Report on the
2002 Faculty Salary Equity Study

The University of North Carolina at Chapel Hill

A Report Commissioned by
the Office of the Executive Vice Chancellor and Provost

Prepared by:

Lynn Williford, PhD
Bernadette Gray-Little, PhD

Report on the 2002 Faculty Salary Equity Study

The University of North Carolina at Chapel Hill

Introduction

This report describes the findings of a multiple regression analysis of faculty salaries to determine if systematic patterns of disparity by gender and ethnicity might exist at the University of North Carolina at Chapel Hill. A number of equity-related analyses have been conducted at the University during the past decade with selected faculty populations. These studies included analyses of salary compression in Academic Affairs and non-clinical areas of Health Affairs (1996, 1999, 2000, 2001), multivariate analyses of gender equity in faculty salaries in Academic Affairs (1997), and "glass ceiling" studies of gender differences in tenure/promotion rates (1996, 1997). On an annual basis, formal salary equity reviews are conducted by the School of Medicine, and the Faculty Council's Faculty Welfare Committee and Committee on the Status of Women do extensive examinations of data on hiring patterns, female/minority presence by rank, and salary patterns by department.

However, findings of several widely publicized reports in the past two years concerning the status of women faculty in major research institutions have increased the interest of the campus community in further examining conditions at the University of North Carolina at Chapel Hill. Studies by the Association of American Medical Colleges (AAMC) (2001, 2002), MIT (1999), and other research institutions including neighboring North Carolina State University (2001) have suggested that the increased number of women faculty in some disciplines has not necessarily led to salary and status equity. In other disciplines, the number of women faculty remains very low despite increased production of women doctoral degree recipients (*Chronicle of Higher Education*, 2002).

Several campus groups, including the Committee on the Status of Women, the Association of Women in the Medical School, the Carolina Women's Center, and the Association of Women Faculty and Professionals, expressed an interest to Chancellor James Moeser and Executive Vice Chancellor and Provost Robert Shelton in late 2001 for more research on equity issues concerning women and minority faculty. Provost Shelton asked Executive Associate Provost Bernadette Gray-Little to work with Dr. Lynn Williford, Assistant Provost and Director of Institutional Research, to conduct a campus-wide study on this topic. During January and February 2002, Drs. Gray-Little and Williford solicited input from these committees and other parties about the specific research questions they wished to see addressed. Recommended areas of study (see Appendix A for a list) varied considerably, ranging from a focus on salary equity alone to a much broader examination of climate and employment conditions that might be perceived as barriers by women and minorities. All of the recommendations were considered by Provost Shelton in terms of the availability of resources, the quantity and quality of existing data sources, the effort needed to collect from departments the data not maintained in campus data bases, and the desire to deliver meaningful results to the campus within the year 2002. The decision was made by Provost Shelton to initially confine the study to the question of whether systematic salary differences by gender and ethnicity could be detected after controlling for variables that are logically related to salary. The other topics will be reconsidered for possible study by the Office of the Provost in future years.

The present study differed from previous salary analyses commissioned by the Provost's Office in two important ways. First, it was to be a campus-wide study that would include all academic units in the University. Second, this study would include fixed term (non-tenure track) faculty. The additions of Medicine, Dentistry, and non-tenure track faculty added considerable complexity to the collection and the analysis of the data for this study, as described below.

Methodology

Choice of Methodology

Multiple regression analysis is the statistical method most often used to examine the effects of gender and ethnicity on salaries. Faculty salaries within an institution are influenced by a number of variables, including rank, market value of the discipline, education level, and years of experience. A simple comparison of average salaries by gender and ethnicity tells us little about the actual status of females and minorities at UNC-Chapel Hill because it fails to take into account other factors that might explain these observed differences. Multiple regression analysis used in this context involves the development of a statistical model that predicts current salary (referred to as the dependent variable) as a function of a number of specific predictor variables (also referred to as independent variables). The goal of the analysis is to determine if gender and ethnicity appear to impact salaries after holding constant career-related factors that should be related to, or predict, salaries.

While a substantial body of literature exists on the general topic of equity analysis, a number of publications specific to faculty salary equity analyses were reviewed in the process of designing this study. In addition, the Association of American University Professors (AAUP) has published detailed guidelines for institutions attempting analyses of equity conditions on their campuses, beginning with *The Higher Education Salary Evaluation Kit* (Scott, 1977), followed by *Achieving Pay Equity on Campus* (Gray, 1990). Its most recent publication, *Paychecks: A Guide to Conducting Salary-Equity Studies for Higher Education Faculty* (Haignere, 2002) was used extensively in making decisions concerning the construction of variables used in this study.

