

September 23, 2011

## **SENATE RESEARCH OFFICERS COMMITTEE (ROC):**

### **2010-2011 ACADEMIC YEAR FINAL REPORT**

*Salary equity study:* In May 2010, Provost Steele publicly released a Salary Study of Officers of Research (Attachment A). To quote from his cover letter, the report “finds some evidence of statistically significant differentials in pay by gender and race/ethnicity.... There is also evidence that some of these differentials are related to starting salaries.” The Provost shared the report with the appropriate senior administrators on the Medical and Morningside campuses. He asked for reviews of current salaries and for adjustments where appropriate. He also asked for a review of the process for setting starting salaries “to ensure that starting salaries are comparable, all else being equal.” One year later, in May 2011, we met with Senior Vice Provost Stephen Rittenberg and P&S vice deans Anne Taylor (Academic Affairs) and Robert Kass (Research). Despite the passage of a year, these three senior administrators were unaware of any such salary adjustments or changes in procedures for setting starting salaries.

*CUMC salary issues:* In a 2007 study the Provost’s Office found that the average raises of CUMC Research Officers (ROs) were lower than those of their Morningside counterparts. In 2010 the Provost’s Office found the same disparity again. The ROC discussed this issue in May 2011 with Drs. Rittenberg, Taylor, and Kass. A solution remains to be found.

*Fraction of research funds generated by RO Principal Investigators (PIs):* The ROC met in February 2011 to discuss the fraction of total research funds that RO PIs bring to the University with two administrators from the CUMC Sponsored Projects Office: Executive Director Mario Reyes and Carol Tycko, Director of Business Systems. The SPO had prepared a report showing that 12 percent of external funding across the University is brought in by some 300 RO PIs.

*Effort reporting:* By law, Federal grant funds may not be used to compensate researchers for the time they spend writing grant proposals. Such support must come from “non-sponsored” sources. The ROC remains concerned that the University does not have adequate funding sources for this purpose, an issue that we have raised several times in meetings with various senior administrators over the past few years.

*Benefits:* The ROC met several times with Dr. Mingfang Ting, the RO member of the Provost’s Task Force on Fringe Benefits, to discuss various issues of concern to the RO community. The ROC also provided input to the task force both electronically and at the various Town Hall meetings discussing the recommendations of the Task Force. The

ROC has been disappointed by the extent of the reductions in fringe benefits for our constituents.

*Postdoctoral issues: Postdoctoral issues:* In September 2010 the ROC met with Lily Bao Secora, Director of The Office of Postdoctoral Affairs (OPdA) to discuss a number of issues of concern to the Postdoctoral Researcher community. The main issues were the healthcare benefits and minimum stipend levels for Postdoctoral Research Fellows. The ROC discussed these issues in May 2011 with Senior Vice Provost Rittenberg, Vice Dean Taylor, and Vice Dean Kass. Upon request from Vice Dean Kaas, the HR department at the medical campus now ensures that all Postdoctoral Fellows receives the minimum stipend level according to NIH guidelines from their fellowship or with additional support from the PI. It is the goal that this arrangement becomes a university wide standard. Vice Provost Rittenberg informed the ROC that he would contact the Deans and faculty to discuss the possibility of implementing a minimum stipend levels. As of to date we have not received confirmation of a minimum stipend level and the ROC will continue to work on this issue.

*Town Hall meeting:* At an ROC Town Hall meeting at the Medical Center on June 6, 2011 at the Medical Center. The community raised concerns about impending reductions in fringe benefits, the lack of clarity in the termination policy for ROS, misunderstandings among new hires about RO job titles, and the need for non-sponsored funding sources to meet federal effort reporting regulations on the writing of research grants.

Respectfully,

University Senate Research Officers Committee

Daniel Wolf Savin, Chair, *Senior Research Scientist*, Astrophysics Laboratory

Hatim Diab, *Senior Staff Associate*, SEAS Center for Computer Learning Systems

Mona Diab, *Research Scientist*, Engineering and Applied Science

Mercy Davidson, *Senior Research Scientist*, Radiation Oncology

Guy Garty, *Research Scientist*, Center for Radiological Research

Stefan Mrozewski, *Senior Staff Associate*, Lamont-Doherty Earth Observatory

Angela D. Nelson, *Senior Staff Associate*, Medicine

Mette Skinbjerg, *Postdoctoral Research Scientist*, Psychiatry

## **Attachment A**

1. Cover letter from Provost Claude Steele
2. Salary Study of Officers of Research, Ad Hoc Advisory Committee to the Provost

# COLUMBIA UNIVERSITY

IN THE CITY OF NEW YORK

OFFICE OF THE PROVOST

May 13, 2010

Sharyn L. O'Halloran  
George Blumenthal Professor  
International and Public Affairs  
727 IAB  
MC: 3323

Dear Sharyn,

I am forwarding to you the Salary Study on Officers of Research that was recently completed by an *ad hoc* advisory committee convened by Alan Brinkley in early 2009.

The report looks at officers of research on the Morningside campus, the Health Sciences campus, and the Earth Institute as of Fall 2007. It uses descriptive statistics and multiple regression analysis to flag substantial and/or statistically significant differences in pay while controlling for individual and job-specific characteristics. The analysis looks separately at the three job families: Staff Officers of Research, Postdoctoral Officers of Research, and Professional Officers of Research. It looks only at those officers of research who hold full-time appointments and are on the University's payroll.

The report finds some evidence of statistically significant differentials in pay by gender and race/ethnicity, although these are not the same across the various campuses or job families. There is also evidence that some of these differentials are related to starting salaries.

The nature of the findings has led the *ad hoc* committee to conclude that the schools and departments should review both the current salaries of their officers of research and their processes for determining initial salaries for those officers. Consequently, I have asked schools to assess whether any equity adjustments should be made in the salaries of their full-time officers of research currently receive, given their levels of responsibility, qualifications and performance. In addition, I am requesting that they consider whether their processes for setting starting research salaries should be adjusted to help avoid the type of pay differentials identified in the report. I will be in touch with the Deans during the summer to follow up on what actions, if any, were taken in response to the report's findings. We expect to update this analysis again in the next few years.

Associate Provost Lucy Drotning or Senior Vice Provost Stephen Rittenberg are available to answer any questions that you may have about the report.

Regards,



Claude Steele

**Salary Study of Officers of Research**

**Ad Hoc Advisory Committee to the Provost**

**Columbia University**

**December 2009**

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## Executive Summary

The purpose of this study is to test for systematic pay differentials between men and women, between racial groups, across age, and between U.S. citizens/permanent residents and non-residents among Officers of Research working at Columbia University as of Fall 2007. The study looks at Officers of Research on the Morningside campus, the Health Sciences campus, and the Earth Institute.<sup>1</sup> It uses descriptive statistics and multiple regression analysis to flag substantial and/or statistically significant differences in pay while controlling for individual and job-specific characteristics.<sup>2</sup> The analysis looks separately at the three job families: Staff Officers of Research, Postdoctoral Officers of Research, and Professional Officers of Research.

