THE STATUS OF
WOMEN IN STEM:
RETENTION & PROMOTION

UCLEAF
Leadership, Empowerment and Advancement for Women Faculty

Funded through a grant from the National Science Foundation's ADVANCE Institutional Transformation Program
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TABLE OF CONTENTS

Introduction .................................................................................................................. 2
Terms ................................................................................................................................. 2
Overview ......................................................................................................................... 2
Gender Differences in Retention and Advancement .................................................. 3
    Assistant Professors .................................................................................................. 3
    Associate Professors ................................................................................................. 4
Gender Differences in Productivity ........................................................................... 5
    Beginning Assistant Professors .............................................................................. 5
    Last Year in Rank as Assistant Professors ............................................................ 5
    Assistant Professors Who Leave UC ................................................................... 6
    First Year in Rank as Associate Professor ............................................................ 6
    Last Year in Rank as Associate Professor ............................................................ 7
Gender Differences in Grantsmanship and Commercialization ............................. 7
    Proposals .................................................................................................................. 7
    External Awards ..................................................................................................... 8
    Women as Principal Investigators ....................................................................... 9
    Funding Differences by Discipline ...................................................................... 11
    Funding for Commercialization ......................................................................... 12
Appendix A ................................................................................................................... 13
INTRODUCTION

In 2015, UC LEAF published *The Status of Women in STEM at UC (Main Campus)*, which analyzed the status of women in STEM on UC’s main campus over the past 25 years and offered analysis of trends not previously examined, including time to promotion and rates of departure. The report illustrated that pre-tenure women faculty in STEM depart the institution at significantly higher rates than men. One common assumption is that faculty who leave R-1 institutions prior to tenure do so because of issues with productivity and thus concerns about achieving tenure. The purpose of this report is to examine more closely differences in faculty productivity as measured by publication rates, H-indices, citations rates, grantmanship, and technology transfer across the careers of faculty in STEM at UC.

UC LEAF

LEAF is a university initiative funded by a National Science Foundation (NSF)’s ADVANCE Institutional Transformation Grant. The goal of NSF’s ADVANCE program is to develop systemic approaches to increasing the representation and advancement of women in academic STEM careers. UC LEAF’s mission is to ensure the university provides an environment that promotes the advancement of women and underrepresented minority faculty in the STEM disciplines on UC’s main campus.

TERMS

STEM Faculty

This report includes data on all faculty represented by the AAUP in NSF-defined STEM departments. These include faculty in the Colleges of Arts and Sciences (A&S), Business (COB), Engineering and Applied Science (CEAS), and Medicine (COM). Data covering other faculty are also occasionally provided for comparison.

A&S STEM units included in this report: Anthropology, Biological Sciences, Chemistry, Communication, Geography, Geology, Mathematical Sciences, Philosophy, Physics, Political Science, Psychology, and Sociology. COB STEM includes Economics. CEAS STEM units include all departments in the college. COM STEM units include: Cancer Biology; Environmental Health; Molecular and Cellular Physiology; Molecular Genetics, Biochemistry, and Microbiology; and Pharmacology and Cell Biophysics. In this report, Economics is treated as if it has been in COB since 1989, though it previously was in A&S; Computer Science is treated as if it has been in CEAS since 1989, though it too used to be in A&S; and Organization Leadership is treated as if it has always been in Psychology, though it used to be an independent center and before that was embedded in Economics. Faculty currently in any of these units but who were originally hired in University College or the College of Applied Science have been excluded from this analysis.

OVERVIEW

Efforts to increase the representation of women faculty in STEM often focus on recruitment. However, recruitment is only half the battle. The retention and promotion of the women who do come to UC is the other half. Accordingly, this report examines differences in the research productivity of men and women from the time of hire and through promotion to full professor as well as gender differences in grantmanship and commercialization activities.
The data tell us that in the STEM disciplines:

- Women begin their careers at UC as assistant professors with publication records essentially equivalent to those of men.
- Women are more likely to leave before getting tenure; however, their research productivity is not different from men.
- Despite similar productivity rates, women are far less likely to achieve tenure than men and more likely to move into administrative, staff, and teaching positions.
- Women are less likely than men to leave UC after reaching the rank of associate.
- Women and men who stay at UC past tenure obtain promotion to full at about the same rates, but women markedly outperform men at the time of promotion.
- In general, women get fewer grants but receive larger grants (though this varies by college).
- There are no gender differences in commercialization activities.