Reports describing salary equity studies conducted by other large research institutions were also examined. These included Michigan, UCLA, UC-San Diego, UC-Irvine, MIT, the SUNY System, Cal Tech, Wisconsin, Illinois, Duke[1], Washington University, Texas, Connecticut, and NC State University. Appendix B provides a comparison of the variables and methodological considerations described in the reports of a selected group of peer institutions. A brief bibliography is included in Appendix C for those who are interested in further exploring the literature in this area.

Data Sources

The data for this study were extracted from University Payroll and Human Resources electronic files by the Office of Institutional Research. For all academic units except the School of Medicine, the data represent a "snapshot" of the faculty as of September 30, 2001, and individual changes in status or income after that date were not recorded. In conversations with School of Medicine staff to understand the components of their compensation system, it was learned that some forms of clinical income are distributed as bonus payments at various points during the fiscal year, with individual faculty members often receiving more than one payment. In order to capture each faculty member's total clinical income payments for a given year, it was necessary to use data from the fiscal year ending in June 2001. The "snapshot" of School of Medicine faculty with regard to demographics, professorial status, and base salary was taken from the December 31, 2000 payroll file, and clinical bonus payments were filled in from fiscal year-end summary reports dated June 30, 2001.

To insure data quality, rosters containing data elements on individual faculty members were prepared by the Office of Institutional Research and forwarded to department chairs and business managers for review and validation. Missing data were flagged, along with inconsistencies noted during the electronic edit procedures that might or might not indicate errors. Examples of modifications made by departments included correcting tenure and rank codes, adding terminal degrees received since the

[1] Duke University's written report was not available for review, but Director of Institutional Research David Jamison-Drake graciously provided details concerning the methodological approaches taken in their study through email conversations with the author.

date of hire, clarifying administrative titles, and updating salaries for faculty on leave. Department staff were also asked to provide the following pieces of information that could not be determined from the centralized payroll or human resources files: (1) year appointed to current rank prior to employment at UNC-Chapel Hill; (2) base salary without administrative stipends or overloads; and (3) previous administrative experience that might have had an impact on current salary.

Population

This study included individuals with a primary appointment as a faculty member who met the following criteria:

(1) Employed on September 30, 2001 (all units except School of Medicine), or December 30, 2000 (School of Medicine analysis only);

(2) Permanent full-time (100% FTE) appointment;

(3) In "Active," "On Leave With Pay," or "On Leave Without Pay" status if the department anticipated that the faculty member would return to active status and could estimate their current salary.

(4) Did not hold an administrative appointment as Chancellor, Vice Chancellor, Provost, Associate Provost, Dean, or director of a major center or institute reporting to the Provost or Vice Chancellor for Research and Graduate Studies.

A total of 2,564 faculty members met the initial criteria for analysis. Table 1 displays the distribution of the study population by school and tenure status, and Table 2 shows the gender/ethnicity breakdowns by rank. Two characteristics relevant to salary can be noted in Table 2. First, both females and minority faculty are underrepresented in the full professor ranks, relative to the proportions they occupy in the total faculty. Second, the percentage of faculty in the ranks of instructor and lecturer (both of which are fixed term) who are female is nearly double the percentage of total faculty who are female.

Table 1
Study Population by School and Tenure Status

School	*Tenure Track*	*Tenured*	*Fixed Term*	*Total*
Academic Affairs				
College of Arts & Sciences	146 (19.7%)	512 (68.9%)	85 (11.4%)	743
Kenan Flagler Business School	20 (21.5%)	59 (63.4%)	14 (15.1%)	93
School of Education	10 (18.2%)	35 (63.6%)	10 (18.2%)	55
School of Government	11 (30.6%)	23 (63.9%)	2 (5.5%)	36
School of Info & Library Science	4 (20.0%)	13 (65.0%)	3 (15.0%)	20
School of Journalism & Mass Comm	7 (19.4%)	26 (72.3%)	3 (8.3%)	36
School of Law	4 (9.1%)	33 (75.0%)	7 (15.9%)	44
School of Social Work	3 (4.5%)	21 (31.9%)	42 (63.6%)	66
Subtotal	**205 (18.8%)**	**722 (66.0%)**	**166 (15.2%)**	**1,093**
Health Affairs				
School of Dentistry	10 (9.2%)	54 (49.5%)	45 (41.3%)	109
School of Medicine	185 (17.6%)	427 (40.7%)	438 (41.7%)	1,050
School of Nursing	13 (16.5%)	28 (35.4%)	38 (48.1%)	79
School of Pharmacy	9 (16.4%)	27 (49.1%)	19 (34.5%)	55
School of Public Health	28 (15.7%)	93 (52.2%)	57 (32.0%)	178
Subtotal	**245 (16.7%)**	**629 (42.8%)**	**597 (40.5%)**	**1,471**
Total	**450 (17.5%)**	**1,351 (52.7%)**	**763 (29.8%)**	**2,564**

