

ECONOMICS OF ACADEMIA: THE TWO-BODY AND DUAL-HIRE PROBLEM
REVISITED

By

TYLER WILLIAM LAFERRIERE

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To the Faculty of Washington State University:

The members of the Committee appointed to examine the thesis of TYLER
WILLIAM LAFERRIERE find it satisfactory and recommend that it be accepted.

Jill J. McCluskey, Ph.D., Chair

Ana Espinola-Arredondo, Ph.D.

Thomas L. Marsh, Ph.D.

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ECONOMICS OF ACADEMIA: THE TWO BODY AND DUAL HIRE PROBLEM

REVISITED

Abstract

by Tyler William Laferriere, M.S.
Washington State University
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Chair: Jill J. McCluskey

The research objective of this thesis is to understand how different policies are related to female representation in academia, specifically examining female tenure-track faculty in economics and agricultural and applied economics. This essay employs data from 2017 economics and agricultural economics department and compares them to the presence of Dual-Hire programs, including programs that assist with partner employment, NSF Advance grantee status, and on-site childcare in the recruitment and retention of female tenure-track faculty. This essay also addresses the revealed preferences question of faculty who decide or not to provide a curriculum vitae or commensurate information regarding their academic, professional and publication history. Finally, the analysis of agricultural economics controls for extension appointments for faculty members to account for the possibility of these faculty placing greater time and emphasis on bulletins and similar publications over journal articles, books and book chapters. This study is performed on a combined sample of economics and agricultural economics faculties, on the sample of economics departments and finally on the sample of agricultural economics faculty. The full sample results indicate NSF Advance programs improving the lot of female assistant professors but detracting from the prevalence of female associate professors. Dual career policies appear to benefit female associate professors and their

male counterparts. Surprisingly, agricultural and applied economics departments appear to possess significantly higher proportions of female faculty at all levels but do not predict promotion to higher academic ranks. When only sampling economics departments, work-life programs do not appear effective in helping women climb the tenure ladder. Moreover, top 50 university credentials and top 50 university employment benefits male faculty members but not female. Childcare and NSF Advance programs increase the proportion of female assistant and full professors while Dual Hire programs increase numbers of female associate professors. On-campus childcare appears to hinder the promotion of female agricultural economics faculty yet predicts increased percentages of female assistant faculty. Finally, NSF Advance programs correlate to higher percentages of female assistant and associate agricultural economics professors.

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CHAPTER ONE: INTRODUCTION

Motivation

This thesis strives to address the underlying question of what women can do and be in keeping with Nussbaum's definition of capabilities (Nussbaum 2011). The tradeoff historically is between mother and worker, though economic and professional pressures often mean women outsource childcare to providers after a certain age. In other instances, the spouse undertakes some of the childcare responsibilities, but this then requires the presence and work flexibility of the spouse to perform this role. Juraqulova, McCluskey and Mittelhammer (2017) referred to this as the work-life balance, departing from the notion of labor-leisure exchange in favor of recognizing other life activities, including maintaining relationships and raising families, as part of an inferred equilibrium between activities inside and outside the office and classroom. Nussbaum's approach to philosophical inquiry evaluated institutional structures and programs by determining if they address and support the valuable things a human being might develop the capacity to do. Her definition of ten central capabilities included life and affiliation. The former capability addresses the capacity and opportunity to live a life worth living, in other words, one in which a person need not be confined to solely either a home or office in the context of the work-life tradeoff. The other, affiliation, allows for the development of the capability to live with and for others. Here this can be applied to a woman academic being able to live for her partner and family, not solely for her career.

Having established a theory-based heuristic for this thesis, the National Center of Education Statistics provided in 2013 the data-based justification for continued analysis of

women in the various levels of academia. Specifically, women accounted for 54 percent of lecturers and 56 percent of instructors, neither of which are tenure-track positions and may or may not account for high proportions of research productivity depending on the appointment. 50 percent of assistant professors were estimated to be women while women accounted for only 43 percent of associate level positions and 30 percent of full professorships. These figures disregard discipline specification.

A 2013 study published by the Association of American Universities Data Exchange (AAUDE) estimated only 22.5 percent of tenure-line faculty are female in the interval between 2010 and 2012 at sampled AAUDE institutions. The AAUDE also estimated that female faculty account for 31.1 percent of assistant professors and 22.3 percent of associate professors but only 13.3 percent of full professors at 35 sampled member institutions. However, the total number of women in the tenure pipeline has consistently increased between 1993 to 2011 (Carr 2013).

Research Objectives

The purpose of this thesis is to empirically determine the effectiveness of Dual Hire or partner accommodation programs; NSF Advance IT programs; and onsite university childcare in improving the presence of women in the tenure pipeline. This paper reviews a previous sample of Ph.D.-granting economics departments first studied in 2012 but also examined 32 faculties granting Ph.D.'s in agricultural or applied economics. In this process of analyzing program effectiveness, this paper reviews the correlation of top 50 Ph.D. level education and university rankings to the number of female faculty in each university department. The aim of this thesis is

to provide additional insight to ongoing research into gender disparities in STEM faculties and the impact of programs intended to lessen these disparities.

Thesis Format

This thesis is formatted into three chapters. The first introduces the Capabilities Approach theoretical framework, the statistical motivation of the inquiry and the aims, structure and summarized finding of the thesis. The second chapter examines the previous research, explains the model used in this thesis and the data and conclusions of this work. Finally, the third chapter reviews the empirical findings and offers suggestions for future inquiries. Appendices of data tables and variable definitions follow.

Summary of Findings

The combined sample yielded that 30 percent of all faculty members sampled were female. More women than men were assistant and associate professors while fewer women than men were full professors. Greater proportions of women worked at institutions with Dual Career policies, NSF Advance programs and onsite childcare. Women published almost a quarter of all publications recorded in the data, though women published fewer articles or books per year. The estimates from ordered probit regressions where academic rank was the response showed unions and NSF Advance policies benefited the advancement of women when distinction was not made between department types. However, Dual Hire programs were correlated with upward advancement of male faculty across departments. However, on-campus childcare predicted lower

proportions of female full professors while unions related to lower levels of both female assistant and full professors. NSF Advance policies were correlated with higher percentages of female assistant professors and lower percentages of female associate professors; however, Dual Hire policies had the opposite impact. Of greatest note is that agricultural and applied economics faculties related to higher percentages of female faculty at all levels.

For only economics departments, this work found slightly more than a third of female faculty in the economics faculty sample were full professors compared to over half of male faculty. Moreover, roughly equal proportions of male and female faculty worked at institutions with onsite childcare, NSF Advance programs and Dual Hire programs. Of the faculties on campuses with these services, roughly 20 percent were female. Of the predictors for promotion through the tenure pipeline, experience, average publications and being female were the most significant while coming from a top-ranked Ph.D. program and being at a top-ranked institution only proved significant predictors for male faculty. Across assistant, associate and full professorial positions, NSF Advance programs significantly improved the proportions female assistant and full professors while Dual Hire programs improved proportions of female associate professors but diminished the proportion of female full professors. Similar proportions of female full professors within agricultural and applied economics were found vis-à-vis those in economics departments. The proportions of female applied and agricultural economics faculties at institutions with NSF Advance and Dual Hire programs and with onsite childcare were also roughly equal to their male counterparts. Again, the experience and annual average publications significantly predicted promotion through the tenure stream. However, onsite childcare facilities negatively predicted women moving through the tenure pipeline. On a position-by-position basis, onsite childcare correlated to higher proportions of female assistant professors but lower

proportions of female full faculty. NSF Advance programs related to higher proportions of female assistant and associate faculty, but urban settings correlated to lower proportions of all levels of female faculty.

The descriptive results for agricultural and applied economics departments echoed those of the economics departments with a few major differences. Almost all universities with agricultural economics faculties had on-campus childcare and ten percent more had Dual Hire programs compared to economics faculties. Over 20 percent more had NSF Advance programs. However, childcare was negatively correlated with the promotion of women. The only other significant predictors of advancement were the meritocratic predictors, in other words, experience and publications. On a rank by rank basis, childcare significantly predicted higher percentages of female assistant faculty but lower levels of female full faculty. Dual Hire policies had not impact at any level while NSF Advance policies increased percentages of assistant and associate female professors. Urban-based institutions had fewer female faculty at all levels while public institutions correlated to higher associate and full female professors.

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CHAPTER TWO: THE DUAL HIRE PROBLEM REVISITED

Introduction

Though changing, institutional and cultural factors still often make economics and its derivatives, such as agricultural or applied economics, the “dismal science” for women. The Committee on the Status of Women in the Economics Profession (CSWEP) in its 2016 annual report estimated only a slight increase in first year female Ph.D. students in economics compared to the previous year, 33.4 percent compared to 30.2 percent. In 2016, 31 percent of new doctorates awarded were to women. Along the tenure pipeline, 28.3 percent of assistant professors, 25.6 percent of associates and 13.1 percent of full professors were women. The pipeline, apparently, has sprung leaks (Lundberg 2016). Williams and Ceci (2011) contend this underrepresentation of women in math-intensive fields despite earning a large proportion of science and mathematics related undergraduate degrees, issues of family formation, gender expectations and career preferences away from math-intensive graduate fields contribute to underrepresentation and a faulty pipeline.

Ginther and Khan (2004) demonstrated gender-based characteristics correlated to achieving tenure. They reported women are proportionately less likely to be married and have young children 10 years after receiving a Ph.D. but take proportionately higher amounts of time to achieve tenure at all and achieve tenure within 10 years after receiving their Ph.D. On average, their study reported roughly seven years for male faculty to achieve tenure while females took 8.3 years to do so. Finally, women are 21 percent less likely than men to have a tenured job.

Furthermore, McDowell, Singell and Ziliak (1999) demonstrated women as being 36 percent less likely to be promoted from assistant to associate academic positions, but the likelihood of promotion was only 9 percent less for women from associate to full professorships vis-à-vis their male counterparts. However, the situation has improved over time: McDowell et al. demonstrated in 2001 that despite persistent hurdles for women at each rung of the tenure ladder the overall trend of disadvantage has not persisted over time. Rather, promotion prospects diminish over time from the 1960's forward and reduce once a female faculty member has achieved associate status.