The main statistically significant findings of the study are:

- There is no evidence that women Officers of Research are paid less than men except in two instances:
  - In the Staff ranks, women earn of 5-7% less than men.
  - In the Postdoctoral ranks, women have salary differentials of -3% at the Health Sciences and -2% at the Earth Institute.
  - In both cases, the effects are no longer statistically significant when starting salary is included in the model.
- There is evidence that some Asian researchers are paid less than Whites.
  - The analysis indicates that, in the Professional ranks, Asians (U.S. citizens or permanent residents) earn about 6% less than Whites if rank, which controls for job level or title within a job family, is not in the model.
  - Wages for Asian Staff researchers are 9-10% lower than for the baseline group. The difference is 4% when adjusting for starting salary in the model.
- Non-resident aliens (“NRA”) earn less than their counterparts in several cases:
  - NRA Staff researchers earn 7-11% less than White U.S. citizens or permanent residents; the effect goes away when starting salary is included in the model.
  - NRA Postdoctoral researchers have an unexplained wage gap of about 4%. There is no difference when starting salary is controlled for in the model.
  - An unfavorable wage gap of 9% was found for NRA Professional researchers compared to citizens and permanent residents when controlling for rank and 5% when controlling for starting salary.
- By campus, the analysis shows that:
  - For Staff, there are negative salary differentials in the Health Sciences for Asians and NRAs.

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<sup>1</sup> The Earth Institute is comprised of the Earth Institute, the Lamont-Doherty Earth Observatory, Center for Global Health, the International Research Institute for Climate and Society, CIESIN-Center for International Earth Science Information Network, and the Center for Climate System Research. Some units are located on the Morningside campus, some are at the Lamont-Doherty Earth Observatory in Palisades, N.Y., and some are at other locations.

<sup>2</sup> The Committee decided that it would consider criteria of both statistical and substantive significance to flag differences between comparison groups worthy of further investigation. Significance is flagged in the tables at the 0.10, 0.05, 0.01, and 0.001 levels. Substantive differences were considered noteworthy when they showed salary differentials of 5% or more, irrespective of statistical significance, if they were consistent with a pattern of findings from a group of related models.

- For Postdocs, there are salary differentials for NRAs at the Health Sciences and for Asians at Morningside and at the Earth Institute before starting salary is included.
- For Professional Researchers, there is a 10-13% negative gap for Asians at Morningside, a negative gap for NRAs of 7-8% at the Earth Institute and of 13% at the Health Sciences,

Based on these findings, the Committee recommends that:

- the Provost share this report with the Executive Vice President for Health Sciences, the Executive Vice President for Arts of Sciences, the Deans of the Morningside Professional Schools, and the Director of the Earth Institute and ask them to review current salaries and adjust where appropriate.
- the Provost ask the Executive Vice President for Health Sciences, the Executive Vice President of Arts of Sciences, the Deans of Morningside Professional Schools, and the Director of the Earth Institute to review processes for setting salaries for new employees to ensure that starting salaries are comparable, all else being equal.
- the Provost should subsequently follow up with these individuals to determine what actions, if any, were taken in response to the report's findings.
- the Provost update this analysis on a regular basis.

This study was carried out by the Offices of Planning and Institutional Research and the Senior Vice Provost for Academic Administration under the auspices of an advisory committee to the Provost established for the purposes of this study. The chair of the committee was Bruce Levin, Professor (Biostatistics) and the members of the committee were Nachum Sicherman, Professor (Business), Geraldine Downey, Vice Provost for Diversity Initiatives, Mingfang Ting, Doherty Senior Research Scientist (Lamont-Doherty) and Neeraj Kaushal, Associate Professor (Social Work). We would also like to thank Mercy Davidson, Senior Research Scientist (Neurology), Jean Howard, Vice Provost for Diversity Initiatives, Kim Kastens, Senior Research Scientist (Lamont-Doherty) Professor David Lee (Economics), Professor John Morgan (Math), Professor Dan Rabinowitz (Statistics), Maya Tolstoy, Research Scientist (Lamont-Doherty) for reviewing the earlier iterations of the study and for their advice on context, theory and methodology.

## **BACKGROUND**

In June 2001 the Morningside Salary and Promotional Equity Committee reported on their findings from a study on salary equity outside of the Health Sciences. The committee used data for Research Officers as of October 1, 2000 (N=456).

The methodology employed in the study included measures of age, years of experience and seniority, rank, and categorical variables for females, minorities, educational attainment and a dichotomous variable for each of the 35 departments outside the Health Sciences. Regressions were then run for Staff Associates and Research Scientists separately. The committee concluded that there were statistically significant salary differentials for female Research Scientists and female Staff Officers of Research. The committee was unable to pinpoint any legitimate source for these salary differentials.

This report was submitted to Jonathan R. Cole, Provost and Dean of Faculties.

In 2007, Provost Alan Brinkley formed an advisory committee to examine the current situation for Officers of Research at Columbia. This report lays out the methodology for the study, reports on the findings and makes recommendations to the current Provost based on the analysis.

## **METHODOLOGY**

Salary equity studies present various methodological issues. This study posed three particular challenges, namely:

1. Imprecision and variation of job descriptions: this represents a problem particularly within the Staff ranks, where two people with the same job title may be doing completely different work within a department. For example, it is very likely that jobs requiring IT expertise command higher salaries than those positions requiring basic lab work due to higher wages in the private sector.
2. Range of departments: As of Fall 2007, Officers of Research were employed by 100 departments throughout the university. Each department has idiosyncratic budgetary concerns and hiring practices, which complicates statistical analysis.
3. Individual productivity: Although we have proxy variables such as highest degree earned and years of experience, we lack a quantitative indicator of a measurable output from Research Officers which could be correlated with salary (such as number and quality of publications, used for salary studies on faculty).

In addition, it is important to recognize that the inherent difficulties of performing a salary equity study for any heterogeneous population are compounded by the fact that non-faculty employees have not enjoyed the same amount of scrutiny as faculty.<sup>3</sup> In particular, the sources of funding

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<sup>3</sup> "...there are very few studies of pay equity addressing non-faculty employees. Those that exist are limited to very few positions out of the countless jobs performed on campus... and much of this information has not been subjected to more rigorous empirical testing." Toutkoushian, Robert (Editor). *Conducting Salary-Equity Studies: Alternative Approaches to Research*. New Directions for Institutional Research, Number 115 Fall 2002, San Francisco, p. 32.

for Officers of Research, the wide variation in types of appointments and work responsibilities as well as recent changes in minimum salary requirement policies required great care in the initial data assembly. For this reason, the current cross-sectional study of Officers of Research employed as of Fall 2007 is an important step towards understanding their remuneration history at the University.

The preceding caveats notwithstanding, we believe that to a large extent, wages are set by market forces (supply & demand) and by individual productivity.<sup>4</sup> Since productive capacity cannot be estimated directly, educational attainment, years of experience and seniority are used as proxies. A person's rank can also be a measure of productive capacity, although some of the literature suggests that rank may actually be hiding gender and ethnic bias (a "tainted" variable). As a result, salaries within a rank may be comparable, but men and women with similar measures of productivity (experience, education) may be promoted at different rates.<sup>5</sup> For this reason, we estimate regressions without and with rank to illustrate two possible scenarios, respectively -- one where rank may introduce bias and one where rank is a gender- and race-neutral measure of productivity.

Market forces refer to the interaction of supply and demand for a specific discipline, which exert competitive pressure on wages and act independently and simultaneously to reflect individual productivity. The limited number of cases and the large number of departments that employ Officers of Research precluded the option of employing dummy (grouping) variables for each individual department. Instead, we have assumed that market forces act somewhat uniformly upon groups of disciplines, roughly along the lines of the University's official academic divisions. Similarly, we found no practical way of measuring resource constraints for individual departments or labor market differentials for different jobs under the same job title (for example a Staff Associate could be performing basic research assistance or very technical IT functions).