Table 2 Study Population by Rank, Gender, and Race					
Rank	*Male*	*Female*	*White*	*Minority*	*Total*
Academic Affairs					
Professor	418 (77.7%)	120 (22.3%)	493 (91.6%)	45 (8.4%)	538
Associate	155 (64.9%)	84 (35.1%)	195 (81.6%)	44 (18.4%)	239
Assistant	138 (58.7%)	97 (41.3%)	184 (78.3%)	51 (21.7%)	235
Instructor/Lecturer	29 (35.8%)	52 (64.2%)	68 (84.0%)	13 (16.0%)	81
Subtotal	**740 (67.7%)**	**353 (32.3%)**	**940 (86.0%)**	**153 (14.0%)**	**1,093**
Health Affairs					
Professor	353 (79.7%)	90 (20.3%)	410 (92.6%)	33 (7.4%)	443
Associate	231 (61.9%)	142 (38.1%)	329 (88.2%)	44 (11.8%)	373
Assistant	292 (53.7%)	252 (46.3%)	452 (83.1%)	92 (16.9%)	544
Instructor/Lecturer	29 (26.1%)	82 (73.9%)	96 (86.5%)	15 (13.5%)	111
Subtotal	905 (61.5%)	566 (38.5%)	1,287 (87.5%)	184 (12.5%)	1,471
Total	**1,645 (64.2%)**	**919 (35.8%)**	**2,227 (86.9%)**	**337 (13.1%)**	**2,564**

Organization of the Analysis

Considerable thought was given to how to group academic units for analysis, and if in fact separate analyses should be conducted at all. A review of reports from other institutions (see Appendix B) revealed a great deal of variability with regard to decisions about aggregating different faculty populations for analysis. For example, NC State University used all faculty in the same model, and controlled for the different schools within the institution. Other institutions conducted separate regression analyses for each school, even when the resulting sample sizes fell below what would be considered reasonable sample sizes per predictor according to current conventions (Maxwell, 2000). Still others used a combination of approaches, such as doing a separate analysis of Medicine, aggregating at the institution level but controlling for individual departments or disciplines, and adding Pharmacy to the Nursing analysis to provide male comparators.

The decision to organize the analysis into just a few models with large numbers of cases as opposed to a number of separate models with small numbers of observations was based partially on the large number of predictor variables required. For example, campus groups had asked that fixed term faculty be included as well as administrators. To adequately control for possible salary-related group differences, more variables were needed than would have been necessary with a more homogeneous population of non-administrative, tenure track faculty. Health Affairs disciplines tend to have more variations in degrees than in Academic Affairs, where the issue might be simply whether a terminal degree had been received or not. For example, separate indicator variables were needed to model four types of salary-related educational levels in Dentistry: Below doctorate, PhD only, DDS only, and DDS+ (a DDS plus a subsequent terminal degree such as an MS in Orthodontia).

The Academic Affairs and Health Affairs areas were analyzed separately due to differences in appointment length (9-month versus 12-month contracts) and the nature of faculty work in those divisions. Table 3 provides an overview of the organization of the analysis. One regression model was built for all faculty in Academic Affairs, with controls for each department within each of the schools. Secondary analyses were conducted using tenured/tenure track faculty only, and faculty in the College of Arts and Sciences.

Because of the uniqueness of their compensation patterns, a separate regression model was developed for the School of Medicine, controlling for departments and divisions. Tenured/tenure track faculty were analyzed as a subgroup. Faculty in Clinical Medicine departments, with the exception of the Department of Allied Health Sciences[2], were also analyzed separately. In conversations with School of Medicine dean's office staff, it was learned that average salaries by discipline and subdiscipline in the academic medicine marketplace, collected annually by the American Association of Medical Colleges, are used as benchmarks in their internal equity studies. Faculty salary equity studies of the schools of medicine at the University of Michigan and the University of Wisconsin also used market salaries as predictor variables in their regression models, in addition to departmental controls. However, the AAMC data provide peer averages only for individuals with either the PhD or MD degree. One hundred nine (109) faculty in the School of Medicine without doctoral or MD degrees were dropped from the multiple regression analyses in order to be able to use the AAMC peer data in the salary equity regression models.

The Schools of Dentistry, Nursing, Pharmacy, and Public Health were combined for one analysis, controlling for departments within those schools. Although Dentistry faculty receive part of their compensation from clinical activities, that income is embedded in the annual salary listed in the payroll files, and there are no bonuses paid at other points during the year as with Medicine. In that respect, and because of its relatively small size (n=109), it seemed appropriate to combine Dentistry with the other non-Medicine areas under Health Affairs.

