



# Institutional Assessment of Women in Science: Introduction to the Symposium

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In this special issue, the *Journal* publishes a set of papers that present methodologies for investigating the factors that help to explain the processes that lead to the under-representation of women in the academic science labor force. My objective in organizing this issue was to create a set of papers that constitute technology transfer from basic and applied social science researchers to academic institutions that intend to evaluate the status of women scientists in order to identify barriers to their participation. Although I expect that this issue will be of interest to the *Journal's* regular readers, it should also be of interest to university leaders, their institutional researchers, and program officers of the nation's science funding agencies. Each paper presents its methodology in detail so that other researchers can adapt them to their own institutional context. If the methodological information provided here is insufficient, I strongly encourage interested researchers to contact the authors for more information. It is my hope that the issue will contribute to the ability of the nation's universities to evaluate objectively their successes and failures to create more gender equitable conditions.

The first paper examines the French context, reminding us that women scientists face obstacles to achievement in other national settings as well. Further, Sabatier, Carrere, and Mangematin show how longitudinal data and modeling improve our capacity to understand the career dynamics of academic scientists and engineers. The next two papers set the stage for examining women in science within a US context. Leggon's paper provides a broad overview of the under-representation of

women on university faculties. The next paper by Rosser and Chameau discuss the National Science Foundation's (NSF) ADVANCE initiative, which seeks to increase institutional capacity to recruit, retain, and advance women scientists. Through a case study of the ADVANCE project at the Georgia Institute of Technology, they articulate a set of heuristics for institutional leaders to use in assessing their readiness and capacity for institutional transformation.

The remaining papers present research methodologies for assessing the status of women faculty in particular universities using a variety of social science techniques. Each paper was made possible through the NSF ADVANCE initiative. Frehill uses the longstanding and reliable global indicators of social stratification (difference and similarity) to assess gender stratification at several universities. Survey methodology is another means of investigating gender in a quantitative way, and one which improves the researcher's ability to tease out causal arguments. The fourth and fifth articles—by Callister and Bilimoria and colleagues—use different formal surveys at different universities to investigate statistically the causal relationships among job satisfaction, departmental context, and outcomes. The last two papers—by Fox and Colatrella and Sheridan and colleagues—present qualitative semi-structured interview methodologies that assess the cultural and institutional context of working academic scientists. Taken together, the methodological papers provide a set of tools for both assessment and explanation of gender inequality.

## 1. An overview of the papers

Women's under-representation on science and engineering faculties is longstanding and well-

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documented. The first paper is the only one to evaluate the effects of gender in a scientific context outside the United States. Using duration models, Sabatier, Carrere, and Mangematin examine how gender affects the velocity of career trajectories among French life scientists. They find that female scientists must become more involved in scientific networks to be promoted in scientific research institutions. Although the balance of this special issue deals with scientists within a US context, this paper underscores that processes leading to gender stratification in science are not unique to the United States. Furthermore, their use of longitudinal econometric modeling constitutes an important methodological tool for the evaluation of gender dynamics in science, which occur over long periods of time, and within multiple institutional and relational contexts.

In the second paper, Leggon provides a broad overview of the components of this under-representation of women—and especially women of color—in the American academic labor force. Using extant national data resources, she shows that women, and especially women of color, are under-represented in the nation's universities. This is especially true in the nation's research universities. Leggon summarizes an extensive literature that argues that the racial and gender composition of the scientific labor force affects the conditions and topics of what is possible in scientific research and training. In short, the under-representation of women on academic faculties affects the nature of science itself, as well as representing a waste of human resource talent and a challenge to ideas of scientific fairness and meritocracy.

It is against this broad context of the under-representation of women on science faculties that this special issue focuses on research at specific research universities. The papers assembled here represent the direct effect of a major shift in policy focus at the National Science Foundation. Each of the papers was researched and written by scholars at an NSF ADVANCE institution. In the third paper, Rosser and Chameau discuss the origins of NSF's ADVANCE initiative. Until this initiative, resolving the problem of the under-representation of women on faculties was considered to be appropriately targeted at the individual level. The NSF ADVANCE initiative is focused on making major

academic institutions better able to recruit, retain, and promote women scientists. The scope of the initiative is necessarily small, but potentially revolutionary. Rosser and Chameau use their own institution, the Georgia Institute of Technology, as a case study for evaluating the readiness of universities to embark on a program of institutional transformation. Is there an institutional commitment and capacity to transform itself into a more gender equitable system?

Indices of dissimilarity and association have been used to study social stratification processes for decades. In this innovative use of these valid and reliable measures, Frehill demonstrates how they can be used to evaluate gender-based occupational segregation on university faculties. Like Leggon's aggregated statistics, the picture is grim: Frehill concludes that gender stratification in scientific disciplines remains fundamentally unchanged over the period she studies, from 1973 to 2001. Cause for optimism, however, can be found in the high degree of variation among academic institutions. This suggests that institution-specific practices can affect the gender-based occupational segregation evident within US universities.

