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Agricultural and Applied Economics versus Economics:

Work-Life Policies and Female Faculty Representation across Academic Ranks

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Abstract: We examine the relationship between institutional work-life policies and female faculty representation in doctoral–granting economics and agricultural economics departments. We collected data on institutions and faculty members from 131 Ph.D.-granting economics departments and 32 Ph.D. granting applied/agricultural economics departments across United States. The analysis shows that the leaky pipeline of tenure still endures for female faculty in both economics and agricultural economics disciplines.

Keywords: gender gap in labor market outcomes; family friendly policies

JEL codes: I2, J10, J16

Introduction

Though changing, institutional and cultural factors still often make Economics and its subfield Agricultural and Applied economics, a "dismal science" for women. Agricultural and applied economics departments have historically had slightly fewer women than economics departments, but female tenure track faculty are significantly underrepresented in both types of academic departments. The commonly offered reasons for the lack of female academics at higher ranks, or delays in the tenure process, are family issues that include pregnancy decisions and caring for children. Women holding tenure-track jobs are less likely to progress through academic ranks when they face work-family role conflicts or childrearing responsibilities (Kahn 1995; Ginther and Kahn 2006). Work-life policies may enable female academics to keep their research agendas moving forward while they manage family commitments and/or care for young children. The culture of Agricultural and Applied Economics has been historically more conservative relative to Economics in terms of the percent of females in each field, but this has changed since the turn of the century Perry 2010). Consequently, our research is whether the existence of work-life programs has a differential relationship with the representation of female faculty in Economics departments compared to Agricultural and Applied Economics departments.

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 2017). Ceci and Williams (2011) contend that issues of family formation, gender expectations and career preferences pull women away from

math-intensive fields despite women earning a large proportion of STEM-related undergraduate degrees. This, in turn, leads to the underrepresentation of women in math-intensive fields.

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.

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: 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 (McDowell, Singell and Ziliak, 2001).

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.

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, the academic and promotional potential of lower level female faculty, female

graduate students and female undergraduate improves with more female faculty in the department. Neumark and Gardecki (1998) found that through mentoring relationship female faculty helps their female graduate students complete their degrees in less time. Ferber (1995) added to this by asserting women are more receptive to female instructors, and Berg and Ferber (1983) 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, whom 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 paper 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 paper 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.

A 2015 study under the auspices of NSF Advance IT 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 (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 paper focuses on the advancement of faculty, the broadest definition of Dual Hire – those which focus only on faculty, especially tenure-track faculty - was use 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 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 faculties 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 (Ward and Wolf-Wendel 2004; 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.

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 paper 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

Juraqulova, McCluskey and Mittelhammer (2017) studied the impact of work-life policies on female faculty's promotion probabilities from 121 U.S. Ph.D. – granting economics departments, while our paper studies similar issues with updated dataset with an additional economics departments and 32 Ph.D. – granting departments in applied and agricultural economics. This paper sampled 133 doctoral granting economics departments and 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 in addition to teaching and research services. 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.

Other differences have been observed in salary structures and returns to career publishing success for doctorate-granting economics and agricultural economics departments. Hilmer, Hilmer and Lusk (2012) find greater variation in monthly salaries and larger estimated returns to career publishing success for members of economics departments than their colleagues from agricultural departments.

Data

Following Juraqulova, McCluskey and Mittelhammer (2017), the sampled data 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 fields[2]. These institutions are assumed to produce and require the highest level of faculty productivity regarding original research, publication, teaching and advising.

Institutional and individual data were gathered from 133 Ph.D.-granting economics and 32 Ph.D.-granting agricultural and applied economics departments, and their faculty members. Though there is some institutional overlap between samples, they are distinct samples with the exceptions of Iowa State University and Washington State University, which have blended programs. Information on work-life supported programs or policies were gathered from institutions and other sources discussed in Appendix A.

Institutional/Departmental Variables

Institutional variables included institutional rankings, extension and type of university as either public or private. 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. Thus, the indicator variable *Current job at top 50* was created to define ranking of faculty's current institutional affiliation. Juraqulova et al. (2017) employed the IDEAS/Research Papers in Economics (RePEc) for school rankings, this paper chose to use the US News and World Reports for several

[2]"Basic Classification Methodology." The Carnegie Classification of Institutions of Higher Education. http://carnegieclassifications.iu.edu/methodology/basic.php.

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 rate[3]. 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 paper 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.

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 mentioned extension as part of his or her academic appointment on online academic web profile or curriculum vitae.

[3] 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-calculted-the-rankings.