Table 3
Organization of Units for Analysis

	N
Academic Affairs	
1. Total population	1,093
2. Tenured/tenure track only	927
3. College of Arts & Sciences	743
School of Medicine	
1. Total population	941
2. Tenured/tenure track only	612
3. Clinical Medicine depts. only[2]	676
Other Health Affairs Units (Dentistry, Nursing, Pharmacy, Public Health): Total population	421

Regression Methods Used

A number of different approaches to multiple regression analysis can be taken in salary equity studies; there is no universally accepted method that fits all populations and purposes (Moore, 1993). Methods differ based on the groups included in the models, the way that the dependent variable is

[2] The divisions in the Department of Allied Health Sciences were excluded from the separate analysis of Clinical Medicine because of their primary focus on the preparation of non-physician health care practitioners and researchers. Others excluded from the Clinical Medicine analysis were faculty in the Basic Sciences (Biochemistry and Biophysics, Biomedical Engineering, Cell and Developmental Biology, Cell and Molecular Physiology, Genetics, Microbiology and Immunology, Pathology and Laboratory Medicine, and Pharmacology). The Department of Social Medicine contains a mix of faculty from clinical medicine, basic sciences, and social science fields, but was included in Clinical Medicine for this analysis after email correspondence with the program chair concerning its placement.

measured, the types of variables that are used as predictors, and the way in which the predictors are entered into the regression model. As recommended in *Paychecks*, several different methods were attempted in this study, including transforming the salary variable to the natural logarithm,[3] and developing a model based on white males and applying it to females and minorities to determine the difference between actual salaries and the salaries that would be predicted for white males.[4] The overall conclusions from the results of those efforts were essentially the same, regardless of the regression method attempted. To simplify the presentation of the overall findings of this study, only the results from the regression analysis of the total population (i.e., all gender and minority categories) with salaries expressed in actual dollars are provided. This method is most often recommended in the literature due to the ease of interpretation of results expressed in actual dollars compared to logarithmic expressions, and because it is thought to provide more valid results than white male model approach in situations where there are departments and levels in the analysis with females and minorities but no white male comparators. Details concerning the application of the other methods can be obtained from the authors by request.

In the results that follow, gender (coded as Female=1 and Male=0) and ethnicity (coded as Minority=1 and White=0) are part of the set of independent variables used to predict salaries. The regression coefficients associated with gender and ethnicity can be directly interpreted as the dollar amount of difference between the average salaries of females and white males, and minorities and white males, after controlling for all the other independent variables in the model. For example, if the coefficient for Female is –2,000 and the coefficient for Minority is 1,000, we estimate that on average females earn $2,000 less than white males and minorities earn $1,000 more than white males after adjusting for the other predictor variables used in the regression.

There is considerable controversy in the literature concerning the use of tests of statistical significance in faculty salary equity studies. Technically speaking, statistical significance is a concept that concerns the probability of error in making inferences about a population from observations gathered from a random sample. When the entire population of interest is used for analysis, some researchers (Moore, 1993) contend that since no inferences are being made the resulting coefficients and residuals from the regression analysis should be interpreted as actual group differences. Others (Tesfagiorgis, 1991) regard the faculty members in the analysis as a sample of all possible sets of subjects that could have been on the faculty at any given time, and therefore consider tests of statistical significance to be important in the interpretation of the results. Nearly all of the institutional case studies reviewed did rely heavily, and often solely, on the tests of statistical significance in determining whether an observed difference was large enough to be considered evidence of disparity. The present authors chose to follow the advice of other researchers (Snyder, Hyer, & McLaughlin, 1994; Haignere, 2002; and Gray, 1990) as well as statisticians consulted on the UNC-Chapel Hill campus to use statistical significance

[3] The transformation of salaries to the natural logarithm prior to regression analysis is seen frequently in the literature on faculty salary equity analysis. The advantage of this method is that the transformation sometimes results in a better fitting overall model when salaries are very skewed or otherwise not normally distributed. The coefficients from the model must undergo a mathematical conversion to be read as a percentage differences in salaries (Halvorsen & Palmquist, 1980; Kennedy, 1981), and are not as easily understood by general audiences as when expressed in dollars (Ferree & McQuillan, 1998).

[4] The white male model approach, in which the regression equation that best predicts white male salaries is applied to the female and minority subjects' data, is very popular and has been recommended frequently in the literature (Scott, 1977). If the mean difference between the actual salaries of females or minorities is substantially different from their white male model predicted salaries, it suggests that those groups are being compensated at a different rate than white males for the same attributes. It is thought to have some advantage over the total population approach, in which the coefficients or weights that describe impact of the independent variables on salaries are the result of averaging across all members of the population. However, the validity of this method depends on having sufficient numbers of white males at each level of the variables used in the analysis, and that is often not possible in university settings where females tend to dominate the fixed term ranks and certain disciplines like nursing and women's studies (Haignere, 2002).

tests as only one of several points of information when drawing conclusions about the results, considering also the effect sizes and general pattern and pervasiveness of negative coefficients and residuals.