Ginther (2002) estimated that the promotion gap between men and women hovers at 18 percent. She also noted that women in economics spend less time married and have fewer children than men. Ginther and Khan (2006) indicated startling disparities between women and men regarding marriage and child rearing decisions. Specifically, they estimate a single female without children is 11 to 21 percent more likely than men in a scientific field to achieve a tenure-track appointment within five years. Moreover, marriage increases a male's probability of an appointment by 22 percent compared to only 5 percent for women. Having a child younger than six years old decreases a female faculty member's likelihood of a tenure-track appointment by 8 percent.

Perna (2005) reported from the 1999 National Study of Postsecondary Faculty estimates a smaller share of women than men hold tenured positions, 44 percent to 66 percent respectively – However, higher shares of women than men hold tenure track positions, 27 percent to 19 percent, and non-tenure track positions, 29 percent to 16 percent. However, Perna demonstrated that fewer tenured faculty have not been married and have no children than tenure-track or non-tenured faculty, supporting hypotheses of confounding between decisions about family and

children and the pursuit of tenure. These findings offer necessary evidence for ongoing inquiries into questions of work-life balances and the capabilities of tenure-track faculty to justly accommodate personal and professional interests and development. Perna (2005) also indicated marital and familial sex differences: women have fewer dependents and are more likely to never be married, widowed, divorced or separated. Perna's conclusion would indicate women are not being given the same capabilities to address the formation of families and relationships outside their work as academics.

Motivation

Though well and good, citing the disparity between male and female faculty members regarding the numbers in higher faculty echelons and apparent barriers to entry to higher academic ranks does not in and of itself compel this investigation. Rather, motivation must be provided to underpin programs intended to advance the progress of women in higher academic echelons.

Ample evidence exists to suggest that preexisting female faculty in departments create capabilities and a human capital feedback loop in both undergraduate and graduate studies. In other words, female faculty already in the department in question improve the potential of their female counterparts lower on the tenure ladder, their graduate students and their undergraduate students. Neumark and Gardecki (1998) found that female faculty through mentoring relationships positively correlate to their female graduate students completing their degrees in less time. Ferber (1995) added to this by asserting women are more receptive to female instructors, and Berg and Ferber (1989) argued women form more robust student-teacher and

mentorship relationships with women faculty. Hale and Regev (2014) demonstrated a positive correlation between the proportion of female faculty in top economics Ph.D. departments and the number of women in the graduating Ph.D. cohort six years later. Koplin and Singell (1996) showed that high-ranking economics departments that were loath to hire female faculty after the 1970's not only had less success in recruiting female faculty in subsequent years but also declined in the number of publications in later years. This productivity extends to efforts among faculty members: female faculty will more likely collaborate with their female counterparts on research and co-authored publications (Ferber and Teinman 1980; McDowell and Smith 1992).

To address the goal of greater work life balance irrespective of gender, universities across the United States have worked to enhance the presence and prevalence of female faculty in all disciplines through childcare accommodations, parental leave, dual hire or partner accommodation programs (PAP's) and other programs designed to address the work-life balance problem. According to the 2014 Academic Institutions Report from INOMICS, the United States ranked fourth concerning best places to work as an economics academia professional but seventh in terms of providing work-life balance. However, the 2013 Economics Job Market Report determined flexible working hours and work-life balance was second in terms of preferences of economists in the market (Hoffmann 2013). Not only are there empirical motivations behind wanting to provide institutional frameworks for addressing the disparity in outcomes of work-life balances between men and women; there are also preferences and utilities to be addressed regarding market demand for work-life balance in the economics job market. The literature would suggest addressing these distinct yet closely related needs through institutional provisions like Dual Hire, onsite childcare and NSF Advance Institutional Transformation (IT) programs and grants serve to enhance faculty productivity; enlarge the room for promotion; and increase

professional involvement in a faculty member's own academic pursuits and the educational and research aims of their institutions (Xie and Shauman 2003; Stewart and Lavaque-Manty 2008).

Moreover, despite an ever-increasing body of literature studying and attesting to the benefits of programs serving to improve the work-life balance for academic faculties, this paper recognizes and hinges on a broad variance of work-life provisions across institutions based on their respective cultures and goals. This work seeks to continue the body of previous investigations into which programs work, who they benefit and how the methodologies might improve on how to examine the effectiveness of work-life provisions. In examining the work-life balancing provisions, the goals of this thesis come back to Nussbaum's theory of creating capabilities. By programmatically addressing and achieving an albeit unobserved equilibrium between work goals and life preferences, this thesis assumes a maximization of utility and of capability creation for female faculty. By achieving greater proportional parities between male and female faculty in economics and agricultural economics, this presumably occurs since women who have different life preferences yet equal work ambitions vis-à-vis their male counterparts can access the institutional provisions to satisfy these preferences. Moreover, one might argue work-life programs possess the potential for greater impact assuming a continued implicit or explicit expectation of female partners assuming more childcare and household responsibilities.

Defining Dual Hire

A 2015 study under the auspices of NSF AdvanceRIT took a sample of 69 universities, 78 percent of which possessed formal Dual Hire programs. Of those institutions with formal

Dual Hire programs, 74 percent offered employment assistance to secondary partners; 20 percent offered job placement to secondary partners; and 19 percent offered job placement and employment assistance to secondary partners. Employment assistance includes services such as networking, job coaching, interview preparation and resume critiques. Job placement refers to a temporary or permanent placement of a secondary partner. In many instances, this involves an adjunct position that transitions into a tenure-track position after a trial period. 57 percent of institutions with Dual Hire programs only provided services for faculty while 43 percent offered Dual Hire program services for both faculty and staff. Of note is that no institution offered services only staff (Kimbrey 2015)¹.

Further analysis within this report estimated 76 percent of sampled institutions provided employment assistance services to all faculty, 31 percent to all staff and 7 percent services to research faculty only. Of note is that 22 percent Dual Hire programs offered services to tenure-track faculty only (Kimbrey 2015). Since this thesis focuses on the advancement of faculty, the broadest definition of Dual Hire – those which focus only on faculty, especially tenure-track faculty - was used in the collection of these data. However, it is of interest for this and future work that some institutions focus only on offering programs advancing the work-life balance for select groups of faculty. In the context of partnerships where one partner neither seeks nor desires a tenure track position, yet job at the same institution or in the same area is the relational preference, some Dual Hire programs might more appropriately serve some couples more than others. This leads into questions about the two-body problem of academic partnerships, the next section addresses in more detail.

¹ Examples of institutions with formal Dual Hire programs under this study are: Columbia University, Cornell University, Iowa State University, Ohio State University, Stanford University, UC Berkeley and UC Davis.

The Two-Body Problem

As mentioned in the previous section, the question of advancing female faculty, and indeed male faculty, is often a two-body problem. In many circumstances, the issue of movement and stability as it pertains to finding and locking down a tenure-track or tenured position involves many bodies, that is, family. As such, faculties and many universities value initiatives and programs improving work-life balance such as dual career programs, onsite childcare facilities and schedule flexibility. Departments and universities do not only value them for their ability to recruit talent but retain it and push it through the tenure pipeline (Wolf-Wendel et al., 2000; Perna 2005). Additional studies into policies like “stopping the tenure clock,” studied by Manchester, Leslie and Kramer in 2010 and 2013 demonstrated insignificant relationships of promotion to tenure in addition to a wage penalty for both men and women. However, familial reasons motivated women more than men for stopping the tenure clock. Antecol, Bedard and Sterns (2016) demonstrated men benefitted professionally more than women due to the persistence of gender roles wherein women perform the caregiving and men avail of the extra time to work productively toward tenure. As an aside, such policies may not, in fact, benefit female faculty in terms of advancing their capability to develop professionally and personally. Any inquiry into work-life policies should consider this potentiality when evaluating all policies aimed at improving work-life policies.

A Word on Gender Wage Disparities

Though the gender pay gap remains an important material and policy consideration in discussions about labor marketplace equity between men and women, it exists outside the parameters of this thesis. This thesis investigates the hurdles to retention and promotion of women through the tenure pipeline, not salary differentials.

However, the literature indicates many of the same work-life policies addressed by this thesis correlate with faculty earnings. Carlin et al. (2013) suggested books and grants as being equally important to male and female salaries. This study also found academic discipline and faculty rank as important earnings determinants for women and men. Moreover, the paper admits to individual universities being largely incapable of addressing market-level gender disparities in earnings. Agricultural economics may also possess unique dynamics between gender and salary. Thimany (1998) found increases women's salaries in agricultural economics correlate more strongly with journal publication whereas those for men correlate more with books and extension publications. However, gender effects were not found to indicate salary differences between men and women overall. Finally, Carlin et al. indicated the disconnect between productivity and female faculty earnings declined in more recent cohorts of female academics. Ransom (1993) argued the monopsony effect of individual universities on salaries has greater effect over faculty salaries than rank such that seniority and experience at a single institution negatively predict salary vis-à-vis the going market salary. Ransom attributed this difference between institutional and market salary to high moving costs, both material and psychic. This would indicate two ramifications for this paper. First, salary and rank are unique though perhaps not unrelated questions. Second, programs like Dual Hire and onsite childcare

contribute to lowering the unmeasurable psychic moving costs of moving a relationship or family. Thus, more universities with work-life provisions would lower these implicitly moving costs, presumably lessening the monopsony effect which the literature attributes to wage disparities. Therefore, within the scheme of examining work-life policies and female faculty ranks, questions of salary inequalities based on salary can be set aside for future studies.

Previous Studies

Juraquolova et. al. (2017) is the direct predecessor to this thesis. They sought to predict the rank of female faculty in 125 PhD-granting economics departments. Using data from 2012, they demonstrated greater proportions of female faculty at the assistant and associate levels than male faculty but fewer at the full professor level. These findings are consistent with previous research.