**GENDER DIFFERENCES IN RETENTION AND ADVANCEMENT**

**Assistant Professors**

As shown in Figure 1, 73% of women hired as assistant professors in STEM leave their tenure track position before coming up for tenure. While 51% leave the university entirely, 22% switch to Educator or non-faculty roles (i.e., administration, staff). In contrast, only 54% of men leave their tenure track positions, with 43% leaving UC and 11% moving into Educator or non-faculty positions.

*Figure 1: Assistant Professor Retention and Promotion Patterns*

![Figure 1: Assistant Professor Retention and Promotion Patterns](image)

*Note: Data represent position after the 6th year of appointment for 108 men and 74 women hired between 2005 and 2015 at the rank of assistant professor.*

A review of the timing of turnover also reveals subtle gender differences. Figure 2 shows the cumulative percentage of faculty leaving UC over the first six years of their appointments as assistant professors. As shown in the figure, men leave at slightly higher rates in the first two years of appointment. However, after year 2 the
rate of turnover for women increases markedly such that by the end of year 4, women leave at higher rates than men. By the end of year six, more women than men have left UC.

Figure 2: Timing of Turnover for Assistant Professors

![Figure 2: Timing of Turnover for Assistant Professors](image)

**Associate Professors**
For faculty who achieve tenure, the advancement and retention patterns for men and women change. In particular, just over 70% of both women and men promoted to associate professor leave their tenure-track position before coming up for promotion to full. Fewer tenured women in STEM leave UC than men: 45% of the women leave UC, but 57% of the men do. However, 28% of tenured women in STEM move off their tenured line into Educator or non-faculty roles, but only 15% of men switch into Educator or non-faculty positions.

Figure 3: Associate Professor Retention and Promotion Patterns

![Figure 3: Associate Professor Retention and Promotion Patterns](image)

*Note: These data represent faculty positions after the 8th year post-tenure for 115 men and 47 women promoted to associate professor between 2005 and 2015.*
GENDER DIFFERENCES IN PRODUCTIVITY

Beginning Assistant Professors
Publication frequency, citation rates, and h-indices are hallmark indicators of scholarly productivity in the STEM disciplines. Of interest, then, is whether some of the differences in retention and promotion rates for women versus men in STEM fields reflect differences in productivity.

To assess whether the productivity rates for women and men faculty vary by gender, the UC LEAF team reviewed data from Elsevier’s SCOPUS database\(^1\) for faculty in A&S and CEAS\(^2\) hired since 2001 as Assistant Professors. These data include the number of publications, citations, and h-index at the time of hire to 2016. The measure of productivity represents an estimated mean for each of the three indices based on the residuals from a simple model that controls for department and thus takes into account disciplinary differences in publication rates (see Appendix A for a detailed description of these analyses as well as statistical tests of differences).

As illustrated in the Figure 4 below, we find no significant differences in productivity for men and women in STEM after their first year as assistant professors. Though women have slightly fewer publications and slightly lower h-indices than men, they have approximately the same number of citations.

*Figure 4: First Year Results for Assistant Professors*

![Graph showing # of Publications, # of Citations, and H-Index for women and men](#)

Last Year in Rank as Assistant Professors
Figure 5 on the following page illustrates productivity rates for assistant professors in their last year in rank. These data specifically represent those faculty who achieve tenure. As the figures show, women and men continue to publish at approximately equal rates and have similar h-indices. However, it is noteworthy that women have higher citation counts than men.

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\(^1\) SCOPUS is the largest abstract and citation database of peer-reviewed literature, including scientific journals, some books and conference proceedings.

\(^2\) COM data were not included in this analysis because the number hired in STEM in COM because 2001 was too small to allow for meaningful analysis.
Assistant Professors Who Leave UC
UC LEAF also examined productivity rates for women and men who were promoted to associate and compared those to faculty who leave UC prior to receiving tenure. As noted above, female assistant professors in STEM are more likely than their male counterparts to leave UC. One potential explanation for turnover among early career faculty is that they leave because they do not believe they will be successful in obtaining tenure. Consistent with this view, the men who leave UC prior to tenure underperform in all indicators of productivity. However, even though women who leave publish at about the same rate as men who leave, their citation counts and h-indices are substantially higher. Importantly, women who leave have citation counts on par with those who stay and get tenure.

