGA Professors by College/School and Department

Regular, Full-Time Assistant, Associate and Full Professors[1]

January 7, 2015

College/School Department	Total Number of Professors	Number of Female Professors	Number of Male Professors
University-Wide	**1,663**	**566**	**1,097**
College of Arts and Sciences - Biological Sciences			
Biochem and Mol Biology	36	4	32
Cellular Biology	19	6	13
Genetics	24	8	16
Microbiology	18	6	12
Plant Biology	22	7	15
School Of Marine Programs	25	8	17
Total	**144**	**39**	**105**
College of Arts and Sciences - Fine Arts			
Dance	5	5	0
Hugh Hodgson Sch Of Music	46	14	32
School Of Art	39	17	22
Theatre and Film Studies	19	7	12
Total	**109**	**43**	**66**
College of Arts and Sciences - Humanities			
Classics	10	3	7
Comparative Literature	15	5	10
English	38	19	19
Germanic and Slavic Studies	8	3	5
History	32	11	21
Philosophy	14	6	8
Religion	12	2	10
Romance Languages	30	15	15
Total	**159**	**64**	**95**
College of Arts and Sciences - Physical and Mathematical Sciences			
Chemistry	25	2	23
Computer Science	17	2	15
Geology	15	2	13
Mathematics	34	3	31
Physics And Astronomy	21	2	19
Statistics	17	6	11
Total	**129**	**17**	**112**

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Number of UGA Professors by College/School and Department

Regular, Full-Time Assistant, Associate and Full Professors[1]

January 7, 2015

College/School Department	Total Number of Professors	Number of Female Professors	Number of Male Professors
College of Arts and Sciences - Social Sciences			
Anthropology	15	8	7
Communication Studies	14	9	5
Geography	21	7	14
Psychology	30	10	20
Sociology	17	7	10
Total	**97**	**41**	**56**
College of Agriculture and Environmental Science			
Ag and Applied Econ Dept	26	2	24
Ag Lead, Educ and Comm	8	2	6
Animal and Dairy Science	25	5	20
Crop and Soil Sciences Dept	38	3	35
Entomology Department	33	4	29
Food Science and Tech Dept	21	5	16
Horticulture Department	27	5	22
Plant Pathology Dept	18	5	13
Poultry Science Dept	15	2	13
Total	**211**	**33**	**178**
College of Business			
Economics	15	2	13
Finance	14	3	11
Ins/Legal Stud/Real Est	15	3	12
Management	12	4	8
Management Infor Systems	8	3	5
Marketing	12	3	9
Sch Of Acctng	15	7	8
Total	**91**	**25**	**66**

Appendix A

Number of UGA Professors by College/School and Department

Regular, Full-Time Assistant, Associate and Full Professors[1]

January 7, 2015

College/School Department	Total Number of Professors	Number of Female Professors	Number of Male Professors
College of Education			
Career and Inform Studies	17	6	11
Communic Sci and Spec Educ	13	8	5
Counseling and Hum Dev Svc	21	13	8
Education - Deans Office	1	0	1
Educational Psychology	18	10	8
Educational Theory/Practice	19	12	7
Inst Of Higher Education	8	3	5
Kinesiology	24	8	16
Language and Literacy Educ	11	9	2
Lifelong Ed, Admin and Pol	20	15	5
Math and Science Education	19	11	8
Total	**171**	**95**	**76**
College of Engineering			
College Of Engineering	39	5	34
Total	**39**	**5**	**34**
College of Environment and Design			
College Of Envir and Design	32	11	21
Total	**32**	**11**	**21**
College of Family and Consumer Sciences			
Fin Plan, Hsng and Cons Ecn	18	11	7
Foods and Nutrition	15	11	4
Human Dev and Family Scienc	15	8	7
Textile, Merch and Interior	11	7	4
Total	**59**	**37**	**22**
College of Forestry and Natural Resources			
Forestry Coop Ext Service	1	0	1
Sch Forestry and Nat Resour	45	5	40
Total	**46**	**5**	**41**

Appendix A

Number of UGA Professors by College/School and Department

Regular, Full-Time Assistant, Associate and Full Professors[1]