Institutionally, the presence of faculty unions, Dual-Hire programs, NSF Advance grant programs and onsite childcare were also used to predict total, female and male faculty ranks. Experience and average publication count variables predicted the increase in faculty rank, though it should be noted the publication effect for female faculty exceeds that of male faculty. Onsite childcare also significantly predicts an increase in faculty ranks, but it only does so for male faculty. Finally, faculty unions negatively predict the increase of faculty ranks overall.

Further empirical analysis in this study sought to predict the percentage of female faculty by rank. Onsite childcare negatively yet significantly predicted percentages of female assistant professors and positively predicted associate level female faculty. Unions significantly predicted greater numbers of assistant and full female professors yet fewer associate professors. NSF

Advance programs improved the percentages of female faculty at all levels, but a current job at a top 50 ranked university diminished proportions of female assistant and associate professors. Finally, institutions in rural areas were related to lower levels of female assistant and full professors.

Though similar in scope and focus, this thesis departs from this previous work regarding instruments, sample set and philosophical ground. These differences in methods are discussed in the following sections.

Economics versus Agricultural Economics

In addition to reviewing the sample and methodology of the Juraqulova paper, this thesis sampled 32 PhD-granting departments in applied and agricultural economics that are members of the Agricultural and Applied Economics Association. While a distinct subfield of economics, the analysis of agricultural and applied economics departments allowed for an investigation of sub-discipline with distinct attributes. Specificity of applied and agricultural economics means the same rules of prestige as it would relate to the broader population of economics institutions would assumedly not apply as strongly. For example, the University of Minnesota would more presumably hire a PhD graduate from the University of Nebraska at Lincoln over a graduate of Harvard if the Harvard graduate had little to know experience in agricultural or applied economics as it pertains to agronomic topics.

Moreover, applied and agricultural economics appointments often have the unique characteristic of involving extension. According to Druce (1966), the extension appointment of an agricultural economist includes providing economic analysis for agricultural management;

developing new techniques for farm management; providing technical guidance and the interpretation of economic data; and providing training for the farming community in management techniques. Far removed from the consulting the often occurs in the traditional economics setting, extension stands apart as a genuinely applied version of economic practice and thereby distinguishes the work of agricultural and applied economists and their departments from general economics departments.

Data

Following Juraquova et al (2017), the sampled data for this thesis came from only doctoral-granting economics departments. The Carnegie Classification index of colleges and universities separates institutions offering more than 20 PhD's – not including doctorates of practice like JD's or MD's – into categories based on research & development (R&D) expenditures in science and engineering (S&E); R&D expenditures in non-S&E fields; S&E research staff; doctoral conferrals in humanities fields, in social science fields, in STEM fields, and in other fields². These institutions are assumed to produce and require the highest level of faculty productivity regarding original research, publication, teaching and advising.

This paper also considers binary variables for the presence of onsite childcare, official university Dual Hire policies and the presence of National Science Foundation (NSF) Advance programs and grants for Institutional Transformation. These indicators form the suite of variables for this work's analysis of work-life policies intended to predict the representation and advancement of women into higher academic positions. On-campus childcare, especially when

²“Basic Classification Methodology.” The Carnegie Classification of Institutions of Higher Education. <http://carnegieclassifications.iu.edu/methodology/basic.php>.

affordable, may ease the ability to balance childcare responsibilities, traditionally foisted on the female partner, with publishing and academic production responsibilities. The argument follows, then, that childcare provisions in turn may lead to greater representation and rank advancement (Juraqulova 2017). Woolstenhulme et al. (2012) demonstrated academic couples hired under the auspices of a Dual Hire program have higher productivity vis-à-vis colleagues of comparable life situations. This paper then hypothesizes that Dual Hire programs should improve the rank advancement and representation especially of female faculty since productivity correlates to advancement up the academic ladder.

In keeping with Juraqulova's precedent, this thesis includes unionization as a factor for increasing the proportion of women in faculty positions at any level. Though May, Moorhouse and Bossard (2010) concluded by controlling for organizational and institutional factors does appear to increase the overall proportion of women faculty by 1.18 percentage points, they found this result to be segmented such that the rank of assistant professor does not benefit from this proportional increase. Thus, it would appear this factor does not contribute to combating the problem of the "leaky pipeline" of tenure for women. However, the proportional increase of women overall indicates the potential of unions to keep female faculty who move to more advanced stages of the pipeline. Unions, therefore, were again considered in the data used in this thesis. Indeed, May, Moorhouse and Bossard (2010) argue faculty union regulations concerning tenure and promotion creates greater transparency in these procedures. These in turn may enhance female faculty performance, recruitment and retention. Booth et. al (2008) contended the presence of unions correlate strongly with concurrent presence of work-life policies such as childcare and family leave options but also elder care and work schedule flexibility.

The goals of the NSF Advance program are “to develop systemic approaches to increase the representation and advancement of women in academic STEM careers.” Moreover, these programs are meant to develop innovative and sustainable ways to promote gender equity involving women and men in STEM and must contribute to the knowledge base of how to increase gender equity in STEM field³. The NSF Advance program includes economic sciences, mean economics and agricultural (or applied) economics⁴. Since these grants fund small and large scale research and institutional initiatives to create and improve work-life policies for academics with an emphasis on STEM academics. This paper also expects in concurrence with the Juraqulova paper that the presence and implementation of NSF Advance initiatives will improve the presence of female faculty in academic ranks.

Institutional and individual data were gathered from 133 Ph.D.-granting economic departments and their faculty members and 32 Ph.D.-granting agricultural and applied economics faculties. Of note is that Iowa State University and Washington State University have blended programs. Institutional variables included institutional rankings, departmental rankings, student population and type of university as either public or private. Individual variables included years since Ph.D., rank of Ph.D.-granting institution, year of Ph.D. conferral, year joining a faculty member’s current academic department, gender, number of published books and journal articles and average number of publications per annum since Ph.D. conferral. In another departure from the Juraqulova paper, the number of publications was determined by counting those only listed in the economics literature section of academic database EBSCO. A database-derived count of publications was used in favor of relying on faculty curricula vitae due to the

³ Bird, Sharon and Jesse DeAro. “ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers.” http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5383.

⁴ Bird, Sharon and Jesse DeAro. “ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers (Footnote 1).” http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5383.

moral hazard problem of faculty potentially obfuscating the type and number of published journal articles or published books.

Indeed, Broder (1993) found female faculty less likely to publish in top journals while Koplin and Singell (1993) found that women tend to take positions at lower ranking institutions and in fact publish more than their male counterparts but suffer from effects from the ‘quality’ of colleagues. In reviewing similar papers, Kahn (1995) stated significant differences in publication rate remain between men and women even when controlling for experience, age, publication quality and co-authors. However, controls for ranking of Ph.D. and rank of institution cause women to achieve parity with their male counterparts in terms of publication averages if not exceeding rates of publication (Broder 1993). McDowel and Smith (1992) found women less likely to coauthor and that co-authorship offers a premium regarding promotion, meaning women subsequently get promoted less. Since they also found faculty often gender-sort regarding choosing co-authors, this finding is hardly surprising. However, this implies an expected correlation between the number of women in a department and how productive each female faculty member is.

Rankings of departments come from the IDEAS/RePEc database ranking for economics and related sciences. Institutional rankings come from US News and World Report national rankings for college and universities. Broder (1993) found positions in more prestigious departments in addition to production of quality articles positively correlate to an academic’s rank. He found this through two possible feedback models: one in which better academics are hired by better departments, leading to those departments reinforcing their already high quality; and better departments promoting greater quality through institutional resources and the reinforcing effect of an existing high caliber pool of potential collaborators.

Overall, these data parameters resulted in 3206 observations across 134 United States institutions for the economics sample and 32 institutions and 737 observations for the agricultural and applied economics sample.

Methods

An indicator variable for *female* was generated to test for gender differences between and within ranks. This indicator also used for analyses at the institutional level. The variable *experience* was imputed as a continuous variable with the current year less the year an individual received his or her Ph.D. degree. For those who had graduated in the current year, a 1 was imputed to avoid transformations wherein a variable was divided by 0. This became pertinent when a faculty member's average number of publications per year, *Average Annual Publications*, was computed. This variable included the total number of published articles and books as determined from the EBSCO database divided by the years since Ph.D. conferral.

Additionally, the binary variables *Top 50 Ph.D.'s* and *Current job at top 50 departments* were generated to control for institutional prestige of both Ph.D.-granting institutions and current university employer. Both indicators were generated by the rankings provided by US News and World Reports ranking of national universities. In another departure from Juraquova (2017), which employed the IDEAS/Research Papers in Economics (RePEc) for school rankings, this paper chose to use the US News and World Reports for several reasons. First, the RePEc Ideas Ranks economics programs based on the volume of working papers and published journal articles of authors registered with the RePEc Author Service. Moreover, it accounts for

institutional research activities listed in Economics Departments, Institutes and Research Centers in the World and Citations in Economics (CitEc) citations metric. By contrast, the US News provides a broader metric of ranking and includes data related to graduation and retention rates; undergraduate academic reputation; faculty resources; student selectivity; financial resources; graduation rate performance; and alumni giving rate⁵. This decision was made as a departure from the perspective of faculty as only publishers. Dolado, Felgueroso and Almunia (2005) found that women choose economics departments topically, not based on the ranking or quality of said department. This would indicate a publication-based ranking might be deficient in predicting all variables that underpin the choice to work at an institution, especially if teaching a topic is as important as publishing on that topic. Moreover, this thesis wished to examine the sway teaching has over female faculty vis-à-vis male faculty in employment decisions. Since the sampling criteria of this work excluded pure research appointments, teaching to some extent must hold sway over employment decisions. The U.S. News metrics account more for the teaching environment than those provided by the RePEc metrics.

Dichotomous variables were created to account for the type and location of the university. *Public* indicates the university is a publically funded institution, and *urban* indicates an *urban* or city setting. It should be noted the *urban* binary only appeared in the agricultural economics analysis since the setting binary location indicator proved insignificant in the Juraquolova analysis. However, this paper estimates the type of university to possibly hold predictive capability in a new sample of university departments. Peterson's (2015) indicated

⁵ Morse, Robert et al. "How U.S. News Calculated the 2017 Best Colleges Rankings." U.S. News and World Report. <https://www.usnews.com/education/best-colleges/articles/how-us-news-calculated-the-rankings>.

public universities tend to be larger, and as has been previously indicated, universities with larger populations tend to have more women based on proportions.