Figure 6: Productivity for Faculty Who Leave (Last Year in Rank)

These data suggest that high potential female faculty are leaving UC. This finding is also consistent with LEAF exit interviews and surveys conducted with faculty who left UC, which suggest that STEM women leave not because of performance or promotion concerns but because of issues relating to departmental climate.

First Year in Rank as Associate Professor
For faculty completing their first year as Associate Professors at UC (after being promoted from within), the productivity rates for women and men stay constant. Men continue to publish slightly more and their h-indices are slightly higher. And, the total number of citations is still slightly higher for women. These data suggest that the myth that women must perform better than men to be tenured is exactly that: a myth. Instead, in their first year as associate professors, women look very similar to the men.
Last Year in Rank as Associate Professor
As previously noted, women and men at the rank of associate professor advance to full at approximately the same rates. However, as shown below, in their last year in rank as associate professor before promotion, female faculty outperform male faculty in each indicator of productivity. These data tell us that women could be coming up for promotion to full sooner than they actually are.

Figure 8: Last Year in Rank for Associate Professors Promoted to Full

GENDER DIFFERENCES IN GRANTSMANSHIP AND COMMERCIALIZATION

Proposals
We examined external funding using a 5-year average for awards between 2012 and 2106. We compared the frequency with which female and male STEM faculty submitted grant proposals and the number and dollar amount of those awards.

3 Funding from year-to-year may not be valuable to examine for a number of reasons. One issue is the varying degree to which agencies provide funding each year. In addition, UC may get a huge grant in one year that skews the data, making it look like subsequent years are “less successful.” Big grants also generally have a longer normative time, so it becomes problematic to compare funding rates year by year. Finally, comparing the overall number of grants men and women receive could also be misleading, particularly when the actual number of faculty is small, because a faculty member who receives multiple grants skews the successfulness of all faculty in that gender group.
From 2012-2016, women represented 25% of all full-time tenured and tenure-track faculty in STEM departments. During this same time period, STEM faculty submitted an average of 884 grants per year. Female STEM faculty submitted, on average, 179 grants per year as PI or Co-PI, representing 20% of all submissions. They submitted an average of 1.61 grants per year (as PI or Co-PI), while male STEM faculty averaged 2.07 grants. These statistics suggest that female STEM faculty are slightly less aggressive in seeking funding than male faculty.

The preceding numbers could be slightly skewed by one or two faculty members who are exceptionally productive grant writers. To control for this possibility, we re-examined submission averages after removing the most prolific male and female grant seekers. We defined “prolific” as having an average number of grants submitted that was three or more standard deviations above the mean within gender. After removing these individuals, results show that female STEM faculty submitted, on average, 167 grants per year as PI or Co-PI, representing 22% of all submissions. They submitted an average of 1.52 grants per year (as PI or Co-PI), while male STEM faculty averaged 1.80 grants. Thus, after controlling for the most prolific grant writers, the gender gap remains.

External Awards
While a focus on the number of grants submitted is relevant, it is also important to consider the frequency with which grants are actually awarded. During 2012-2016, 309 STEM faculty were awarded at least one grant as either a PI or Co-PI. Of those, 80 (26%) were women. On average, women received 51 awards per year, equating to .46 awards per faculty member and a hit rate of 28.5%. Men received an average of 188 awards per year, equating to .55 per faculty member, with a hit rate of 27%.

These results are consistent with national data. As noted in a 2015 General Accounting Office report (see http://www.gao.gov/assets/680/674719.pdf, pp. 16-17), over the 5-year period from 2009-2013, no differences were found in the success rates of women and men STEM faculty seeking funding from these agencies.
As shown below, women in STEM are PIs or co-PIs on grants at the same rate as men. 26% of all female faculty in STEM were a PI or Co-PI on at least one grant, as were 29% of all male faculty in STEM, a difference that is not statistically significant ($z=-.611$, $p<.05$). However, the average dollar value for external awards is greater for women ($265k$ vs. $233k$).

**Figure 10: PI or Co-PI**

![Graph showing the percentage of female and male faculty as PIs or co-PIs from 2012 to 2016.]

**Figure 11: Award Size**

![Graph showing the average award size for women and men from 2012 to 2016.]

**Women as Principal Investigators**

During 2012-2016, women were PIs on 21% of the grants awarded to the STEM disciplines, which is slightly less than the percentage of STEM faculty who are women in the same timeframe (25%). However, these percentages
do not account for faculty who were the PI on multiple grants. To identify the success of individual faculty members, a better indicator is the number of faculty who are a PI on a minimum of one grant. These results show that, on average, the percentage of women awarded grants as PI (21%) was not statistically different from the percentage of men (23%) ($z = -0.440, p<0.05$).