January 7, 2015

College/School Department	Total Number of Professors	Number of Female Professors	Number of Male Professors
College of Journalism and Mass Communication			
Advertising/Public Relat	21	11	10
Journalism	12	5	7
Telecommunications	14	5	9
Total	**47**	**21**	**26**
College of Pharmacy			
Clinical and Admin Pharm	12	4	8
Pharm and Biomedical Sci	21	5	16
Total	**33**	**9**	**24**
College of Public Health			
Environmental Hlth Sci	9	4	5
Epidemiology and Biostats	13	5	8
Health Promotion and Behav	12	8	4
Hlth Policy and Management	14	8	6
Total	**48**	**25**	**23**
College of Veterinary Medicine			
Infectious Diseases	20	7	13
Large Animal Medicine	13	6	7
Pathology	25	16	9
Physiology and Pharmacology	12	3	9
Population Health	19	7	12
Small Animal Med/Surgery	25	13	12
Vet Biosci and Diag Imaging	12	2	10
Total	**126**	**54**	**72**
School of Ecology			
School Of Ecology	19	7	12
Total	**19**	**7**	**12**
School of Law			
School Of Law	36	13	23
Total	**36**	**13**	**23**

Appendix A

Number of UGA Professors by College/School and Department
Regular, Full-Time Assistant, Associate and Full Professors[1]
January 7, 2015

College/School Department	Total Number of Professors	Number of Female Professors	Number of Male Professors
School of Public and International Affairs			
International Aff - Spia	14	1	13
Political Science	21	5	16
Public Admin and Policy	12	2	10
Total	**47**	**8**	**39**
School of Social Work			
School Of Social Work	20	14	6
Total	**20**	**14**	**6**

Source: Data provided by the University of Georgia

[1]Faculty in the Division of Academic Enhancement, Deans and Executive Administrators are excluded.

4/28/99

TO: Wallace B. Eberhard, Chair
Faculty Benefits Committee, University of Council

FROM: Lynne Billard
University Professor, Department of Statistics

RE: Salary Inequality Study

The 1999 analysis is based on the same methods as used in the 1993 analysis. It is not the same as that used in the first studies of 1990 and 1991, though both methods use the AAUP Salary Evaluation Kit (Scott, 1977), using the statistical methodology of regression analysis. Therefore, we cannot tell if inequities have indeed been elimintated. There are three major differences in the two analyses. These differences, together with possible consequences, are briefly described as follows.

1 Grouping of Faculty

The present analysis has grouped faculty along college, school and division lines. When a single department is small (fewer than about 15 male/15 female members) grouping becomes necessary. Such grouping should be of departments that have similar salary structure, not necessarily similar discipline coverage. More specifically, the salary structure of a group should follow a normal distribution. For example, combining two departments with high and low salary levels respectively, will produce a bimodal nonnormal salary structure. It may be that the present groupings are appropriate. However, there is no evidence that they have been tested for appropriateness. The 1990/1991 groupings were tested for appropriateness and satisfied the necessary statistical criteria.

The current study also groups by rank contrary to the Kit grouping criteria recommendations; see below also.

2 Use of Rank

Intuitively, one would expect that factors such as number of publications, rank, number of students – the usual measures of productivity - should be included as predictor variables. [Predictor variables are those variables which explain the variation in the response.] However, the AAUP Kit recommends that only generic variables such as age, years since higher degree, and/or years employed, be used. This Kit [among others; Scott (1975) looked at 31 possible variables] has also shown how inclusion of additional variables has very little effect on predicted salary values for reasonably homogeneous groupings (such as would follow at a

given institution within which expecations are reasonably common). Indeed, their inclusion can lead to unnecessary difficulties when information on these variables cannot be obtained for all faculty.

Accordingly, both the first and the current studies used years since higher degree and years employed at UGA as predictor variables. Not only are these variables for which information on all faculty is accessible, they are also gender-neutral variables. The current study seems to have included these predictor-variables for the associate professor and full professor groups, and seems to have used no predictor variables for assistant professors.

Further, as emphasised by many authors including Scott (1977, in several places), it is important that gender-biased variables not be used as predictor variables. Indeed, Scott (1977, p8) says "rank (and tenure) should not be employed ..." and "rank is worthless (indeed invalid) as a predictor of salary inequity," with a consequence that "us(e of) such variables as predictors will tend to underestimate the salary inequity of women".

Unfortunately, the 1993 and current studies included rank as a predictor variable. These studies also used rank as part of the grouping. That is, the regression equations not only included years in rank as a predictor variable, the equations were fitted only to salaries for those faculty for a given rank. In contrast, the earlier 1990/1991 study, did not include years in rank as a variable and the regression equations were fitted to salaries over all faculty (over all ranks).