Dichotomous variables were created for institutional work-life programs such as onsite child care, Dual Hire policies and NSF Advance grant-funded programs. The variable *on-campus child care facility* was a binary gathered based on whether an institution provided child care to faculty or staff on campus or near an institution. The *Dual-career policy* indicator binary is collected from publically available policy information from university websites but only counts the policy if it is on a formal university-wide basis. These were then corroborated with Kimbrey's 2015 study on Dual Hire programs. Finally, the *NSF Advance* binary was recorded based on whether they were listed as a recipient of an NSF Grant on the NSF Advance Internet portal. The binary indicator *union* controls for the presence of a faculty union organization as catalogued by the American Association of University Professors (AAUP) website. As previously explained, extension service forms a unique cornerstone of many agricultural economics appointments. Therefore, the binary indicator *extension* controls for if a faculty member's profile or curriculum vitae described extension service as part of his or her appointment.

Finally, a dichotomous variable *Curriculum Vitae Given* was generated depending on whether the individual faculty member gave an accessible curriculum vitae or equivalent information. Though this is not directly related to predicting the promotion of women, this variable was of interest given the revealed information problem to related to giving or withholding professional history.

Model

The dependent variable is a 0 through 2 ordinal categorical variable indicating tenure status within an ordered probit model defining the rank of individual faculty member i in terms of a latent variable Y_i^* and tenure/promotion status Y_i :

$$Y_i^* = X_i\beta + \varepsilon_i;$$

$$Y_i = j \text{ if } b_j < Y_i^* \leq b_{j+1}; j = 0,1,2$$

$$Y_i^* = X_i\beta + \varepsilon_i \varepsilon_i \sim N(0,1) \tag{1}$$

The threshold b_0 is normalized to 0, and thresholds b_1 and b_2 are estimated, as is the vector of parameters β , where j represents successive academic ranks, so that

$$\begin{aligned} Y_i &= 0 \text{ (assistant professor) if } Y_i^* \leq 0 \\ Y_i &= 1 \text{ (associate professor) if } b_1 < Y_i^* \leq b_2 \\ Y_i &= 2 \text{ (full professor) if } b_2 < Y_i^* \end{aligned} \tag{2}$$

Where X_i is a vector of independent variables that are classified under the headings of individual's institutional work-life programs (presence of dual career policy, on-campus child care, and NSF ADVANCE Program for Institutional Transformation), personal characteristics (gender, post Ph.D. experience. and average annual publications) and dichotomous variables for the university's rank, type and location. The error term ε_i is assumed to be normally distributed.

The analysis was performed at the university level and within rank subsamples. There is a strong correlation between dual-career policy and NSF Advance variables since the NSF gives Advance IT grants in the presence of institutional initiatives to improve the prevalence of women in STEM. To control for multicollinearity, we report the results of the impact of NSF Advance

program in Model 1 and the impact of dual-career policy in Model 2. The ordered probit model predicts estimates of the relationship between work-life policies, university attributes with tenure status of faculty members.

A Seemingly Unrelated Regression (SUR) framework was used to examine the effects of work-life programs on the percentage of women across and within academic ranks. The model consists of $j = 1, 2, 3$ linear equations for $i = 1, 2, \dots, N$ universities. The j^{th} equation for economics department i is

$$f_{ij} = x_{ij}' \beta_j + u_{ij} \quad (3)$$

where f_{ij} is the percentage of female faculty in the economics department of university holding academic rank j . The error terms are assumed to have zero means, homoscedastic, and be independent across institutions. For a given department, the errors are assumed correlated across equations such that $E(u_{ij}u_{ij'} | x) = \sigma_{jj'}$. This stands to reason since, as explained above, the presence of women in higher ranks will strongly correlate to the number of women in lower ranks and their promotion potential. X_j is the vector of regressors including work-life support programs, personal and institutional characteristics as for the probit model.

Results

The results here are presented topically i.e. in the order of analysis with the combined sample analysis presented first, the economics faculty next and the agricultural and applied economics analysis providing the analysis of the final set of tables.

Table 1.1 shows more female faculty members occupy assistant and associate professorships by an estimated 4 and 3 percent respectively. Female faculty across both samples also had an estimated three years fewer experience than their male counterparts and produced less than on publication on average per year. 49 percent of female faculty in the combined sample came from agricultural and applied economics faculty, yet only 31 percent of sampled female faculty occupied positions at top 50 ranked institutions compared to 46 percent of male faculty. 9 percent more female faculty than male faculty worked at universities with onsite childcare, and 8 percent more were employed by institutions with NSF Advance IT programs. 72 percent of sampled female faculty worked at institutions with Dual Hire programs while only 69 of male faculty did. 11 percent more female faculty were employed by universities with unions, and 17 percent more female professors worked at public institutions than male professors.

Of note in Table 1.2 is that 24 percent of all publications recorded were authored or coauthored by female academics. This compares to female faculty composing 30 percent of the sample.

The ordered probit analysis demonstrated positive relationships between NSF Advance programs and faculty unions and the promotion of women up the academic rank ladder, as displayed in Table 1.3. However, Dual Hire programs positively correlated to promotions of male faculty. Moreover, a top 50 institutional employers related positively to male faculty receiving promotions but not for female faculty, indicating positive networking effects for top 50 institutional employers for men but not women.

The relationships changed the direction between some institutional programmatic characteristics and proportions of female faculty. On-campus childcare significantly predicted lower percentages of female full professors but had no statistically significant impact any other

level. Unions correlated to lower percentages of assistant and full female professors. NSF advance programs predicted higher proportions of assistant female faculty but lower proportions of associate professors. The opposite was true for Dual Hire programs.

Table 2.1 provides the proportion statistics for the economics sample from the 2017 data. As has been determined in previous studies, the proportion of male faculty far exceeds that of female faculty in full professorships. Moreover, the leaky pipeline of promotion hypothesis for female faculty appears to stand. Specifically, the female assistant professors account for 38 percent of all female faculty, but female associate professors account for only 27 percent of female faculty. The proportion recovers at the female full professor level, which accounts for 35 percent of all female faculty. However, this still pales in comparison to the over 50 percent of male faculty who were full professors. Female faculty on average produced fewer publications per year, roughly 0.72, compared to 1.07 for male faculty. Top 50 institutions were predicted to have statistically significant lower percentages of assistant and full female professors. Public institutions had significantly fewer female faculty members at all levels. However, agricultural and applied economics departments were estimated to have higher levels of female faculty at all levels.

Moreover, fewer women than men in the sample worked at top 50 ranked Ph.D. institution with only 37 percent of women working at said institutions vis-à-vis 47 percent of men. Roughly equal proportions of men and women worked at institutions with on-site childcare, a Dual Hire policy and NSF Advance IT grants. 4 percent more women than men worked at public institutions as the literature would suggest. A development from 2012 is that Dual Hire policies have increased with only 19 percent of sampled institutions having such a policy on the books in 2012 compared to 68 percent of institutions have a formal dual career policy in 2017.

34 percent of female faculty and 35 percent of male faculty work at institutions with faculty unions. This is also an increase from 2012 when only 19 percent of institutions sampled had a faculty union of some sort.

In Table 2.2, of note is that female faculty accounted for only ten percent of all publications produced. Moreover, only 13 percent of full professors were women compared to 26 percent of all assistant professorships and 23 percent of all associate professorships.

Table 2.3 provides the probit model regression estimates. The full sample, female only and male only estimates all indicate a significant positive association between average annual publications and experience and the probability of being promoted to higher ranks. Moreover, the all sample model indicated a significant relationship between the female binary indicator and being promoted to higher ranks. However, the top 50 PhD-granted institution and top 50 current employer rankings predictors only proved significant as predictors for the full sample and male subsample. This would indicate women are not advancing because of the level of their education or employment pedigree. Unions had no impact on the probability of female or male moving higher up the tenure promotion ladder.

Table 2.4 provides the seemingly unrelated regressions (SUR) results. Two models, one with the NSF Advance indicator and one with the Dual Hire policy indicator, were run for the percentage of female faculty at each rank. On-campus childcare only significantly predicted higher percentages of female faculty at the assistant and full professor level at the 0.10 significance level. NSF Advance programs significantly predicted higher percentages of female assistant and full professors. A current job at a top 50 ranked department significantly predicted lower percentages of female faculty at all levels, as did public university employment for female assistant and associate professors. However, employment at a public institution predicted higher

levels of female full professors. As in the ordered probit analysis, the SUR results indicated unions had no impact on increasing the proportions of women at any level along the tenure track.

Table 3.1 demonstrates that proportional trends for female faculty vis-à-vis male faculty in agricultural economics persisted in that fewer women than men occupied full professorships by an estimated 14 percent. The leaky pipeline of tenure all persists as the proportion of female associate professors drops vis-à-vis female assistant professors but recovers at the full professor position. Of note, however, is that more women than men provided CVs. Moreover, 78 percent of all agricultural economics departments were at institutions with Dual Hire programs, and 99 percent of all sample institutions provided onsite childcare. 55 percent of institutions had faculty unions of which 56 percent of female faculty and 55 percent of male faculty worked at universities with unions. Furthermore, 9 percent more women than men were employed by universities in a rural setting. Finally, 31 percent of all faculty were involved in some form of extension work, 23 percent of women and 33 percent of men respectively had some form of extension appointment.

Table 3.2 indicates similar proportions for female faculty versus the overall faculty sample persist between economics and agricultural economics faculties. However, female agricultural economics faculties account for 2 percent more of publications overall than their counterparts in economics. This could, however, be attributed to a much smaller sample size. It should also be noted that all 34 of sample female associate professors of agricultural or applied economics had access to on-campus childcare.