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<sup>4</sup> The following excerpt was extracted from the **Columbia University Faculty Handbook**: "The individual Faculties follow separate programs for determining the levels of salary appropriate to recruit and retain officers of research in their respective disciplines and for ensuring that officers with similar experience and training receive comparable salaries...Initial salaries vary according to the experience and skills of the officers. They also reflect the pattern of compensation in the officer's discipline and the level of funding provided by the grants and contracts supporting the projects on which the officer is working...Merit increases are considered once a year...Promotional increases are considered concurrently with an advancement to a higher grade of office."

<sup>5</sup> For background information on salary studies in higher education see the following references:

- a) National Study of Postsecondary Faculty; Statistical Analysis Report. National Center for Education Statistics, U.S. Department of Education, September 2002.
- b) Haignere, Lois. Paychecks: A Guide to Conducting Salary-Equity Studies for Higher Education Faculty. American Association of University Professors, Washington, DC 2002.
- c) Toutkoushian, Robert. Addressing Gender Equity in Non-faculty Salaries. Research in Higher Education, Vol.41, No.4, 2000.
- d) Toutkoushian, Robert (Ed). Conducting Salary-Equity Studies: Alternative Approaches to Research. New Directions for Institutional Research. Number 115, Fall 2002.
- e) Toutkoushian, Robert (Ed). Unresolved Issues in Conducting Salary-Equity Studies. New Directions for Institutional Research. Number 117, Spring 2003.

## Dataset

The analysis uses data for all full-time, salaried Officers of Research with appointments as of Fall 2007. The data excludes almost 100 part-time Officers of Research and about 1,800 Officers of Research whose salaries are externally determined and not affected by university policy.

Frequency data, organized by campus, is summarized in Table 1.

**Table 1. Fall 2007 Full-time, Salaried Officers of Research by Job Family and Work Location**

	Job Family			Total
	Staff	Postdocs	Researchers	
<b>Health Sciences</b>				
Count	252	311	390	953
% within campus	26.4%	32.6%	40.9%	100.0%
% of Job Family	66.3%	54.3%	58.9%	59.0%
<b>Morningside</b>				
Count	57	216	148	421
% within campus	13.5%	51.3%	35.2%	100.0%
% of Job Family	15.0%	37.7%	22.4%	26.1%
<b>Earth Institute</b>				
Count	71	46	124	241
% within campus	29.5%	19.1%	51.5%	100.0%
% of Job Family	18.7%	8.0%	18.7%	14.9%
<b>Total Count</b>	<b>380</b>	<b>573</b>	<b>662</b>	<b>1,615</b>
<b>Total % within campus</b>	<b>23.5%</b>	<b>35.5%</b>	<b>41.0%</b>	<b>100.0%</b>
<b>Total % of Job Family</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

A total of 1,615 Officers of Research are included in the study. Of these, 953, or almost 60%, work at CUMC, 26% on Morningside, and about 15% are at the Earth Institute. Twenty-four percent are Staff, 36% are Postdocs, and 41% are Professional Researchers.

The following variables were employed in the study:

### Dependent Variable

#### Salary

The main variable of interest in the analysis is the base salary of the employee as of Fall 2007.

All of the regressions in the study use the natural log of base salary as their dependent variable. This is a standard approach used in salary studies to address non-linearities in the data created by the multiplicative nature of salary increases and the presence of positive outliers.

## **Independent Variables**

### ***Employee Characteristics***

#### Gender:

Women were coded as 1 and men as 0.

#### Race:

Dummy variables were created for Hispanics, Blacks and Asians who are U.S. citizens and permanent residents.

#### US Residency Status:

Non-resident aliens of all racial groups were considered separately, in conformity with federal reporting guidelines. U.S. citizens and permanent residents (green-card holders) are compared to Officers of Research under any visa status (EA, F-1, G-1, H-1B, J-1, O-1, PL, SP and TN). The dummy variable NRA is coded as 1 for non-resident aliens and 0 for citizens and permanent residents.

### ***Rank***

Officers of Research can be assigned to three populations with different general profiles: Staff, Postdoctoral and Professional Research Scientists and Scholars. Staff includes Staff Associates and Senior Staff Associates. Postdocs is its own category, and Professional Researchers includes Associate Research Scientists and Scholars, Research Scientists and Scholars and Senior Research Scientists and Scholars. Rank was coded as follows:

*Staff:* Staff researchers were left as is: Staff Associate and Senior Staff Associate. This is, in some sense, its own pipeline because Staff Officers of Research generally do not move up the ranks into the Research Scientists group.

*Postdocs:* Includes Postdoctoral Research Scientists and Scholars. Postdoctoral appointments are limited by University policy to no more than five years. Most leave the University after completing their appointment. Those who remain are typically appointed as Associate Research Scientist.

#### *Professional Research Scientists:*

Associate Research Scientists: Includes Associate Research Scientists and Scholars, as well as Named Associate Research Scientists and Scholars.

Research Scientists: Includes Research Scientists and Scholars, as well as Named Research Scientists and Scholars.

Senior Research Scientists: Includes Senior Research Scientists and Scholars, as well as Named Senior Research Scientists and Scholars.

## Experience

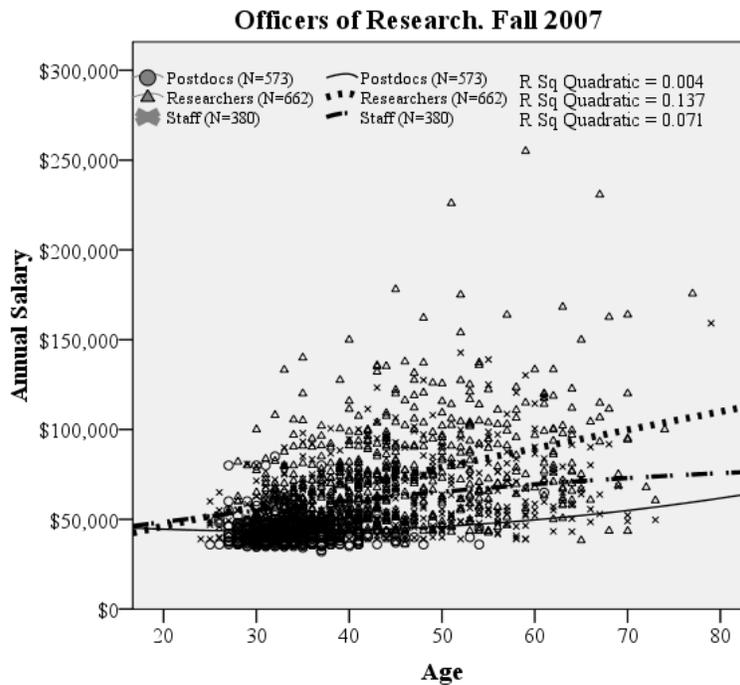
### Education:

Educational attainment is included in the analysis as a proxy for productivity. While Staff may have a range of educational degrees, the majority of scientist or scholar officers possess a Ph.D. or its equivalent, but enough variation exists for this variable to have explanatory power and thus be included in the model. The different academic degrees reported in the raw Human Resources data were grouped, and the resulting categories were Bachelors or less, Masters Degree, Professional Degree and Ph.D.

### Age:

Although age is highly correlated with years of experience, it is a common demographic variable included in the majority of salary studies. For the purposes of this analysis, Age is calibrated for each person as the Age minus 40 divided by 10; forty is the benchmark set by the *Equal Employment Opportunity Commission* protecting individuals over 40 from employment discrimination based on age. A quadratic term, Age\_SQ was included to capture any non-linear impact of age on salary. Figure 1 below illustrates this relationship by job family. The p-value for the quadratic coefficients are indicated by "R Sq Quadratic" in the figure legends.