Variables Used in the Analysis

Dependent Variable

For the Academic Affairs analyses, the dependent variable was 9-month salary, not including summer school or overload teaching stipends. School of Government and other 12-month faculty salaries were converted to 9-month salary equivalents by multiplying by .818 (9/11), which is the practice recommended by AAUP.

Analyses of the School of Medicine data used 12-month total salary as the dependent variable. This included base salary, annual negotiated salary, and bonus payments from clinical income that were received at any point in the 2001 fiscal year.

The analyses of the other Health Affairs units used 12-month salary, not including overload or one-time payments. Salaries for the School of Dentistry included clinical income. Nine-month salaries, primarily in the School of Nursing, were converted to a 12-month equivalent by dividing by .818.

Independent Variables

With some discipline-related deviations that will be described in the sections that follow, the models were all developed to estimate the impact of gender and ethnicity on annual salary, after controlling for other salary-relevant variables. The conceptual model driving the selection of variables and the order of their entry into the regression model can be described as follows:

- Education – level of highest earned degree
- Discipline and market forces – indicators for each discipline/department and measures of the external market value of the discipline
- Status -- appointment type (fixed term, tenure track, tenured) and administrative role
- Experience and service length -- years since terminal degree, years at UNC-Chapel Hill, years in current rank
- Career level -- rank and distinguished professorships
- Demographics -- gender and ethnicity

Table 4 contains a description of the individual predictor variables. Continuous variables such as years can typically be used in their present metric in multiple regression models, but predictor variables that represent categories have to be coded as a series of separate dummy variables for multiple regression analyses. For example, gender is represented by two categories, one assigned the value of zero (for males) and the other the value of one (for females). In regression analyses, one category is left out of the analysis to serve as the reference group for the category(ies) left in the model when interpreting the coefficients.

Administrative role. One way to control for salary differences due to administrative assignments is to eliminate all administrators from the study population. Because of the desire of the campus community to include administrators who still perform some faculty duties, attempts were made to adjust the salaries on a case-by-case basis to what these individuals would make as a “regular” faculty member. Even with help from department representatives, these data were deemed unreliable due to inconsistencies across campus in whether administrative work is rewarded through extra pay, a reduction in instructional workload, or other exchanges that are difficult to quantify. The data collected from departments about previous administrative appointments that might have had some impact on current salary were also found to be too anecdotal and inconsistent, and that variable had to be dropped from the

Table 4 Predictor Variables Used in the Analyses		
Variable Name	**Type**	**Description**
Female	Dummy coded	
Minority	Dummy coded	All non-white categories combined
PhD	Dummy coded	PhD or other doctorate such as DPH, EDD, DFA, DSW, etc.
1st Professional degree	Dummy coded	In Academic Affairs, this includes JD only. In the Health Affairs and Medical School analyses, first professional degrees may include MD, OD, DDS, PharmD, and equivalents.
MD+	Dummy coded	Holder of an MD, with or without subsequent degrees
DDS only, DDS+	Dummy coded	DDS only indicates that DDS is highest or last degree; DDS+ indicates DDS holder who later earned the MS or PhD in an advanced area of Dentistry.
Fixed Term	Dummy coded	Not on tenure track. Includes all Instructors and Lecturers, as well as other ranks with modifiers of clinical, research, and adjunct.
Tenure Track	Dummy coded	On tenure track, but not yet tenured
Tenured	Dummy coded	Holds tenure
Distinguished title	Dummy coded	Holds either a permanent or term distinguished title
Adm1	Dummy coded	Below dept level administrative duties
Adm2	Dummy coded	Dept chair, director of a small-to-medium size unit, assistant dean
Adm3	Dummy coded	Associate dean, director of a major center or institute
Professor	Dummy coded	
Associate	Dummy coded	
Assistant	Dummy coded	
Instructor/Lecturer	Dummy coded	These ranks were combined due to their small numbers
Prev Exper: Centered*	Continuous	Years between highest degree and date of at UNC-Chapel Hill, centered.
Prev Exper: Centered & Squared*	Continuous	Years between highest degree and date of at UNC-Chapel Hill, centered and then squared.
Yrs at UNC: Centered*	Continuous	Years between initial hire at UNC-Chapel Hill and date of current rank, centered.
Yrs at UNC: Centered & Squared*	Continuous	Years between initial hire at UNC-Chapel Hill and date of current rank, centered and then squared.
Years in rank: Centered*	Continuous	Years since appointment to current rank at UNC-Chapel Hill, centered.
Years in rank: Centered & squared*	Continuous	Years since appointment to current rank at UNC-Chapel Hill, centered and then squared.
Market Ratio	Continuous	The average salary for peer institutions for a given field and a given rank divided by the average peer salary of all fields for a given rank. Sources for peer salary averages by discipline were: (1) Academic Affairs analysis: The Association of American Universities (AAU) Data Exchange and the American Assembly of Collegiate Schools of Business (AACSB). (2) School of Medicine analysis: Association of American Medical Colleges. (3) Other Health Affairs analysis: Peer salary averages by department were not available for Public Health, so it was not possible to use a market ratio for this analysis.
Schools/Depts	Dummy coded	Faculty school or departmental affiliation was coded in a series of dummy variables. In the Academic Affairs analyses, 53 separate variables were created to represent each department in the College of Arts & Sciences, each discipline area in KF School of Business, and each of the following schools: Education, Government, Information & Library Science, Journalism & Mass Communication, Law, and Social Work. In the School of Medicine analysis, 45 separate variables were set up to represent each department and subdepartment. In the Other Health Affairs analysis, 21 separate variables were created to represent the 7 departments within Dentistry, the 8 departments within Public Health, the 4 departments within Pharmacy, and the School of Nursing (one variable).