The fifth paper is survey-based. Bilimoria, Perry, Liang, Stoller, Higgins, and Taylor report the results from a survey of 248 faculty members related to the determinants of job satisfaction. Using structural equation models, they find that women's job satisfaction is affected by the supportiveness of professional relationships. By contrast, they find that men are affected by such relationships, and also by academic resources. Their conclusion is that the quality of interactions with colleagues is especially important for women faculty. The policy implication they draw from this finding is that better mentoring programs at the collegial level may be more important than high level leadership in the institution.

Callister reports the results of a survey of 308 academic scientists at a major research university to evaluate the role that job satisfaction plays in the intention to quit. She finds that female faculty members are more likely than their male colleagues to intend or desire to quit. She also finds that men are more satisfied than women with their departmental context. These empirical results lead to the sensible question of whether variations in the departmental context may affect variations in

the desire or intent to quit. Using Baron and Kenny's (1986) theoretical specification of moderating and mediating effects, and ANOVA analysis, Callister finds that women are more sensitive to negative departmental environments. Since departmental environments help to determine job satisfaction, and job satisfaction helps to explain intentions to quit, Callister reasons that one way to increase the retention of women is to improve departmental contexts in research universities.

Together, the papers by Callister and Bilimoria and colleagues highlight the importance of job satisfaction. Bilimoria and colleagues show the institutional determinants of job satisfaction for men and women, while Callister extends this finding to demonstrate that institutionally-mediated job satisfaction affects intentions to quit.

In the two concluding papers of the special issue, qualitative methodologies provide a window on the wide variety of factors that affect faculty experiences, wellbeing, and productivity. Qualitative research methodologies provide insight into the experience of scientists in universities. Indeed, they often provide the deep cultural insights that simply are not possible using quantitative approaches based on extant aggregated data or survey methodology. In the first such qualitative paper, Fox and Colatrella present the results of an analysis of semi-structured interviews. The interviews were conducted with women faculty at all ranks, and from a variety of disciplines. Their findings illuminate that women faculty value what men do: intellectual autonomy and creativity. This reinforces the idea that women scientists are, first and foremost, scientists. They further explore the roles that the professors play in decision making, their confusion about tenure and promotion criteria, and the academic politics they face. Many of the themes that emerged are ones that can potentially be changed, making such an analysis worthwhile for universities interested in women's advancement. The appendix provides the interview questions so that the methodology can be replicated at other universities as well.

The research experience that Sheridan, Brennan, Carnes, and Handelsman report provides an important cautionary conclusion to those who wish to conduct institutional research. The researchers conducted in-depth qualitative discovery inter-

views of 39 senior women scientists to learn about issues facing them at the institution, and to further develop the ADVANCE initiative at their institution. The work highlights the important distinction between research and advocacy, an issue likely to face most people working to increase gender equity in institutions. As researchers, we have an ethical obligation to our human subjects that constitutes a higher standard of confidentiality than what an advocacy perspective may require. Because the authors did not obtain Institutional Review Board approval, they do not report specific findings. They do, however, provide a particularly strong discussion of process and methodology. Specifically, they highlight the methodological challenges and opportunities presented by this study population. On the one hand, these busy key informants are difficult to schedule and interview, but on the other hand, their experiences are vital to policy design and further research. Perhaps most interesting is the effect of involvement in the study on the participants. The authors report that participation created expectations for advocacy, new networks, and collaborations. Such a research effect is entirely consistent with action-oriented research, and a likely consequent of other research reported in this issue. Researchers should be aware of the design and effects of the research process itself, in addition to the results they may find.

## 2. Toward further research

The *Journal of Technology Transfer* has generously provided two special issues for the publication of empirical research on women in science. The first, "Women in Science," which was published in October 2005, presented work that explores how institutional contexts affect different aspects of scientists' work lives. The contextual variations studied in the first issue include: technology transfer offices (through intellectual property disclosures), patenting processes, multidisciplinary science centers, the information technology profession, and Anglophone African science institutions. In each case, a scientist's sex had explanatory power for a variety of outcomes, such as patenting, performance of core academic activities, and retention.

In this second special issue, the papers focus in particular on the use of standard social science

methodologies for the assessment of gender-related processes in research universities. Each paper comes to interesting substantive conclusions about the scientists in its specific institution. Although the external validity of many of these papers is low due to the institution-specific nature of the research, they provide details about how the methodologies can be used in other institutions. Furthermore, none of the institution-specific findings seems to be particularly institution-specific. Future research that replicates these methodologies in additional research university settings is likely to yield similar results.

Taken together, I hope these special issues promote greater interest in conducting theoretically-grounded, empirically driven, social science

research to explain the effects of gender in science establishments. Social stratification processes are, by definition, socially created. Therefore, future research must take into account the social contexts in which gender stratification occurs. It is not enough to study individual scientists in an attempt to explain why men and women differ. The collection of papers in these two special issues demonstrates that powerful institutional forces operate to explain, in part, gender differences in career processes and organizational experiences. It is my hope that future research will use these papers as guides to specify the theoretical mechanisms by which gender operates, and to design rigorous tests using standard empirical social science methodologies.