**Figure 1.**

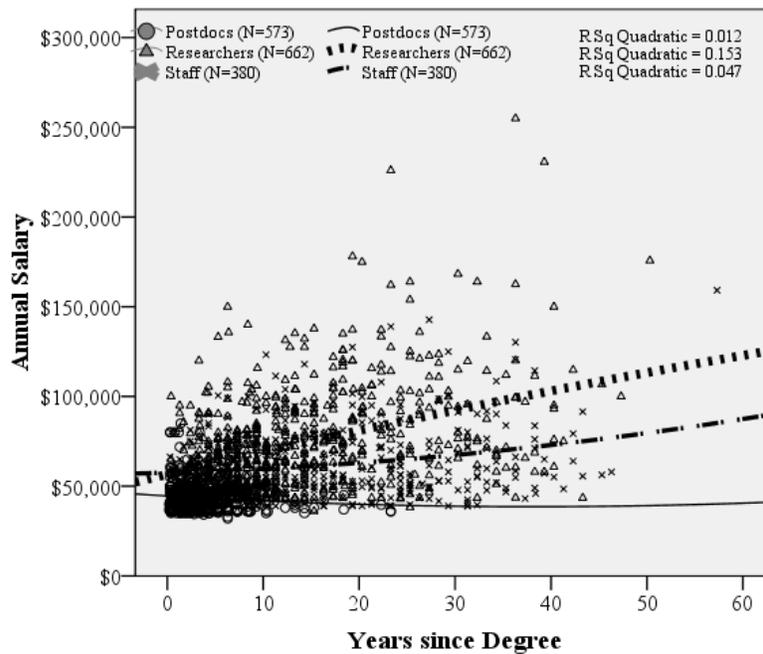


### Years Since Degree:

Although individual employment histories may be inconsistent and contain gaps, we took the number of years since attainment of the person's highest degree as a proxy for work experience. In addition, we considered the possibility that there are decreasing marginal returns to salary as Years Since Degree increases. See Figure 2 below.

**Figure 2.**

**Officers of Research. Fall 2007**

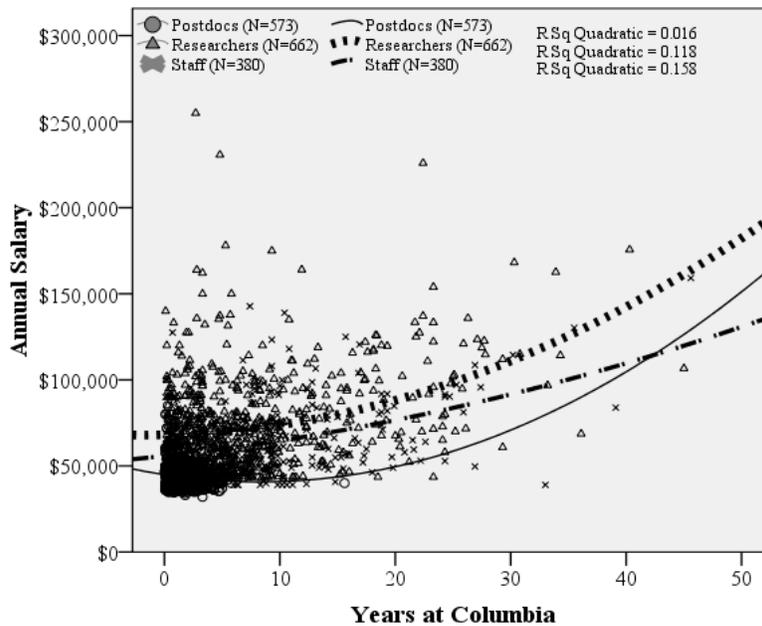


Years at Columbia:

The number of years as a university employee is included as a proxy of “job-specific” knowledge. A scatterplot for salary as a function of seniority revealed a clearly quadratic relation (see Figure 3). A quadratic term was included in the regression.

**Figure 3.**

**Officers of Research. Fall 2007**



As with Age, Years Since Degree and Years at Columbia are both divided by 10 to facilitate the interpretation of the impact of these measures.

### ***Market Effects***

We created groups of departments to control for market forces for a particular set of disciplines. These categories are similar to the academic structure of the university. We used our judgment in assigning centers and interdisciplinary institutes to one of the academic divisions. The Earth Institute and its affiliated centers employ a large number of Officers of Research, and were set as one category. The set of institutional divisions include: Humanities & Social Sciences, Natural Sciences, School of International and Public Affairs, Morningside Professional Schools (other than Engineering), Engineering, Basic Health Sciences, Clinical Health Sciences, and Public Health.

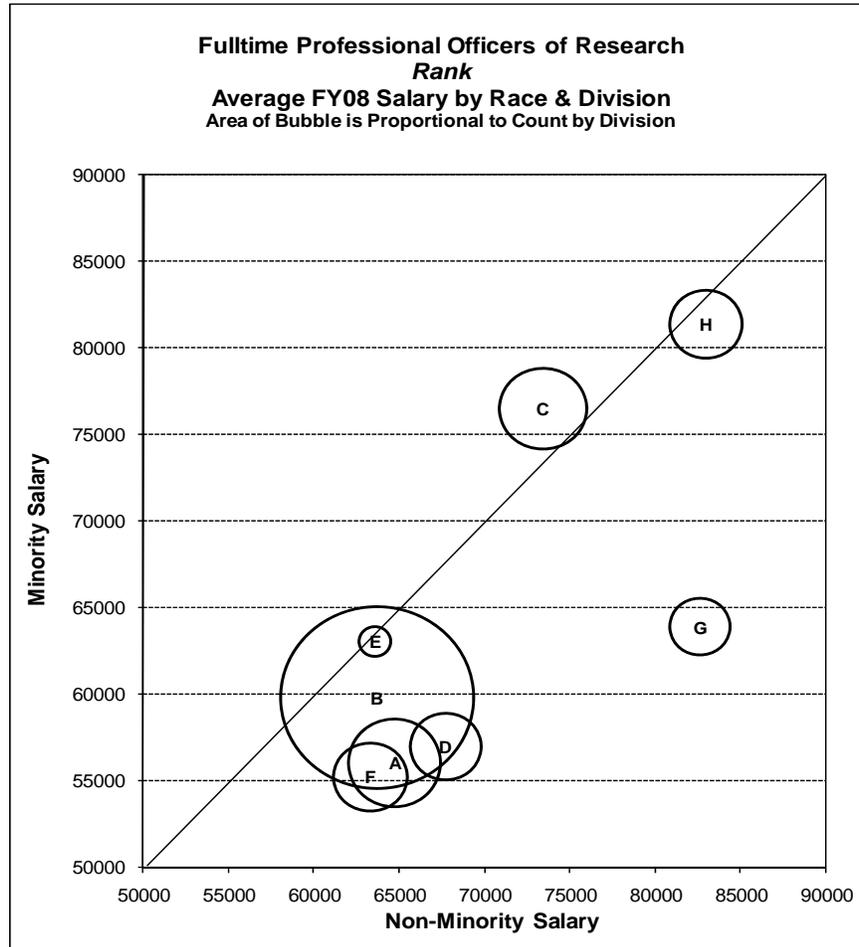
### ***Starting Salary***

When studying salary discrepancies over time, it is useful to discern if existing pay gaps are the result of inequitable starting salaries or differences in salary increases over time. To answer this question, we included the log of starting salary as an independent variable in one of the specifications of the model. It stands to reason that an employee's current salary (the independent variable) will be largely determined by their salary when first starting as an Officer of Research because the dollar amount of subsequent salary increases which are given in percentage terms are a function of starting salary. By comparing regression models with and without starting salary, one can tell if the differences in salary between men and women and race groups may be explained by differences in starting salary, e.g., if differentials disappear when starting salaries are included in the models. If shortfalls persist even when starting salaries are included, this may reveal differential rates of salary growth over time. A separate analysis of starting salaries was not undertaken because data from employees no longer at Columbia would have been required but not readily retrieved.