analysis. Consequently, salary variation attributable to administrative duties was modeled using four dummy variables: (1) No administrative role (the reference category), (2) Below department chair duties, (3) assistant dean, department chair, or director of a medium sized center or program, and (4) associate dean or director of a major center or institute.

Experience variables. The variables "Years since terminal degree," "Years at UNC-Chapel Hill," and "Years in current rank" have important implications for salaries. However, these measures overlap, and their high intercorrelations make it difficult to sort out their individual effects on the dependent variable in multiple regression analyses. The strategy recommended in *Paychecks* to avoid collinearity was to reorganize the time variables into these categories: (1) "Prior Experience" – the number of years between receipt of the terminal degree and being hired at UNC-Chapel Hill; (2) "UNC Years Prior to Current Rank" – the years between initial hire at UNC-Chapel Hill and the date appointed to the current rank; and (3) "Years in Current Rank" – the year appointed to current rank at UNC-Chapel Hill subtracted from 2001.

Many authors have pointed out that time-related and service length variables are often not linearly related to salary. For example, after 7 years as an assistant professor, or 10 years as an associate professor, additional years in rank may in fact be negatively related to salary after controlling for all other career-relevant characteristics. To adjust for possible nonlinearity, several authors (Haignere, 2002; Balzer et al, 1996) recommended entering a quadratic term (the original variable squared) to the model in addition to the original variable. A variable and its square are highly correlated, and to avoid multicollinearity problems, the original variable is first centered (i.e., each subject's value on that variable subtracted from the mean of that variable) and then squared. Both the centered variable and its square replace the original predictor in the model.

Controls for department and discipline. The question of how to account for salary-related differences related to department and discipline affiliation was considered extensively. In early efforts to develop regression models for Academic Affairs, it became obvious that simply controlling for the professional schools and the four divisions within the College of Arts and Sciences (Fine Arts, Humanities, Sciences, Social Sciences) was not sufficient. Within the Division of Social Sciences alone, there is considerable variation in departmental salaries related in part to the marketability of faculty talent outside of academia (e.g., Economics). The distinctions were even more dramatic in the School of Medicine, where the variations occurred not only across departments in Clinical Medicine, but across subspecialties within departments as well.

Two solutions used in other campus salary equity studies (Michigan, Wisconsin, Connecticut) were adopted for this study. First, for each analysis, a set of dummy variables was constructed to control for department. Officials in the School of Medicine assisted in identifying subdepartments that should also be treated as departments for salary purposes. Second, for the Academic Affairs and School of Medicine analyses, a market variable was developed using average peer salaries at each rank in each discipline. While there is sometimes redundancy in the use of both types of variables, the departmental indicators are intended to control for interdepartmental differences such as the amount of clinical income available to allocate to faculty, and the market variable controls for external forces that have differential impacts on average salaries by discipline. Peer salary information by department/discipline was available for Dentistry, Nursing, and Pharmacy, but not for Public Health, so for the Other Health Affairs analysis, only departmental indicator variables were used.

Productivity and Quality of Outputs. Notably missing from this study are measures of faculty productivity and quality. Reports on attempts to include productivity factors in statistical studies have acknowledged a host of data problems and results of questionable value (Toutkoushian, 1994). Measures of productivity are not maintained in central campus databases, and even with the recent advances in web-based publication and citation indices, the data collection efforts and reliability checks required for assembling such data for a faculty of 2,500+ are prohibitively labor-intensive. Even if such data were readily available, there is little agreement on how to weigh the value of different types of faculty products – journal articles vs. books, etc. The quality of individual academic outputs may also vary considerably, and methods of evaluating the professional contribution of a given piece of work are highly

subjective and embedded in the norms of specific disciplines and departments. **Therefore, for the purposes of the present analysis only, it will be assumed that no gender or ethnicity differences exist in the academic productivity or the quality of the work performed by faculty used in this study.**