The probit modeling presented in Table 3.3 indicates that childcare predicts lower probability of being in higher faculty ranks for female faculty. The NSF Advance binary predicts higher faculty ranking in the overall sample. Participation in extension activities also did not

predict high or lower faculty rankings for either male or female faculty. Moreover, unions did not significantly predict higher or lower faculty ranks for male or female faculty. Finally, average annual publication and experience predict a faculty member will be in a higher rank for male faculty, female faculty and faculty members in general.

Finally, the SUR results for the agricultural and applied economics sample in Table 3.4 demonstrated strong positive significance for childcare as predictor for the percentage of female assistant professors. Conversely, the onsite childcare binary predictor related to a decrease in the percentage of female full professors in agricultural economics. The NSF Advance parameter estimate significantly predicted higher proportions of both assistant and associate female professors. Unions only significantly correlated to a decrease in the percentages of female full professors of agricultural or applied economics. The estimates for top 50 ranked employer were significant for all rank levels across all six regressions. Urban location significantly related to fewer female faculty members across all six iterations of the model while a public university correlated to increased percentages of female associate and full professors in agricultural or applied economics. Finally, extension significantly predicted more associate level female faculty at 5 percent significance.

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Chapter 2 Tables

Table 1.1 Descriptive Statistics for Economics and Agricultural/Applied Economics Doctoral Granting Institutions (Year=2017/2016)

<i>Characteristics</i>	<i>Full sample (No = 2868)</i>		<i>Female sample (No = 519)</i>		<i>Male sample (No = 2349)</i>	
	<i>Mean</i>	<i>Std. D.</i>	<i>Mean</i>	<i>Std. D.</i>	<i>Mean</i>	<i>Std. D.</i>
Faculty Characteristics						
Female	0.30	0.46				
Assistant Professor	0.26	0.44	0.29	0.45	0.25	0.43
Associate Professor	0.22	0.41	0.24	0.43	0.21	0.41
Full Professor	0.52	0.50	0.47	0.50	0.54	0.50
Experience (years)	20.75	13.92	18.57	12.82	21.64	14.25
Average annual publication	1.03	0.90	0.94	0.93	1.07	0.88
Curriculum Vitae Provided	0.92	0.35	0.92	0.27	0.92	0.33
Agricultural/Applied Economics	0.19	0.39	0.49	0.50	0.07	0.25
Current job at top 50 ranked university	0.42	0.49	0.31	0.46	0.46	0.50
Employed by a top 50 department	0.51	0.50	0.46	0.50	0.53	0.50
Institutional Characteristics						
On-Campus Child Care Facilities	0.83	0.38	0.89	0.31	0.80	0.40
Dual Career Policy	0.70	0.46	0.72	0.45	0.69	0.46
NSF ADVANCE IT Program	0.23	0.42	0.29	0.45	0.21	0.41
Union	0.38	0.49	0.46	0.50	0.35	0.48
Public	0.67	0.47	0.79	0.41	0.62	0.49

Table 1.2 Female Distribution on Key Variables for the Combined Sample

	<i>Total</i>	<i>Assistant</i>	<i>Associate</i>	<i>Full</i>
Number of Faculty	3,861	1,004	849	2,008
Number of Female Faculty	1,139	330	273	535
Percent Female	30%	33%	32%	27%
<i>On Campus Child Care Facilities</i>				
Number of Faculty	3,205	833	705	1,667
Percent Female	32%	33%	34%	29%
<i>Dual Career Policy</i>				
Number of Faculty	2,703	703	594	1,406
Percent Female	30%	34%	33%	27%
<i>NSF ADVANCE Program</i>				
Number of Faculty	888	231	195	462
Percent Female	37%	41%	41%	34%
<i>Union</i>				
Number of Faculty	1,467	382	323	763
Percent Female	36%	40%	39%	32%
<i>Average annual publications</i>				
Total Published Articles and Books	89,461	3,397	10,285	75,658
Percent Female Publications	24%	36%	32%	22%
<i>Curriculum Vitae Provided</i>				
Number of Faculty	3,552	924	781	1,847
Percent Female	30%	33%	32%	27%
<i>Current job at top 50 ranked department</i>				
Number of Faculty	1,622	422	357	843
Percent Female	22%	24%	24%	20%

Table 1.3 Ordered Probit Estimation, Dependent Variable Rank, Combined Sample

	<i>All</i>		<i>Female</i>		<i>Male</i>	
	<i>b(se)</i>	<i>b(se)</i>	<i>b(se)</i>	<i>b(se)</i>	<i>b(se)</i>	<i>b(se)</i>
Female	0.132* (0.058)	0.124* (0.058)				
Dual Career Policy		0.085 (0.057)		0.037 (0.107)	0.146*	(0.072)
On-Campus Child Facilities	0.118 (0.073)	0.076 (0.072)	0.050 (0.159)	0.001 (0.156)	0.116 (0.084)	0.081 (0.083)
Union	0.079 (0.057)	0.118* (0.055)	0.156 (0.107)	0.214* (0.104)	0.044 (0.070)	0.069 (0.068)
NSF Advance	0.179** (0.062)		0.244* (0.110)		0.110 (0.080)	
Average annual publications	0.843*** (0.065)	0.843*** (0.065)	0.711*** (0.096)	0.702*** (0.096)	0.947*** (0.096)	0.943*** (0.096)
Experience	0.219*** (0.018)	0.219*** (0.018)	0.240*** (0.013)	0.239*** (0.013)	0.349*** (0.015)	0.351*** (0.015)
Experience2	-0.002*** 0.000	-0.002*** 0.000	-0.002*** (0.000)	0.002*** (0.000)	0.005*** 0.000	0.005*** 0.000
Current job at top 50 ranked universities	0.309*** (0.061)	0.300*** (0.061)	0.135 (0.116)	0.141 (0.116)	0.451*** (0.077)	0.425*** (0.078)
Public	-0.044 (0.070)	-0.070 (0.070)	-0.150 (0.145)	-0.193 (0.142)	-0.039 (0.083)	-0.74** (0.085)
Agricultural/Applied Economics	-0.129 (0.076)	-0.080 (0.072)	-0.140 (0.118)	-0.080 (0.112)	-0.118 (0.131)	-0.084 (0.124)
cut1	2.930*** (0.164)	2.908*** (0.168)	2.834*** (0.230)	2.752*** (0.234)	3.960*** (0.197)	3.995*** (0.201)
cut2	4.699*** (0.205)	4.674*** (0.208)	4.770*** (0.300)	4.768*** (0.305)	4.738*** (0.267)	4.735*** (0.271)
Number of observations	3754	3754	1087	1087	2667	2667
Chi-square	1222.467	1218.857	370.739	372.198	752.266	747.598
PseudoR2	0.570	0.569	0.583	0.581	0.615	0.615
Log - Likelihood	-1661.855	-1664.580	-482.389	-484.591	-1038.348	-1037.104

Table 1.4 SUR Estimation Results for Percentage of Economics and Agricultural/Applied Female Faculty by Rank

Independent variable	Assistant Professor		Associate Professor		Full Prof
	b(se)	b(se)	b(se)	b(se)	b(se)
On-campus child care	3.93 (2.08)	2.21 (1.93)	-3.56 (2.04)	-3.05 (1.92)	-4.02*** (1.21)
Union	-3.09* (1.47)	0.09 (1.20)	0.59 (1.52)	-0.40 (1.51)	-1.60 (0.91)
NSF ADVANCE	4.29** (1.52)		-8.16*** (1.66)		-1.10 (0.94)
Dual Career Policy		-3.080* (1.42)		6.40*** (1.58)	
Current job at top 50 ranked departments	-11.90*** (1.44)	-10.99*** (1.94)	0.07 (1.57)	-2.06 (1.68)	-5.306*** (0.80)
Agricultural/Applied Economics	6.05*** (1.69)	10.77*** (1.48)	27.64*** (1.47)	24.69*** (2.04)	29.86*** (0.99)
Public school	-8.08*** (1.91)	-5.42*** (1.48)	-8.34*** (1.93)	-8.94*** (2.04)	-3.69*** (0.99)
Constant	38.83*** (2.54)	39.313*** (2.23)	37.79*** (2.21)	33.35*** (2.15)	29.70*** (1.33)

Notes: *** denotes significance at 1%, ** at 5%, and *at 10%. The omitted reference category (location suburban)

Table 2.1 Descriptive Statistics for 133 U.S. Economics Doctoral Granting Institutions (Year=2017)

<i>Characteristics</i>	<i>Full sample (No = 3206)</i>		<i>Female sample (No = 601)</i>		<i>Male sample (No = 2605)</i>	
	<i>Mean</i>	<i>Std. D.</i>	<i>Mean</i>	<i>Std. D.</i>	<i>Mean</i>	<i>Std. D.</i>
Faculty Characteristics						
Female	0.19	0.39				
Assistant Professor	0.27	0.44	0.38	0.49	0.24	0.43
Associate Professor	0.22	0.41	0.27	0.44	0.21	0.41
Full Professor	0.51	0.50	0.35	0.48	0.55	0.50
Curriculum Vitae Given	0.92	0.33	0.92	0.28	0.92	0.34
Experience (years)	20.86	14.22	15.75	12.50	22.04	14.33
Average annual publication	1.01	0.85	0.72	0.57	1.07	0.88
Top 50 Ph.D.	0.71	0.45	0.71	0.45	0.71	0.46
Current job at top 50 ranked department	0.45	0.50	0.37	0.48	0.47	0.50
Institutional Characteristics						
On-Campus Child Care Facilities	0.80	0.40	0.80	0.40	0.79	0.40
Dual Career Policy	0.69	0.46	0.68	0.47	0.69	0.46
NSF ADVANCE IT Program	0.20	0.40	0.21	0.41	0.20	0.40
Union	0.34	0.47	0.35	0.48	0.34	0.47
Public	0.61	0.49	0.64	0.48	0.60	0.49