### **Bubble Charts**

Bubble charts are an effective way to illustrate variation in salary. These charts provide a quick visual snapshot of the extent to which average salary for a group varies compared to another group. In the hypothetical example below, average salary for minorities is compared the average salary for non-minorities by academic division for the Associate Research Scientist rank.

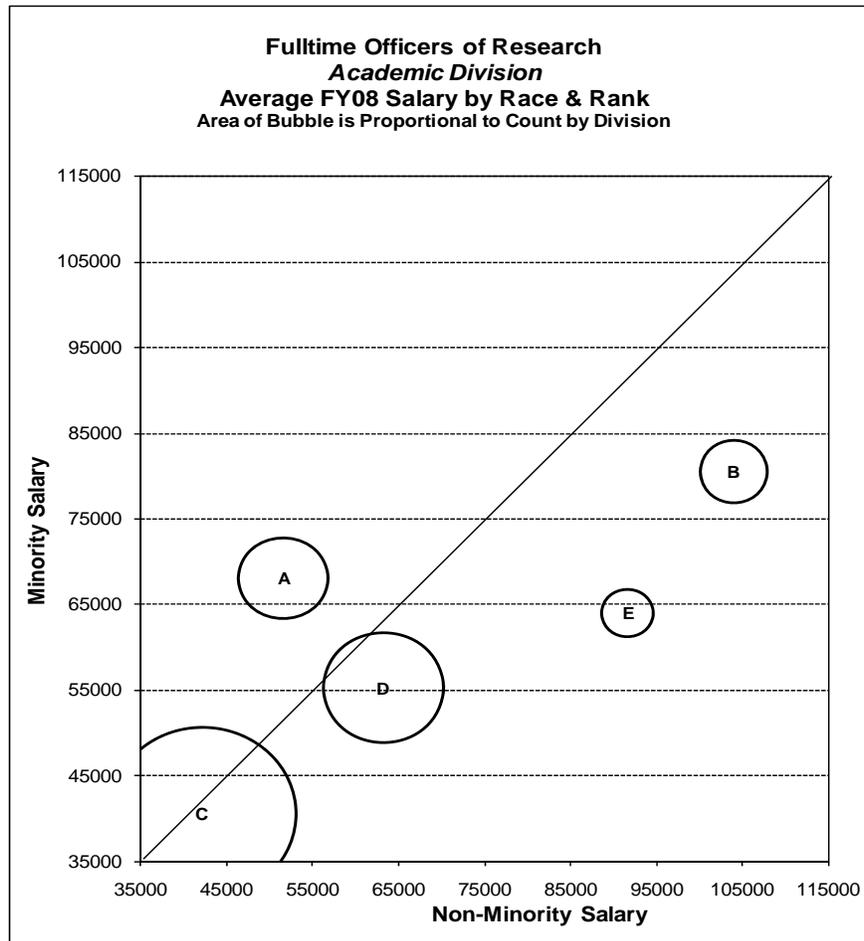
Figure 4.



The size of the bubble is proportional to the representation of that group overall. For example, bubble “B” represents 155 people and bubble “C” represents 31 people. In addition, bubble “C” is very close to the 45° line which indicates that the average salaries for the two groups are comparable. Bubble “G,” on the other hand, is below the 45° line and tells us that the average salary for minority Associate Research Scientists is lower than for non-minorities in this academic division.

Figure 5 facilitates comparisons of minorities and non-minorities by rank within an academic division. In this example, minorities and non-minorities make comparable average salaries in Divisions C and D. But, in Divisions E and B, minorities make less on average than non-minorities. In Division A, the average salary for minorities is higher than that for non-minorities.

**Figure 5.**



The committee looked at the Officer of Research data using the bubble charts to compare across three groups: Minority/Non-Minority, NRA/U.S. Citizens, and Men/Women. They analyzed each group by academic division and by Rank. By portraying them in both ways, the committee was able to identify which division(s) might have equity issues for Officers of Research within a given rank and which ranks might have equity issues in an academic division. This information helped shape the regression methodology used in the study.

### **Robust Regression**

Robust regression analysis was performed separately on the three Officer of Research job families. Robust regression can be used in any situation in which there are data points that might be considered outliers, but they are not points that are data entry errors or from a different population than the rest of the data. There is no reason to exclude them from the analysis, but it is desirable to weight them differently than the other observations.<sup>6</sup>

<sup>6</sup> Robust regression is a compromise between deleting these points, and allowing them to violate the assumptions of OLS regression. For more details, see Introduction to SAS. UCLA: Academic Technology Services, Statistical Consulting Group from [http://www.ats.ucla.edu/stat/Stata/output/stata\\_robust.htm](http://www.ats.ucla.edu/stat/Stata/output/stata_robust.htm) (accessed October 14, 2009).

Several models were specified for Staff, Postdocs, and Professional Researchers. Within each population, regressions were run by campus. The three campuses in the analysis are: Health Sciences, Morningside, and the Earth Institute.<sup>7</sup>

Following is an overview of the models specified and the rationale behind them, which is also portrayed in Table 2 below:

**Table 2.**  
**Robust Regression: Determinants of Salary**  
**ALL CAMPUSES & DIVISIONS**  
*Dependent Variable is the Natural Log of Base Annual Salary as of Fall 2007*

	Model (1)	Model (2)	Model (3)	Model (4)
Female	X	X	X	X
Asian	X	X	X	X
Black	X	X	X	X
Hispanic	X	X	X	X
Non-resident Alien	X	X	X	X
Controls for:				
Experience (age, years since degree, years at Columbia); Education (highest degree); Market Effects (institutional Divisions)	X	X	X	X
Experience (quadratic forms)		X	X	X
Rank (not applicable for Postdocs)			X	X
Starting Salary				X

- Model 1: This is the “bare bones” model containing the basic demographic and experience variables and dummies for each academic division
- Model 2: Model 1 plus the square terms for age and seniority
- Model 3 (for Staff and Research Scientists only): Model 2 plus a dummy variable for Senior Staff Associate in the case of Staff, and Researcher and Senior Researcher in the case of Research Scientists. This model was not run for Postdocs because there is no rank variable for this job family.
- Model 4: Model 3 plus the log of starting salary. As explained above, this variable is added to add explanatory power to the model and to determine whether salary discrepancies are a result of gaps in starting salaries, different rates of salary growth or both.

<sup>7</sup> As described in an earlier footnote, the Earth Institute is not formally a campus as several of its units are on the Morningside campus and others are located at the Earth Observatory, but it can be considered one for the purposes of salary.

The natural log of salary is the dependent variable for all the models. The interpretation of the regression is the percentage change in salary for one unit change in the independent variable. More precisely, the interpretation of the regression coefficient corresponding to an independent variable is, approximately, the percentage change in the average (geometric mean) salary corresponding to a one unit change in the independent variable. We measure statistical significance at the four widely-used levels across the social sciences: .10, .05, .01 and .001.

*Caveats:* It is important to note that changes between Models 2 and 3, where rank is included, are difficult to interpret because of the possibility that promotions from one rank to the next are not unbiased. Similarly, the inclusion of Log of First Salary in Model 4 must be interpreted with care. The assumption for this analysis is that there are no differences across Race, Residency Status, or Gender in the determination of starting salaries.<sup>8</sup>

## **FINDINGS**

### **Descriptive Statistics**

Men and women differ from each other not only in their salaries, but also in some of the variables correlated with productivity such as experience and seniority. The raw differences in average salaries and average measures of experience for males and females are presented in Table 3a, and for race/citizenship groups in Table 3b.