As in the other institutional studies reviewed, this analysis used academic rank and the possession of a distinguished professorship as proxies for productivity and quality of output. However, some researchers in the area of salary equity contend that even the seemingly straightforward variable academic rank might in fact be "tainted" by gender or racial discrimination ingrained in the tenure and promotion system, and should not be used in such analyses. Some support for the use of rank as an unbiased predictor of salary can be found in recent studies of tenure and promotion at UNC-Chapel Hill. The extensive "glass ceiling" studies (1996, 1997) conducted by the Office of the Provost suggested that no such biases were perceived by Academic Affairs and Health Affairs female faculty who had sought promotion during a 15-year period, and that their promotion rates were not significantly different from males in their cohort groups. Analysis of the entering assistant professor cohorts from 1980 through 1994 revealed that years-to-tenure averages were quite close for the following comparison groups: Males=5.7, Females=5.9; White=5.7, Minority=6.0. In addition, average years between promotion to associate professor and promotion to full professor for tenured faculty also indicated no significant differences: Males=6.84, Females 6.97; White=6.84, Minority=7.38. Based on these findings, it seems reasonable to use rank as an indicator of career maturity in modeling UNC-Chapel Hill salaries.

Results

The results of the analyses are grouped by Academic Affairs, School of Medicine, and Other Health Affairs Units. Descriptive statistics on each of these major populations are provided in Appendix D. Computer output for the regression analyses described can be referenced in Appendix E.

Examination of the descriptive statistics for all three faculty groupings suggests that, compared to male faculty, female faculty are more likely to:

- Hold a fixed term appointment
- Have the rank of assistant or instructor
- Not hold a distinguished title
- Have spent fewer years in their current ranks
- Not hold the highest degree awarded in their fields
- Be in a lower-paying discipline area

In comparison with white faculty, minority faculty are more likely to:

- Be on tenure track but not yet tenured
- Have spent fewer years in their current ranks

Academic Affairs Regression Analyses

The results of the three regression analyses are summarized below in Table 5. The same independent variables were used in each analysis with only minor modifications.[5] Each of the blocks of

[5] For the Academic Affairs total population and tenured/tenure track only analyses, the market ratio variable did not contribute to the model over and above the department dummy variables, and was dropped to remove collinearity. In the tenured/tenure track model, the variable "Tenure" was removed due to its high correlation with associate and full professor ranks, since virtually all faculty in those ranks hold tenure.

variables that entered the model (education level, status, department/discipline, experience, and career level) made substantial contributions to the prediction of salary. When entered last, the variables Female and Minority did not change the percentage of variance already accounted for by the overall model, which averaged 80% across the three analyses.

The gender coefficients for each analysis indicate that females are on average receiving lower salaries than the white male reference group after controlling for all other variables in the model. The disparity is somewhat higher in the tenured/tenure track only analysis due in part to the higher average salaries earned by that population compared to the faculty groups included in the total population and the College of Arts and Sciences analyses which included fixed term. Minority coefficients were positive in each analysis, indicating that minority faculty tend to earn higher salaries than white males after adjusting for other variables.

Table 5
Academic Affairs
Multiple Regression Analysis Results

	N	%	Adjusted R^2	Coefficient
Total Population	1,090	100.0%	81.9%	
Female	353	32.3%		-$1,332
Minority	153	14.0%		$1,680
Tenured/Tenure Track Only	927	100.0%	81.4%	
Female	261	28.1%		-$1,830
Minority	129	13.9%		$1,249
College of Arts & Sciences	743	100.0%	78.6%	
Female	211	28.4%		-$1,169
Minority	106	14.3%		$629

**Indicates a statistically significant finding at p<.05. Refer to page 6 of this report for a discussion of the use of statistical significance in this study.*

School of Medicine Regression Analysis

The School of Medicine data presented a number of analytical challenges due to a very heterogeneous faculty, wide variations in the market values of its disciplines, and differentiated income plans. With two minor exceptions, all models used the similar predictor variables in the analysis. "Tenured" was deleted in the tenured/tenure track analysis because of its high correlations with the ranks of professor and associate professor. In addition, the market ratio variable was not used in the tenured/tenure track analysis due to collinearity with the departmental variables. This finding might reflect the School of Medicine's direct efforts in recent years to use these market rates as benchmarks for making internal salary decisions, with the result that over time its department average salaries increasingly mirror the national averages.