Table 2.2 Female Distribution on Key Variables for 2017 Economics Departments

	<i>Total</i>	<i>Assistant</i>	<i>Associate</i>	<i>Full</i>
Number of Faculty	3194	862	703	1629
Number of Female Faculty	600	228	162	210
Percent Female	19%	26%	23%	13%
<i>On Campus Child Care Facilities</i>				
Number of Faculty	2,555	690	562	1303
Percent Female	19%	26%	23%	13%
<i>Dual Career Policy</i>				
Number of Faculty	2203	595	485	1124
Percent Female	19%	26%	23%	13%
<i>NSF ADVANCE Program</i>				
Number of Faculty	639	172	141	326
Percent Female	20%	28%	24%	14%
<i>Union</i>				
Number of Faculty	1,086	293	239	554
Percent Female	19%	27%	24%	13%
<i>Curriculum Vitae Provided</i>				
Number of Faculty	2938	793	647	1499
Percent Female	19%	26%	23%	13%
<i>Average annual publications</i>				
Total Published Articles and Books	74,346	2,527	8,160	63,659
Percent Female Publications	10%	23%	20%	9%
<i>Top 50 Ph.D.</i>				
Number of Faculty	2,268	612	599	1,157
Percent Female	19%	26%	23%	13%
<i>Current job at top 50 ranked department</i>				
Number of Faculty	1,437	388	316	733
Percent Female	15%	22%	19%	11%

Table 2.3 Ordered Probit Estimates for the Economics Ph.D. Granting Departments (Year=2017)

	<i>All</i>		<i>Female</i>		<i>Male</i>	
	<i>M1</i>	<i>M2</i>	<i>M1</i>	<i>M2</i>	<i>M1</i>	<i>M2</i>
	<i>b(se)</i>	<i>b(se)</i>	<i>b(se)</i>	<i>b(se)</i>	<i>b(se)</i>	<i>b(se)</i>
Female	0.176**	0.176**				
	(0.065)	(0.065)				
Dual Career Policy		0.061		0.071	0.116	
		(0.063)		(0.145)		(0.073)
On-Campus Child Facilities	0.076	0.052	-0.032	-0.056	0.108	0.084
	(0.073)	(0.072)	(0.172)	(0.169)	(0.085)	(0.084)
NSF Advance	0.098		0.085		0.067	
	(0.070)		(0.172)		(0.079)	
Union	0.097	0.115	0.269	0.287	0.050	0.063
	(0.063)	(0.061)	(0.150)	(0.147)	(0.072)	(0.070)
Average annual publications	1.064***	1.063***	1.520***	1.518***	1.004***	0.999***
	(0.097)	(0.097)	(0.251)	(0.249)	(0.107)	(0.107)
Experience	0.216***	0.216***	0.245***	0.245***	0.352***	0.353***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.016)	(0.016)
Experience2	-0.002***	-0.002***	-0.001***	-0.001***	-0.005***	-0.005***
	0.000	0.000	(0.000)	(0.000)	0.000	0.000
Top 50 Ph.D.	0.180**	0.179**	0.183	0.186	0.201**	0.197**
	(0.063)	(0.063)	(0.157)	(0.157)	(0.071)	(0.071)
Current job at top 50 ranked departments	0.371***	0.363***	0.340*	0.333	0.481***	0.458***
	(0.070)	(0.071)	(0.169)	(0.173)	(0.082)	(0.083)
Public	-0.005	-0.017	-0.071	-0.084	-0.013	-0.041
	(0.072)	(0.074)	(0.168)	(0.172)	(0.085)	(0.086)
cut1	3.201***	3.199***	3.655***	3.663***	4.162***	4.191***
	(0.182)	(0.185)	(0.348)	(0.347)	(0.221)	(0.224)
cut2	5.026***	5.020***	5.688***	5.670***	6.255***	6.287***
	(0.227)	(0.230)	(0.422)	(0.419)	(0.299)	(0.304)
Number of observations	31331	3131	589	589	2542	2542
Chi-square	964.141	963.661	232.390	232.130	644.454	642.220
PseudoR2	0.584	0.584	0.599	0.599	0.623	0.623
Log - Likelihood	-1343.935	-1344.362	-256.509	-256.505	-961.516	-960.580

Table 2.4 SUR Estimation Results for Percentage of Female Economics Faculty by Rank (Year = 2017)

Independent variable	Assistant Professor		Associate Professor		Full Professor	
	b(se)	b(se)	b(se)	b(se)	b(se)	b(se)
On-campus child care	4.46* (1.98)	2.78 (1.89)	0.66 (1.78)	0.23 (1.71)	1.28* (0.61)	1.41* (0.62)
NSF ADVANCE	7.89*** (1.69)		-1.90 (1.61)		1.71*** (0.53)	
Dual Career Policy		-1.26 (1.61)		6.52*** (1.58)		-2.68*** (0.60)
Current job at top 50 ranked departments	-12.89*** (1.66)	-12.24** (1.34)	-2.43 (1.56)	-4.48** (1.63)	-3.35*** (0.63)	-2.60*** (0.65)
Public school	-7.55*** (2.05)	-3.80* (1.57)	-3.02 (1.78)	-4.37** (1.85)	0.94 (0.67)	1.54* (0.72)
Union	-2.15 (1.69)		-1.41 (1.49)	-1.64 (1.46)	-0.13 (0.62)	0.29 (0.60)
Constant	32.75*** (2.23)	35.06*** (2.44)	25.86*** (1.99)	23.07*** (1.91)	12.77*** (0.71)	13.99*** (0.72)

Notes: *** denotes significance at 1%, ** at 5%, and *at 10%. The omitted reference category (location suburban)

Table 3.1 Descriptive Statistics for 32 U.S. Doctoral Granting Institutions in Agricultural Economics (Year=2016)

<i>Characteristics</i>	<i>Full sample (No = 737)</i>		<i>Female sample (No = 142)</i>		<i>Male sample (No = 595)</i>	
	<i>Mean</i>	<i>Std. D.</i>	<i>Mean</i>	<i>Std. D.</i>	<i>Mean</i>	<i>Std. D.</i>
Faculty Characteristics						
Female	0.19	0.39				
Assistant Professor	0.23	0.42	0.39	0.49	0.19	0.39
Associate Professor	0.23	0.42	0.24	0.35	0.22	0.42
Full Professor	0.54	0.50	0.35	0.48	0.59	0.59
Extension Professor	0.31	0.46	0.23	0.42	0.33	0.47
Experience (years)	20.37	12.40	14.06	9.78	21.94	12.49
Average annual publication	1.16	1.08	1.00	0.81	1.20	1.14
Current job at top 50 ranked department	0.23	0.42	0.26	0.44	0.22	0.42
Curriculum Vitae Given	0.94	0.24	0.97	0.17	0.93	0.25
Institutional Characteristics						
On-Campus Child Care Facilities	0.99	0.12	0.99	0.12	0.99	0.12
Dual Career Policy	0.78	0.41	0.76	0.43	0.78	0.41
NSF ADVANCE IT Program	0.44	0.50	0.48	0.50	0.44	0.50
Union	0.55	0.50	0.56	0.50	0.55	0.50
Urban	0.69	0.46	0.62	0.49	0.71	0.45
Rural	0.31	0.46	0.38	0.49	0.29	0.45
Public	0.95	0.21	0.96	0.20	0.95	0.12

Table 3.2 Female Distribution on Key Variables for Agricultural/Applied Economics

	<i>Total</i>	<i>Assistant</i>	<i>Associate</i>	<i>Full</i>
Number of Faculty	737	169	168	400
Number of Female Faculty	142	58	34	50
Percent Female	19%	34%	20%	13%
<i>On Campus Child Care Facilities</i>				
Number of Faculty	730	168	166	396
Percent Female	19%	34%	20%	13%
<i>Dual Career Policy</i>				
Number of Faculty	575	132	131	312
Percent Female	19%	33%	20%	13%
<i>NSF ADVANCE Program</i>				
Number of Faculty	324	74	74	176
Percent Female	21%	38%	22%	14%
<i>Extension</i>				
Number of Faculty	228	52	52	124
Percent Female	14%	26%	15%	9%
<i>Curriculum Vitae Given</i>				
Number of Faculty	693	159	158	376
Percent Female	20%	35%	21%	13%
<i>Average annual publications</i>				
Total Published Articles and Books	16,723	911	2,392	13,420
Percent Female Publications	12%	29%	21%	9%
<i>Public University</i>				
Number of Faculty	700	160	160	380
Percent Female	19%	35%	20%	13%
<i>Current job at top 50 ranked department</i>				
Number of Faculty	170	39	39	92
Percent Female	22%	39%	23%	14%

Table 3.3 Ordered Probit Estimation, Dependent Variable Rank Agricultural/Applied Economics

	<i>All</i>		<i>Female</i>		<i>Male</i>	
	<i>M1</i>	<i>M2</i>	<i>M1</i>	<i>M2</i>	<i>M1</i>	<i>M2</i>
	<i>b(se)</i>	<i>b(se)</i>	<i>b(se)</i>	<i>b(se)</i>	<i>b(se)</i>	<i>b(se)</i>
Female	-0.012 (0.152)	-0.003 (0.152)				
Dual Career Policy		-0.033 (0.160)		0.188 (0.359)	-0.104 (0.182)	
On-Campus Child Facilities	-0.276 (0.915)	-0.054 (0.917)	- 5.091*** (0.491)	- 4.785*** (0.513)	0.227 (1.151)	0.471 (1.158)
NSF Advance	0.289* (0.137)		0.424 (0.312)		0.252 (0.150)	
Union	0.097 0.134	0.156 0.131	0.012 0.316	0.163 0.286	0.107 0.147	0.139 0.146
Extension	0.092 (0.141)	0.090 (0.142)	0.112 (0.348)	0.092 (0.370)	0.127 (0.153)	0.126 (0.153)
Average annual publications	0.548*** (0.101)	0.542*** (0.102)	0.638*** (0.177)	0.641*** (0.175)	0.531*** (0.116)	0.524*** (0.116)
Experience	0.373*** (0.033)	0.370*** (0.033)	0.419*** (0.055)	0.409*** (0.059)	0.366*** (0.041)	0.365*** (0.041)
Experience2	- 0.005*** (0.001)	- 0.005*** (0.001)	- 0.006*** (0.001)	- 0.006*** (0.001)	- 0.005*** (0.001)	- 0.005*** (0.001)
Current job at top 50 ranked universities	-0.170 (0.160)	-0.257 (0.150)	-0.222 (0.343)	-0.331 (0.298)	-0.143 (0.180)	-0.218 (0.171)
Urban	-0.032 (0.126)	-0.078 (0.128)	0.038 (0.281)	-0.007 (0.274)	-0.089 (0.145)	-0.133 (0.148)
Public	0.157 (0.310)	-0.091 (0.279)	0.350 (0.546)	0.034 (0.418)	0.133 (0.377)	-0.088 (0.350)
cut1	3.680*** (0.997)	3.463*** (0.994)	-0.230 (0.774)	-0.347 (0.798)	3.960** (1.251)	3.753** (1.245)
cut2	5.671*** (1.044)	5.442*** (1.045)	1.465 (0.868)	1.317 (0.923)	6.096*** (1.326)	5.885*** (1.323)
Number of observations	692	692	138	138	554	554
Chi-square	279.774	273.921	479.061	464.060	225.266	226.775
PseudoR2	0.596	0.593	0.567	0.561	0.599	0.597
Log - Likelihood	-284.105	-286.302	-64.245	-65.036	-216.151	-217.316