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<sup>8</sup> If any subsequent reviews of these measures reveal problems, they should be taken into account in future salary studies for Officers of Research. In the case of any analysis of starting salaries, the most convincing analysis would include, if possible, all employees in a particular entering cohort, even those who have since left the institution. Ideally, such an analysis would also take into account the nature of previous positions and specialized expertise required of specific positions.

**Table 3a. Average Salary and Experience by Gender and Job Family**

	Gender		Total
	Female	Male	
<b>Staff</b>			
Count	217	163	380
% in Job Family	57.1%	42.9%	100.0%
Average Salary	59,114	66,539	62,299
Average Age	44.3	44.8	44.5
Avg Years Since Degree	15.9	16.9	16.3
Avg Years at Columbia	6.2	7.8	6.9
<b>Postdocs</b>			
Count	228	345	573
% in Job Family	39.8%	60.2%	100.0%
Average Salary	43,694	43,531	43,596
Average Age	34.0	33.8	33.9
Avg Years Since Degree	3.7	3.4	3.5
Avg Years at Columbia	1.5	1.6	1.6
<b>Researchers</b>			
Count	243	419	662
% in Job Family	36.7%	63.3%	100.0%
Average Salary	69,156	75,833	73,382
Average Age	43.0	46.0	44.9
Avg Years Since Degree	12.1	14.7	13.8
Avg Years at Columbia	6.2	7.7	7.1
<b>Total Count</b>	<b>688</b>	<b>927</b>	<b>1615</b>
<b>Total % in Job Family</b>	<b>42.6%</b>	<b>57.4%</b>	<b>100.0%</b>
<b>Total Average Salary</b>	<b>57,551</b>	<b>62,177</b>	<b>60,206</b>
<b>Total Average Age</b>	<b>40.4</b>	<b>41.2</b>	<b>40.9</b>
<b>Total Avg Years Since Degree</b>	<b>10.5</b>	<b>10.9</b>	<b>10.7</b>
<b>Total Avg Years at Columbia</b>	<b>4.6</b>	<b>5.4</b>	<b>5.1</b>

The average salary in Table 3a is lower for women than for men for Staff and Professional Researchers. In addition, Years Since Degree and Years at Columbia for Staff and Age, Years Since Degree, and Years at Columbia for Research Scientist/Scholars are lower for women than for men. The measures for Postdocs are all fairly comparable for men and women.

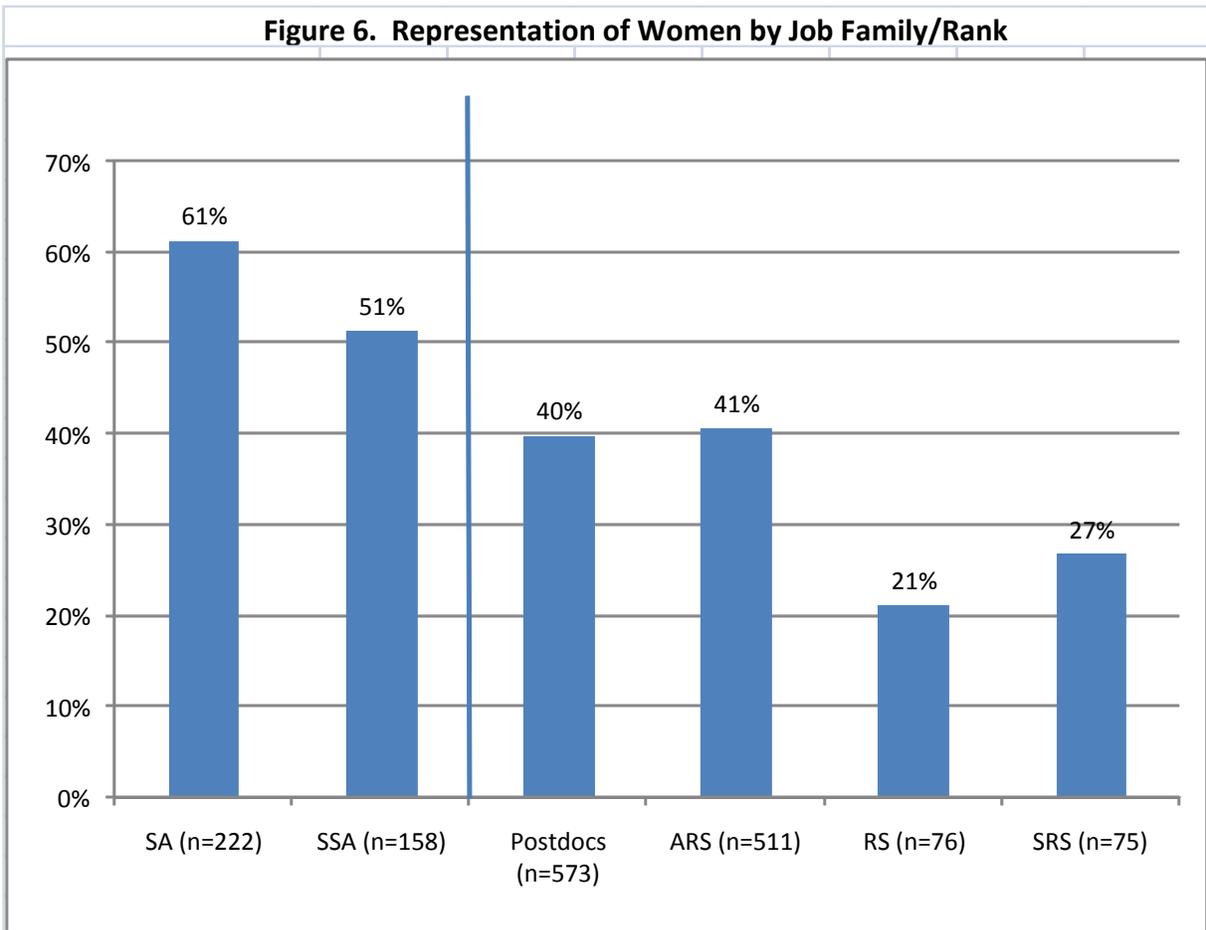
Table 3b compares average salary and experience measures across racial groups and non-resident aliens. For Staff, the salary for NRAs is almost \$14,000 less than Whites; the experience measures for NRAs are lower as well. Asian Staff also have a gap in salary, but Age and Years Since Degree are higher than for Whites. There are similar differences for Professional Researchers. Differences across racial groups for Postdocs are not big due to the nature of the appointment.