*Figure 12: PI Status*

However, the average number of awards as PI for women (.35 per faculty) was less than the number of awards for men (.39). This difference is statistically significant ($t = -5.801, p<0.01$).

*Figure 13: Average Number of Awards*
But, the average amount of the grants awarded to female PIs ($138,217) is larger than those awarded to projects with male PIs ($107,354). This difference is statistically significant ($t = 9.472, p < .01$).

**Figure 14: Award Amount**

<table>
<thead>
<tr>
<th>Year</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>$138,217</td>
<td>$107,354</td>
</tr>
</tbody>
</table>

**Funding Differences by Discipline**

Significant differences in PI and Co-PI funding rates and award amounts exist across disciplines and colleges. For example, over the five-year period examined, women in CEAS received fewer awards than men (.72 versus .96 per faculty member) for less money ($181K versus $196K per faculty member), but women in the natural sciences (Biology, Chemistry, Geography, Geology, Math, Physics, Psychology) received essentially the same number of grants as men (.37 versus .35 per faculty member); yet, the grants women in the natural sciences received tend to be smaller ($122K versus $170K per faculty member). Women in the social sciences (Anthropology, Communication, Economics, Philosophy, Political Science, Sociology) and the College of Medicine (STEM faculty only) received more awards (.12 versus .08 per social science faculty member and .88 versus .47 per COM faculty member) for more money than men ($38K versus $5K per social science faculty member and $934K versus $561K per COM faculty member).

**Figure 15: Disciplinary Differences in Average Number of Awards**
Funding for Commercialization
In August 2015, UC LEAF released a report summarizing findings from a study of the commercialization efforts at UC. We examined the number of proposals submitted, reviewed, and presented, as well as the ratings assigned to presentations by gender and race/ethnicity. No differences were found in terms of the percentage of men and women or by URM status who applied for funding, who proceeded to the presentation stage, or who received funding.
APPENDIX A

To assess whether the productivity rates for women and men faculty vary as a function of rank and time in rank, the UC LEAF team pulled data from Elsevier’s SCOPUS database. SCOPUS is the largest abstract and citation database of peer-reviewed literature, including scientific journals, books and conference proceedings. Specific data drawn for each research faculty member (i.e., tenured or tenure-eligible) in A&S and CEAS included the number of publications, citations, and h-index at the time of year to the present. These are faculty hired since 2001 and who were hired into tenure-track positions as Assistant Professors (as opposed to being initially appointed to a non-tenure track position or at a higher rank).

The measure of productivity represents an estimated mean for each of the three indices based on a residual from a simple model that controls for department. Thus, using data from Table 1a as an example, the mean for cumulative career publications by women after their first year in rank indicates that the average female first year assistant professor had fewer publications than would be predicted from their departmental membership, while men had more.

Values in the far-right column represent the d-statistic (or Cohen’s D), the effect size used to indicate the standardized difference between two means. We consider an effect size of .20 to be small, .50 is moderate, and .80 or greater is large. Therefore, we highlight in each table all differences that appear to be non-negligible (d > .20).

Table A1a: Gender Differences in the First Year of Appointment for Assistant Professors

<table>
<thead>
<tr>
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<th></th>
<th>Men</th>
<th></th>
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<td>N</td>
<td>Mean</td>
<td>N</td>
<td>Mean</td>
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</tr>
<tr>
<td>Citations</td>
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<td>31.54</td>
<td>76</td>
<td>29.46</td>
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<tr>
<td>Publications</td>
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<td>76</td>
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<tr>
<td>h Index</td>
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<td>2.93</td>
<td>76</td>
<td>3.22</td>
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Table A2a: Gender Differences in Last Year of Appointment for Assistant Professors (Promoted)

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<td>Mean</td>
<td>N</td>
<td>Mean</td>
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<tr>
<td>Citations</td>
<td>22</td>
<td>133.75</td>
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<td>h Index</td>
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Table 2a: Gender Differences in Last Year of Appointment for Assistant Professors (Attrited)

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<td>14</td>
<td>10.18</td>
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Table 3a: Gender Differences in First Year of Appointment for Associate Professors

<table>
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Table 3b: Gender Differences in Last Year of Appointment for Associate Professors (Promoted)

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