Table 3.4 SUR Estimation Results for Percentage of Agricultural/Applied Female Faculty by Rank

Independent variable	Assistant Professor		Associate Professor		Full Professor	
	b(se)	b(se)	b(se)	b(se)	b(se)	b(se)
On-campus child care	36.32*** (5.37)	40.47*** (5.77)	---	---	-16.13*** (1.14)	-13.28*** (1.24)
NSF ADVANCE	8.22* (3.95)		6.04** (2.12)		2.381** (0.85)	
Union	-0.87 (3.63)	01.00 (3.74)	2.64 (2.20)	3.00 (2.54)	-2.46** (0.78)	-2.06* (0.80)
Dual Career Policy		0.00 (4.05)		-3.49 (3.01)		-1.22 (0.94)
Extension	-3.30 (4.21)	-3.30 (4.33)	4.87** (1.83)	4.72* (1.91)	-0.340 (0.72)	-0.64 (0.73)
Current job at top 50 ranked universities	11.00* (4.41)	8.46* (4.04)	18.03*** (2.84)	16.21*** (2.92)	-2.56* (1.12)	-3.39*** (0.99)
School in urban area	-11.79** (4.23)	-10.91* (4.44)	-15.49*** (3.01)	-16.97*** (3.07)	-1.93* (0.92)	-2.54** (0.88)
Public school	5.86 (4.93)	-2.61 (3.59)	24.20*** (4.78)	19.22*** (4.70)	9.613*** (1.12)	7.55*** (1.01)
Constant	-5.00 (6.14)	1.61 (5.65)	-1.50 (4.32)	9.93 (5.07)	21.46*** (1.37)	23.17*** (1.25)

Notes: *** denotes significance at 1%, ** at 5%, and *at 10%. The omitted reference category (location suburban) On-campus child care yielded no SUR estimates since every female associate professor sampled had access to on-campus child care.

CHAPTER THREE: CONCLUSIONS

The results presented in Chapter 2 demonstrate that the leaky pipeline of tenure still endures for female faculty in the economics and agricultural economics disciplines. However, it is unclear if economic sciences are still dismal for female professionals in this discipline. Indeed, Dual Hire programs have grown almost threefold since 2012. This indicates a strong trend in colleges and universities wherein institutions of higher education are at least addressing the two-body problem in academia if not outrightly addressing it. NSF Advance grantee status has fallen somewhat, but this could be attributed to a combination of grant expiration and an increased sample size in this paper's analysis vis-à-vis the Juraquolova study. Of interest to future investigations is the significant positive relationship between a department's status as an agricultural and applied economics faculty and percentages of female faculty at all levels.

Top 50 ranked employers also significantly predicted male faculty at higher levels of the tenure ladder but not female faculty. This trend held true for male faculty in economics departments with Ph.D. degrees from top ranked institutions. This indicates the networks and branding bonus of top ranked institutions benefits male faculty but not female. The cross-departmental analysis indicated female faculty needed fewer publications than male faculty to be at higher the levels of the tenure pipeline in terms of the absolute value of the parameter estimate. The absolute difference, however, is small enough to not likely be significant. However, the analyses for the economics and agricultural economics faculties in their individual sample sets indicated female faculty needed more publications to climb the faculty ladder than their male counterparts. This could indicate lower expectations for women when departmental distinctions are ignored; however, female faculty in traditionally male-dominated academic

disciplines must produce more than their male counterparts to receive the same professional advancement.

However, women faculty still only produce roughly a tenth of all publications in both samples. Though this could be attributed to women only making up 19 percent of all faculty overall and 13 percent of full professorships in particular, this does not bode well given promotion is based on productivity. On the other hand, in both samples the merit-based predictors of promotion, average annual publications and experience, were highly significant for men and women. This could perhaps signal a shift toward that happy state when faculty regardless of gender are finding themselves rewarded for their work on the merits and are finding their needs met inside and outside the department building. Indeed, the full economics sample probit analysis would indicate being female as more beneficial and more indicative of a positive probability of promotion than being male. The SUR results for the general economics sample would also indicate work-life policies work well for different rank levels. NSF Advance policies seem to improve the percentages of women at the assistant and full professor levels while Dual Hire programs improve the percentages of associate professors. In other words, NSF Advance programs improve getting women into the pipeline of tenure and out the end while Dual Hire programs usher women through the middle. Moreover, childcare seems to do more for female assistant and full professors in the context of NSF Advance. NSF Advance might also have a signaling effect to female assistant professors such that it ushers them into an institution and work-life balancing initiatives take over from there. Indeed, the signaling effect might be commensurate with programs like “women in STEM” groups and programs that support women at the baccalaureate and PhD level.

The results could also be signalling that women at different academic ranks have different tastes and preferences in terms of the work-life programs important to them. For example, the positive SUR parameter estimates for childcare with regard to female assistant professors of agricultural economics and negative estimates for their female full professor counterparts could be due to age differences. In other words, female assistant professors are more likely at stage of life contemporary to decisions about marriage and childbearing. Full professors by virtue of the time needed to attain this position, either for male or females, make those in this level of academia less likely to be at a lifestage where establishing a family is also part of a decision set.

Moreover, NSF Advance IT initiatives at institutions with agricultural or applied economics departments have significant predictive power for higher percentages of female professors of all levels agricultural or applied economics. The SUR estimates also yielded no prediction for the impact of on-campus childcare on the percentages of associate female professors at sample agricultural economics departments. Further analysis indicated that all 34 female associate professors had access to onsite childcare. The small sample problem likely played a roll here: only 19 percent, or 142 individuals, formed the sample of female faculty from agricultural and applied economics departments. Female agricultural economics also seem to prefer public institutions if they are at the associate or full level, though there were few private institutions in the agricultural economics sample.

Econometrically, the SUR estimates for the agricultural and applied could have been plagued by the use of percentages, or statistics limited to a range between zero and one, as responses. In the case of dealing with an exceptionally small sample compared to the larger

sample set of economics departments, attempting to use counts rather than percentages would provide for additional predictive power in the context of small samples.

The lack of significance for Dual Hire or NSF Advance binary indicators should not be taken as immediately discouraging given the incredible expansion of these programs across institutions in the last five years. Indeed, the lack of predictive power in these variables could be due to a threshold in their effectiveness. If women are not being encouraged to enter into STEM fields, particularly economics, prior to PhD work, it may make no difference how many institutions look to create programs to successfully aid women faculty down the pipeline to tenure and full professorship. Ma (2011) indicated women are three times likely than men to declare a STEM field preference in high school and suggests recruiting women at this level and retention of women in STEM fields at the undergraduate level is essential to keeping women in the STEM track. Future research should be focused on these 'a priori' programs and initiatives aimed at encouraging women into STEM field, including economics, in these formative years. Indeed, post hoc efforts at improving the recruitment and retention of women in economics after they have gone beyond the PhD threshold.

We may also be waiting for the delayed response to many of these programs. Hale and Regev (2014) claimed a larger share of women in economics faculties at top universities has led to more women graduating from those PhD programs. This will, in turn, lead to more female faculty at these and other institutions, leading to more women at both the baccalaureate and graduate levels. Indeed, the CSWEP still estimates that despite a slowdown in the advancement of women in the economic profession the number of women graduating with PhD degrees in economics and entering into the tenured ranks of economics faculties has still grown. A combination of efforts at the secondary school, undergraduate, graduate and professional levels

will all be required to advance the presence and status of women in the economics and all STEM professions. Work-life balance programs will be part of this solution. Even if these programs do not provide the strident increases of women in the economics profession many hope for, they are still normatively good and just for women currently in the economics pipeline. They give women in economics and yet to enter the discipline the stepping stones to have the capability to form meaningful careers and lives. Finally, they provide the context in which ever greater numbers of women will provide role models and guides for future generations of female and also male economists in the United States and abroad.