**Table 3b. Average Salary and Experience by Race/Citizenship and Job Family**

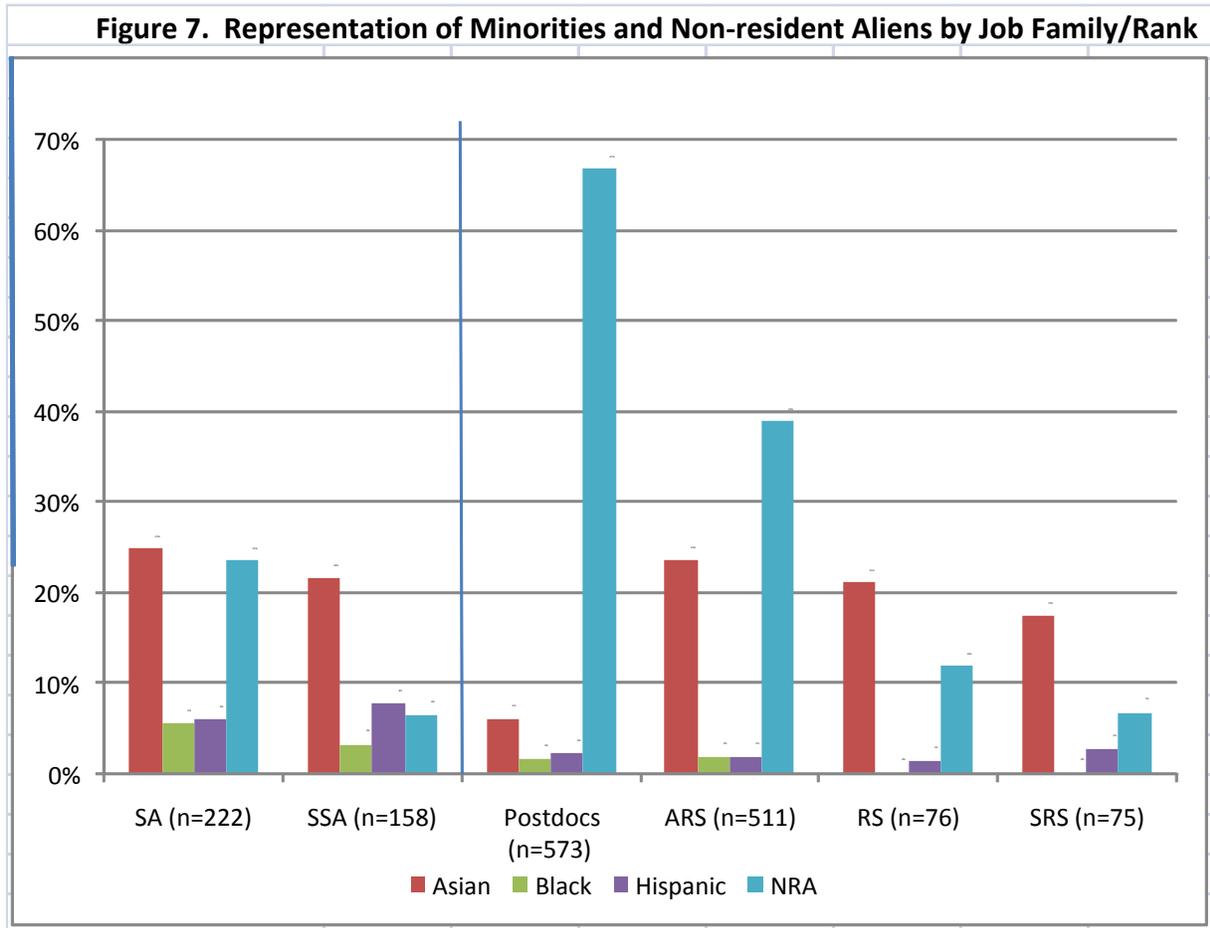
	Race/Citizenship					Total
	Asian	Black	Hispanic	White	NRA	
<b>Staff</b>						
Count	89	17	25	187	62	380
% in Job Family	23.4%	4.5%	6.6%	49.2%	16.3%	100.0%
Average Salary	56,737	56,135	61,312	68,260	54,392	62,299
Average Age	47.2	43.4	41.0	46.1	37.6	44.5
Avg Years Since Degree	19.3	13.2	14.5	17.6	10.0	16.3
Avg Years at Columbia	7.1	6.4	5.4	8.3	3.0	6.9
<b>Postdocs</b>						
Count	34	9	12	136	382	573
% in Job Family	5.9%	1.6%	2.1%	23.7%	66.7%	100.0%
Average Salary	42,289	43,742	44,876	47,314	42,345	43,596
Average Age	37.3	33.8	34.4	33.5	33.7	33.9
Avg Years Since Degree	4.9	2.6	3.6	2.9	3.6	3.5
Avg Years at Columbia	2.9	1.3	1.4	1.4	1.5	1.6
<b>Researchers</b>						
Count	149	9	12	280	212	662
% in Job Family	22.5%	1.4%	1.8%	42.3%	32.0%	100.0%
Average Salary	68,993	73,613	76,729	81,907	65,008	73,382
Average Age	45.9	44.1	46.8	48.3	39.6	44.9
Avg Years Since Degree	14.5	8.2	14.7	17.0	9.1	13.8
Avg Years at Columbia	8.0	2.6	6.8	9.7	3.4	7.1
<b>Total Count</b>	<b>272</b>	<b>35</b>	<b>49</b>	<b>603</b>	<b>656</b>	<b>1615</b>
<b>Total % in Job Family</b>	<b>16.8%</b>	<b>2.2%</b>	<b>3.0%</b>	<b>37.3%</b>	<b>40.6%</b>	<b>100.0%</b>
<b>Total Average Salary</b>	<b>61,645</b>	<b>57,442</b>	<b>61,063</b>	<b>69,873</b>	<b>50,808</b>	<b>60,206</b>
<b>Total Average Age</b>	<b>45.3</b>	<b>41.1</b>	<b>40.8</b>	<b>44.3</b>	<b>36.0</b>	<b>40.9</b>
<b>Total Avg Years Since Degree</b>	<b>14.9</b>	<b>9.2</b>	<b>11.9</b>	<b>14.0</b>	<b>6.0</b>	<b>10.7</b>
<b>Total Avg Years at Columbia</b>	<b>7.0</b>	<b>4.1</b>	<b>4.8</b>	<b>7.4</b>	<b>2.2</b>	<b>5.1</b>

Two common explanations for gender gaps in pay rely on the concentration of women in lower ranks. As can be seen from Figure 6, the proportion of women in the Staff ranks is much higher than in the Research Scientist ranks. In fact, the representation of women decreases as one goes up the ranks.

That being said, it is important to recognize that it is unlikely that a Staff Associate would become a Professional Researcher. Within the Staff ranks, the percentage of women decreases between the two rank categories, Staff Associate and Senior Staff Associate, from 61% to 51%. Postdocs and Associate Research Scientists ranks are about 40% female while the higher ranks, Research Scientists and Senior Research Scientists are 21% and 27% female, respectively.



The picture for minorities and non-resident aliens is similar, as Figure 7 illustrates, though some of the percentages are small. The representation of these groups decreases as one goes up the ranks, particularly within the Professional Researcher groups. Asians are 23.5% of the Associate Research Scientists and 17% of the Senior Research Scientists. Non-resident aliens are 67% of the Postdoctoral researchers, and minorities are about 10%.



### Regression Analysis

Using the methodology described earlier, robust regression analysis was performed on the three Officer of Research job families. A number of models were specified for Staff, Postdocs, and Professional Researchers and within each population regressions were run by campus: Health Sciences, Morningside, and the Earth Institute. The discussion of the results below focuses on situations where a group earning statistically significantly less than the base group and notes where findings may be substantively significant, or positive. The results should be considered statistically significant at least at the .10 level unless otherwise indicated.

## Staff Officers

The analysis for Staff researchers yields several findings:

- We find evidence of salary differences for women of 5-7% less than men.
- We also find indications of wage gaps for Asian (9-10%) and non-resident alien (7-11%) Staff researchers.
- All else equal, controlling for starting salary lessens the differences for women and Asians, which implies that differences in current salary may be related to differences in starting salaries. For women, the difference is mitigated by adjusting for starting salary. For Asians, the difference is 4% and is still statistically significant.
- By campus, the analysis finds a salary differential for Asians and NRAs in the Health Sciences. For NRAs, the differential is no longer statistically significant when starting salary is in the model.