As an addendum, if in fact rank is not gender-biased, then there is no need to include it anyway. Any information contained in such a variable is already there in the other predictor variables. On the other hand, if rank is gender-biased, then it is important it not be used.

3 The Model

The 1990/1991 study ran separate regression analyses for each of its groupings. The current study elected to use an indicator variable for the groupings and so wrapped them all together, so to speak, into the one larger regression analysis. Either approach is statistically valid, provided all the interaction terms between each indicator variable (Journalism, Law, etc) and each predictor variable (years since highest degree, etc) are included in the combined model. If the correct model is used, then either approach should give the same prediction equation for each case (grouping). Unfortunately, these interaction terms seem to be missing in the current study.

One consequence of the model used in the current study is that, after adjusting for differing starting/base salaries, all prediction equations are parallel to each other. Thus, the current model assumes that the average incremental yearly increase is the same in $'s for all disciplines regardless of differential base salaries across disciplines. In reality, as we all know, it is the average percentage (not $'s) increase that is the same across disciplines

each year. That is, the increase in $'s is larger (or smaller) for disciplines with higher (or lower) base salaries, and should be reflected in the prediction equation by discipline dependent regressor parameter values for each of the predictor variables. See the Appendix for elaboration.

Appendix

For illustrative simplicity, let us take only years since highest degree (or simply, Years, X) as the predictor variable, and let us take just two groupings Journalism and Law. Then, the present (1999) analysis gives the regression equation for male Full Professor salaries as

$$Y = 69354 + (122)(\text{Journ}) + (38814)(\text{Law}) + (836)(\text{Years}). \quad (1)$$

Thus, for Journalism faculty, by setting Journ = 1 and Law = 0 in equation (1), we have

$$\begin{aligned} Y_{jour} &= 69354 + 122 + 0 + 836 \ \text{Years} \\ &= 69476 + 836(\text{Years}). \end{aligned} \quad (2)$$

Likewise, for Law, by setting Journ = 0 and Law = 1, we have

$$Y_{law} = 108168 + 836(\text{Years}). \quad (3)$$

The base (69,476 for Journalism and 108,168 for Law) reflects starting salary. We recognize different disciplines have different base salaries.

Notice however the (regression slope) value 836 is the same for both Journalism and Law. That is, equation (2) and (3) are parallel equations increasing at the same rate of $836 per year. This 836 figure represents the average raise for each year, in $'s. If starting/base salaries are the same for both disciplines and/or if average annual increments are the same in $'s, the correct prediction equations should emerge.

However, when starting/base salaries differ and when the same average percentage increase occurs (as is the case for UGA annual raises), then these prediction equations must include all interaction terms. In this case, the model (1) should be

$$Y = \alpha + \beta_1 \ \text{Journ} + \beta_2 \ \text{Law} + \beta_3 \ \text{Years} + \beta_4 \ \text{Journ} * \text{Years} + \beta_5 \ \text{Law} * \text{Years}, \quad (4)$$

with the values for the parameters α, $\beta_1, \ldots, \beta_5$ being estimated from the data. Thence, the relevant prediction equations for Journalism and for Law, respectively, can be found.

The effect of using (1) instead of (4) is to produce predicted salaries which appear to be closer overall than they really are. See Billard et al (1994) for a worked example showing this distinction where instead of Law and Jorunalism we have male and female.

In that case, incorrectly omitting the interaction term produced the prediction equations

$$\begin{aligned} Y_{male} &= 33033 + 332.8(\text{Years}), \\ Y_{female} &= 24501 + 322.8(\text{Years}). \end{aligned}$$

Inclusion of the interaction term (or by fitting males and females separately) gave the correct prediction equations

$$\begin{aligned} Y_{male} &= 30799 + 473.0(\text{Years}), \\ Y_{female} &= 29150 + 25.5(\text{Years}). \end{aligned}$$

For the complete set of groupings and predictor variables used in the current study, the correct statistical model must include, in addition to those already present, interaction terms for each of the groupings interacting with each of the predictor variables (i.e., Journ * Yrshideg, Journ * Yrsampl, Journ * Yrsrank, ..., Phy * Yrshideg, Phy * Yrshideg, Phy * Yrsrank).

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Scott, E. L. (1977). *Higher Education Salary Evaluation Kit.* American Association of University Professors, Washington, D.C.