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APPENDIX

Appendix A. Variables Definition and Sources

Variable	Description
Gender ^a	1 if female, 0 otherwise
Rank ^a	Indicators for assistant, associate and full professors
U.S. Bachelor Degree ^a	1 if U.S. bachelor degree, otherwise
Experience (years)	Years since Ph.D. graduation
Average annual publications ^a	Number of publications divided by years of experience
Top 50 Ph.D. ^{a, b}	1 if an individual obtained his/her PhD degree at one of 50 top ranked economics departments, 0 otherwise
Current job at top 50 ranked departments ^{a, b}	1 if 50 top ranked economics department, 0 otherwise
% Female ^a	Percent of full-time female faculty
% Female by Rank ^a	Percent of full-time female faculty in each rank
% Female Publications ^a	Percent of Female publications in department
Percent Female Publications by rank ^a	Percent of Female publications in each rank
On-Campus Child Care Facility ^c	1 if on-campus child care facility, 0 otherwise
Dual Career Policy ^c	1 if the university supports dual-career initiatives via the official webpage, 0 otherwise
NSF ADVANCE Program ^d	1 if the university has received an IT NSF ADVANCE Grant, 0 otherwise
Union ^e	1 if the university has a faculty union, 0 otherwise
Campus ^f	Indicator variables for rural, urban, and suburban locations of universities
Type ^f	Indicator variables for private and public universities

^a Economics and Agricultural Economics Departments' websites and faculty resume

^b 2012, 2017 U.S. News and World Report Rankings of Best Grad Schools and Research Papers in Economics Ideas Rankings of International and Nationals Economics Schools

^c University websites

^d ADVANCE Portal at <http://www.portal.advance.vt.edu/index.php/awards>

^e *Directory of U.S. Faculty Contracts and Bargaining Agents in Institutions of Higher Education*, The National Center for the Study of Collective Bargaining in Higher Education and Professions, New York, NY: March 2012. (for the Juraquolova Study); American Association of University Professors website <https://www.aaup.org/aaup-chapter-websites> (for the Laferriere Study)

^f The Carnegie Classification of Institutions of Higher Education, 2012 Edition

Appendix B. U.S. PhD Granting Economics Departments in 2017 Sample

American University	Oklahoma State University	University of Miami
Arizona State University	Oregon State University	University of Michigan - Ann Arbor
Boston College	Penn State University	University of Minnesota
Boston University	Princeton University	University of Mississippi
Brandeis University	Purdue University	University of Missouri - Columbia
Brown University	Rensselaer Polytechnic University	University of Missouri - Kansas City
California Institute of Technology	Rice University	University of Nebraska - Lincoln
Carnegie Mellon University	Rutgers University	University of Nevada - Reno
Claremont University	Southern Illinois University	University of New Hampshire
Clark University	Southern Methodist University	University of New Mexico
Clemson University	Stanford University	University of New Orleans
Colorado School of Mines	SUNY-Buffalo	UNC - Chapel Hill
Colorado State University	SUNY-Stony Brook	UNC - Greensboro
Columbia University	Syracuse University	University of Notre Dame
Cornell University	Teachers College-Columbia University	University of Oklahoma
CUNY-City University of New York	Temple University	University of Oregon
Duke University	Texas A&M University	University of Pennsylvania
Emory University	Texas Tech University	University of Pittsburgh
Florida International University	Tulane University	University of Rhode Island
Florida State University	University of Alabama - Tuscaloosa	University of Rochester
Fordham University	University of Arizona	University of South Carolina
George Mason University	University of Arkansas - Fayetteville	University of South Florida
George Washington University	University of California - Berkeley	University of Southern California
Georgetown University	University of California - Davis	University of Tennessee
Georgia Institute of Technology	University of California - Irvine	University of Texas - Austin
Georgia State University	UCLA	University of Texas - Dallas
Harvard University	University of California - Riverside	University of Utah
Howard University	University of California - San Diego	University of Virginia
Indiana University	UC - Santa Barbara	University of Washington
Indiana University-Purdue	University of California - Santa Cruz	University of Wisconsin - Madison
Iowa State University	University of Chicago	University of Wisconsin - Milwaukee
Johns Hopkins University	University of Colorado - Boulder	University of Wyoming
Kansas State University	University of Connecticut - Storrs	Utah State University
Lehigh University	University of Delaware	Vanderbilt University
Louisiana State University	University of Florida	Vanderbilt Law and Economics
Massachusetts Institute of Technology	University of Georgia	Virginia Tech
Michigan State University	University of Hawaii	Washington State University
Middle Tennessee State University	University of Houston	Washington University - St. Louis
Mississippi State University	University of Illinois - Chicago	Wayne State University
New York University (NYU)	University of Illinois - Urbana	West Virginia University
North Carolina State University	University of Iowa	Western Michigan University
Northeastern University	University of Kansas	Wharton Business School
Yale University		

Figure 1: Percentage distribution of full-time instructional faculty in degree-granting postsecondary institutions, by academic rank, selected race/ethnicity, and sex, Fall 2013

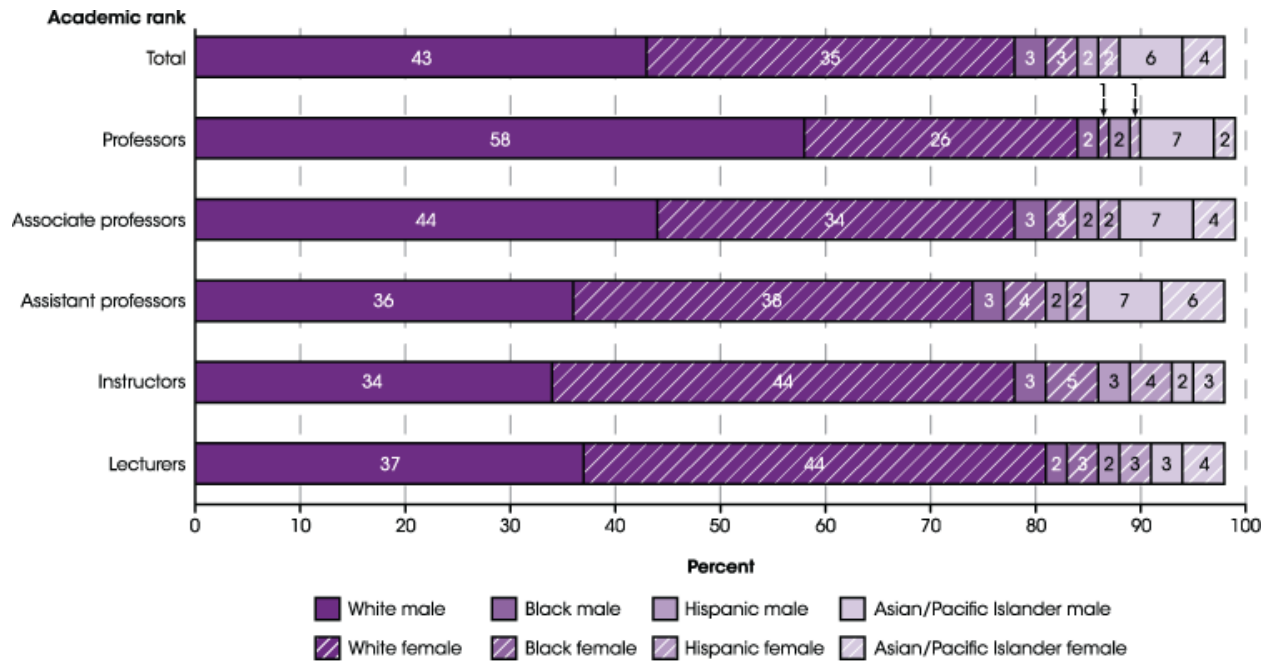
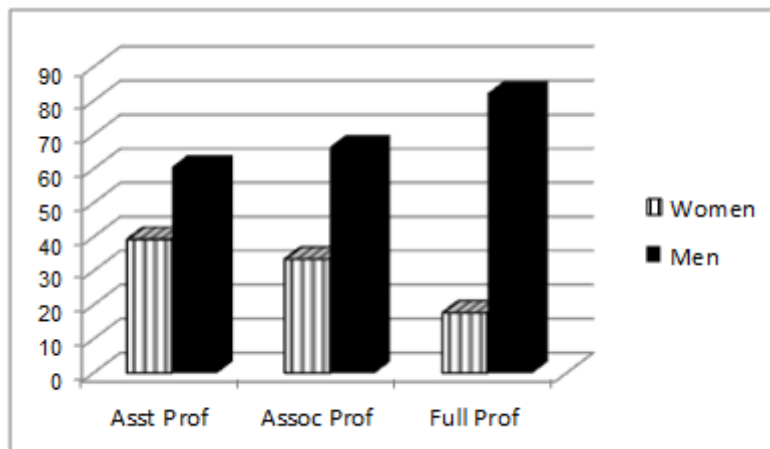


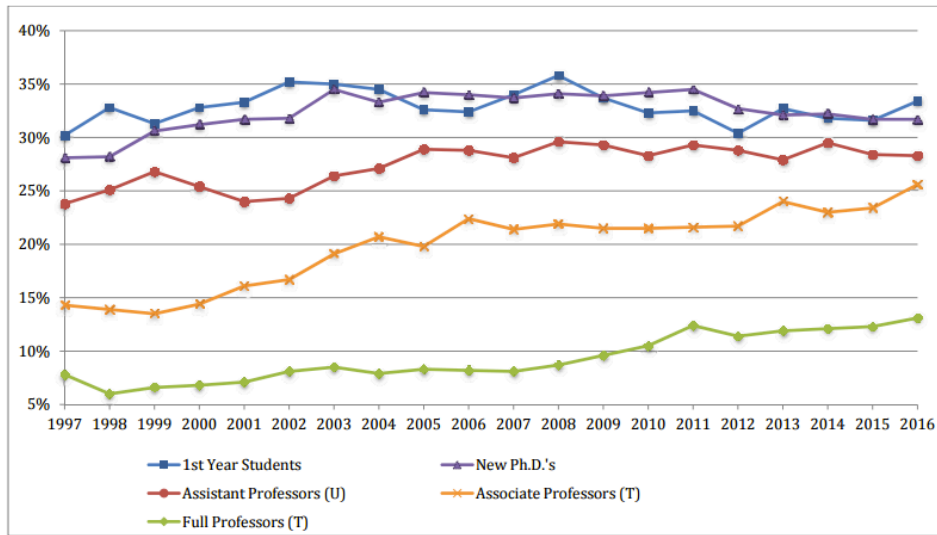
Figure 2: Women as a Percentage of Science and Engineering Faculty at Four Year Colleges and Universities



Source: National Science Foundation. 2011. *Report on Women, Minorities and Persons with Disabilities 2011*. Arlington, VA: National Science Foundation

Figure 3: Pipeline for Departments with Ph.D. Programs in Economics as it pertains to women from 1st year in Ph.D. sequence to full professorship. Taken from the 2016 Report from the Committee on the Status of Women in the Economics Professional of the American Economics Association.

**Figure 1. Pipeline for Departments with Doctoral Programs:
Percent of Doctoral Students and Faculty who are Women, 1997-2016**



URL: <https://www.aeaweb.org/content/file?id=3643>