*Model 1:* When rank is excluded, several predictors showed a statistically significant relationship with current salary compared to our baseline group (White, US citizen or permanent resident, male with a Bachelor's or less and working in the Clinical Health Sciences (CHS)). All else equal, Female Staff researchers make about 7% less than men. Asian Staff researchers make almost 10% less than their non-Asian colleagues with comparable characteristics. Model 1 also shows that non-resident aliens make 11.2% less than U.S. citizens and permanent residents. This model explains 29.1% of the variation in salary.

*Model 2:* Adding quadratic terms to the model does not change the coefficients of interest or their magnitude in any important way. This model explains 29.5% of the variation in salary.

*Model 3:* Adding a variable for Rank, a Senior Staff Associate earns 27.1% more than an otherwise identical Staff Associate. The coefficients for female, Asian and NRA remain statistically significant when rank is introduced to the model though coefficients diminish in magnitude. This model explains 44.5% of the variation in salary.

*Model 4:* The interpretation for the Log of starting salary coefficient is not straightforward,<sup>9</sup> and it is introduced in order to parse out the two components of current salary: starting salary and salary increases. In particular, if a coefficient loses significance from Model 3 to Model 4, one can assert that the observed discrepancy in current salary was produced by a gap in starting salary, and not in the rate of salary increase. Predictors that remain significant once the starting salary variable has been introduced suggest that starting salaries AND salary raises over time are different for this group.<sup>10</sup> For Staff, Asians are shown to make about 4% less than Whites all

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<sup>9</sup> In this analysis, a starting salary that is 1% higher than another employee's, all else equal, results in a .819% increase in Fall 2007 salary. When comparing the log of an independent variable (starting salary) to the log of a dependant variable (current salary) the impact is already expressed as a percentage, so the decimal point need not be adjusted.

<sup>10</sup> The relationship between starting salary and current salary is not one to one because there is variability in the rates of promotion, department of employment and other factors that are accounted for in the error term  $\epsilon$ . For example, two "identical" employees in 2007 hired in 1995 may have been promoted in different years, so that the differences in their current salaries is partly due to differences in starting salaries and partly to other factors. As can be expected, the relationship between starting salaries and current salaries weakens over time.

else equal when starting salary is included in the analysis. The effects found in the previous models for women and NRA's are no longer statistically significant. This model explains 84.6% of the variation in current salary.

*Models 3 and 4 By Campus:* Analysis of Models 3 and 4 show that both Asian and NRAs have statistically significant coefficients greater than 5% in the Health Sciences. At the Earth Institute NRAs also have a statistically significant and positive coefficient greater than 5%; Hispanics are greater than 5% and negative but not statistically significant. On the Morningside campus, Female and Hispanic are greater than 5% but not statistically significant. Similarly, the coefficient for Black is greater than 5% at the Health Sciences and the Earth Institute, but it is never statistically significant. When starting salary is included, these effects are smaller except in the case of NRAs at the Earth Institute where their salary differential is positive.

### **Postdoctoral Officers**

The analysis of Postdocs reveals that:

- Non-resident aliens have about 4% lower salaries than U.S. citizens/permanent residents.
- Women have a salary differential of 2%.
- By campus, there are salary differentials for NRAs at Health Sciences; Asians at Morningside and at the Earth Institute. For women, there is a statistically significant salary differential of less than 5% at the Health Sciences and the Earth Institute.
- Controlling for starting salary lessens the differences all else equal. This implies that differences in current salary may be related to differences in starting salaries which is consistent with the reality that Postdocs only stay in these positions for 2-5 years.

*Model 1:* According to the model, an NRA makes 4.2% less than an identical U.S. citizen or permanent resident. Women make about 2% less than men. The baseline group includes white, male, U.S. citizen or permanent resident with a Bachelors degree in the Clinical Health Sciences.

*Model 2:* Adding quadratic terms for age and seniority did not lessen the coefficients in the model, but the coefficient for women is no longer statistically significant at the .10 level.

*Model 4:* A 1% increase in starting salary results in a .940% increase in current salary. With the addition of starting salary to the model, the coefficient for NRA's is much smaller and no longer statistically significant. This suggests that the salary differential in current salary for NRAs is explained by starting salary.

*Models 2 and 4 By Campus:* Analysis of Model 2 for the Health Sciences, Morningside, and Earth Institute show that both Females and NRAs (greater than 5%) have statistically significant coefficients in the Health Sciences. Asians have statistical significant coefficients at Morningside (greater than 5%) and the Earth Institute (positive). The coefficient for Black is greater than 5% on Morningside, but it is not statistically significant. In all cases, the magnitude of the coefficient is smaller and no longer statistically significant in Model 4 once starting salary is included.

## Research Scientists

- This set of models provides no evidence that women systematically have lower salaries than men.
- In addition, Asians do not have relatively lower salaries when controlling for rank and starting salary.
- The analysis indicates that there is a 13-15% wage gap for Hispanic Research Scientists that decreases to 8% and is no longer statistically significant when starting salary is added to the model.
- The analysis also shows that NRAs are paid 9% less than citizens and permanent residents when controlling for rank and 5% when also controlling for starting salary.
- By campus, there is a 20% gap for Hispanics at the Health Sciences, a 10-13% gap for Asians at Morningside and a 7-8% gap for NRAs at the Earth Institute. The analysis by campus indicates that NRAs at the Health Sciences have salaries lower than the baseline group much of which may be attributed to lower starting salaries.

*Model 1:* The baseline individual for this group is a White U.S. citizen or permanent resident male with a Bachelors degree and working in the Clinical Health Sciences. Asians, Hispanics and non-resident aliens receive salaries that are 6.0%, 13.8% and 9.4%, respectively, lower than the baseline group.

*Model 2:* Adding quadratic terms to the model does not change our coefficients of interest or their magnitude in any important way. This model explains 41.6% of the variation in salary.

*Model 3:* Once rank is controlled, the coefficient for Asian is 3.7% and no longer statistically significant. The coefficients for Hispanic and NRAs are slightly smaller but still statistically significant.

*Model 4:* An additional 1% in starting salary increases current salary by .526%. In the case of NRA's, where the coefficient is 4.7%, both their initial pay and pay increases are less than those of the White baseline group.

*Models 3 and 4 By Campus:* For Model 3 in the Health Sciences, Blacks, Hispanics and NRAs have statistically significant coefficients greater than 5%. The coefficients for Black & Hispanic are still greater than 5% when starting salary is included, but no longer statistically significant; the coefficient for NRA is no longer larger than 5% or statistically significant. At Morningside, Asians have a statistically significant coefficient, and it is greater than 5%. The coefficient for Hispanic is greater than 5% on Morningside, but it is not statistically significant. These patterns hold when starting salary is added. At the Earth Institute, NRAs have a statistically significant coefficient greater than 5% even when controlling for starting salary in Model 4.

## **RECOMMENDATIONS**

1. We recommend that the Provost share this report with the Executive Vice President for Health Sciences, the Executive Vice President for Arts of Sciences, the Deans of the Morningside Professional Schools, and the Director of the Earth Institute and ask them to review current salaries and adjust where appropriate.
2. We recommend that the Provost ask the Executive Vice President for Health Sciences, the Executive Vice President of Arts of Sciences, the Deans of Morningside Professional Schools, and the Director of the Earth Institute to review processes for setting salaries for new employees to ensure that starting salaries are comparable all else equal.
3. We recommend that the Provost should subsequently follow up with these individuals to determine what actions, if any, were taken in response to the report's findings.
4. We recommend that the Provost update this analysis on a regular basis.