As shown in Table 6, the female salary disparity after controlling for other predictors was larger than what was noted in the Academic Affairs areas, in part reflecting the higher average salaries in the School of Medicine. The coefficient for Minority was negative and quite small in the analysis of the total population and the Clinical Medicine departments, but substantial and positive in the tenured/tenure track only analysis. Preliminary examination of the variation in the minority coefficients across the three analyses suggested that the relationship between minority status and salaries, after controlling for other variables, is negative for fixed term minority faculty but positive for tenured/tenure track minority faculty. Further analyses are needed to more thoroughly investigate those relationships, and to determine if certain combinations of characteristics uniquely affect the female salary disparities noted here also.

Table 6 School of Medicine (MD and Doctoral Degree holders only) Multiple Regression Analysis Results				
	N	**%**	**Adjusted R^2**	**Coefficient**
Total Population	941	100.0%	81.7%	
Female	283	30.3%		-$6,976*
Minority	121	12.9%		-$597
Tenured/Tenure Track Only	612	100.0%	79.6%	
Female	139	22.7%		-$6,713*
Minority	65	10.6%		$6,261
Clinical Medicine Depts. Only	676	100.0%	79.3%	
Female	200	33.2%		-$9,293*
Minority	81	12.0%		-$195

**Indicates a statistically significant finding at p<.05. Refer to page 6 of this report for a discussion of the use of statistical significance in this study.*

Other Health Affairs Professional Schools Regression Analysis

This analysis included all tenured/tenure track and fixed term faculty in the School of Dentistry, School of Nursing, School of Pharmacy, and School of Public Heath. School of Dentistry salaries include any clinical income received as part of their total compensation. Dummy variables were used to represent each department within the schools except for Nursing, which was treated as a single department in the model.[6]

The regression model results are summarized below in Table 7. Similar to the other analyses, the regression model explained a large portion of the variance in salaries, although gender and ethnicity contributed virtually nothing over and above the other variables. As in other analyses, being female was negatively related to salaries, while being a minority was positively associated with salaries, controlling for all other variables.

Table 7 Other Health Affairs Units (Nursing, Pharmacy, Dentistry, Public Health) Multiple Regression Analysis Results				
	N	**%**	**Adjusted R^2**	**Coefficient**
Total Population	421	100.0%	80.0%	
Female	196	46.5%		-$3,440
Minority	53	12.6%		$2,552

**Indicates a statistically significant finding at p<.05. Refer to page 6 of this report for a discussion of the use of statistical significance in this study.*

[6] Staff in the School of Nursing confirmed that the school's departmental configurations existed for administrative purposes and were not relevant to salary/market differences.

Summary of Findings

While the populations used in these separate analyses differed in terms of their composition, some important consistencies in the overall results should be highlighted. Each of the models attempted were highly predictive of salaries, with R^2 values averaging .80. This indicates that about 80% of the variability in faculty salaries could be accounted for by the variables included in this study. Furthermore, across all populations and all models attempted, the strongest predictors of salary as indicated by the relative size of their standardized coefficients were those variables that we commonly attribute to higher salaries (in descending order of magnitude):

- Rank of full professor
- Possession of a distinguished title
- Administrator of a large unit
- Tenure track appointment as opposed to fixed term
- Specialization in a high paying discipline
- Fewer years of service at UNC-Chapel Hill (an indicator of career mobility)

After adjustments for the variables expected to be related to higher salaries, the variables gender and ethnicity contributed very little to the overall prediction of salaries. However, examination of the coefficients indicates that status as a minority member was positively related to salary in all but the School of Medicine analyses, where only a very small disparity was noted in two of the models. Average female salaries lagged behind those of white males in every analysis, ranging from a deficit of $1,169 in the College of Arts and Sciences to $9,293 in Clinical Medicine departments. The statistical outputs from this study indicate that neither of the two negative minority coefficients and only three of the seven negative female coefficients were large enough to reach a level that is typically considered statistically significant. Since the entire population was used in this analysis, the meaningfulness of statistical significance in this context is debatable. The position of the authors is that the statistical significance of the differences should be treated as only one of a number of factors that need to be considered in assessing the importance of these findings, with the others being the magnitude of the differences and the overall pattern of the results.

Although the models developed are quite predictive, the results indicate that approximately 20% of the variability in faculty salaries was not explained by the analyses. This remaining variability might well be due to differences in the quality of faculty contributions that are not accounted for in these regression analyses. Most faculty salary increases are allocated to individuals based on merit, and it is quite likely that individual differences in productivity over time account for a great deal of the unexplained variance observed here. The results of multiple regression analysis are sensitive to the specific variables in the model. If we were able to factor in variables that adequately measured the salary-relevant productivity of individual faculty members, the coefficients attached to female and minority status could change in magnitude and/or direction. Given the absence of any quantitative data suggesting that females and minorities are systematically more or less productive than their white male counterparts, the results of this study should be treated as preliminary and diagnostic only. Further analyses at the school/department level might focus on the individuals with large negative disparities between their predicted and actual salaries in an effort to determine what productivity differences or other factors that could not be measured here might account for the observed gap.