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

Individual Variables

The data included individual variables included experience, rank of Ph.D.-granting institution, year of Ph.D. conferral, year joining a faculty member's current academic department, gender, and total number of journal publications and books/book chapters. 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 mentioned above; these counts were determined from the EBSCO database. These data were divided by the years since Ph.D. conferral for each faculty member sampled. A database-derived count of publications was used in favor of relying on faculty curricula vitae due to the moral hazard problem of faculty potentially obfuscating the type and number of published journal articles or published books. The binary variable *Top 50 Ph.D.* captures if faculty received

his/her doctoral degree from one of top 50 institutions which was determined by U.S. News and World Report Rankings of Best Grad Schools.

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.

Finally, a binary 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.

Work-life Programs of Institutions

A set of indicator variables were created to capture the availability of work-life supporting programs at institutions. These are onsite childcares, official university Dual Hire policies and the presence of National Science Foundation (NSF) Advance programs and grants for Institutional Transformation. These variables define whether the university is in favor of work-life support policies which help faculty members advance into higher academic positions.

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. On-campus childcare, especially when 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, McCluskey and Mittelhammer 2017).

The *Dual-career policy* indicator 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 data were then corroborated with Kimbrey's 2015 study on Dual Hire programs. 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.

The *NSF Advance* indicator variable was recorded based on whether an institution was listed as a recipient of an NSF Grant on the NSF Advance Internet portal. 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, the program is 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 field[4]. The NSF Advance program includes economic sciences, mean economics and agricultural (or applied) economics[5]. 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, McCluskey and Mittelhammer (2017) paper that the presence and implementation of NSF Advance initiatives will improve the presence of female faculty in academic ranks.

[4] 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.
[5] 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.

Following Juraqulova, McCluskey and Mittelhammer (2017), this paper includes unionization as a factor for increasing the proportion of women in faculty positions at any level. The binary indicator *union* controls for the presence of a faculty union organization as catalogued by the American Association of University Professors (AAUP) website. May, Moorhouse and Bossard (2010) concluded that faculty unionization does appear to increase the overall proportion of women faculty by 1.18 percentage points after controlling for organizational and institutional factors. However, they found this result to be segmented: faculty unionization does not significantly affect the number of female assistant professors. Thus, unionization 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. 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.

Overall, these data parameters resulted in 3,206 observations from 133 Ph.D. granting economics departments generating the economics sample and 737 observations from 32 agricultural and applied economics departments for the agricultural and applied economics sample.

Summary Statistics

Economics and Applied/Agricultural Economics Departments

Table 1 and 2 show descriptive statistics and female distribution for key variables for the whole sample. More female faculty members occupy assistant and associate professorships by an estimated 4 and 3 percent respectively. From Table 2, 33 percent of assistant level faculty, 32 percent of associates and 27 percent of full professor from the combined sample were women. This is relatively consistent with the 2016 CSWEP report, which estimated women compose 39.8, 38.8 and 24.3 percent of assistant, associate and full professor populations, respectively (Lundberg 2017). 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. 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 more from effects from the 'quality' of colleagues i.e. will publish less is their departmental colleagues are publishing less. 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.

Next, 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 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.

Economics Departments

Table 3 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 work at a top 50-ranked 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. Four 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 has 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 4, 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.

Applied and Agricultural Economics Departments

Table 5 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 6 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.

Methods

An ordered probit model and a seemingly unrelated regression (SUR) model are used to examine the relationship between work-family initiatives and academic ranks in both economics and agricultural economics departments.

Relationship between work-life policies and academic ranks

The ordered probit model predicts estimates of the relationship between work-life policies, university attributes with tenure status of faculty members.

Due to the nature of a dependent variable – academic rank, the ordered probit model is applied to predict estimates of the relationship between work-life policies and faculty's tenure status. 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

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

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

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

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

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

Where $\boldsymbol{X}_i$ 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.

Work-life Policies and Female Representation within Academic Ranks

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

$$f_{ij} = x_{ij}'\beta_j + u_{ij} \tag{3}$$

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 $E(u_{ij}u_{ij'} \mid x) = \sigma_{jj'}$. 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.

Probit and SUR models are run for combined samples, economics and agricultural economics departments.

Results

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 7. 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 9 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 ranked PhD-granted institution indicator variable and top 50 ranked current employer indicator variable only proved significant for the full sample and male subsample. This would indicate women are not predicted to be in higher or lower levels on the tenure ladder because of the level of their education or employment pedigree. Unions had no statistical ability to predict whether male or female faculty were at higher or lower levels along the tenure track.

Table 10 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.

The probit modeling presented in Table 11 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 12 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.

Conclusions

The results presented in 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 hire 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 Juraqulova 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-departemental 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 eocnomics 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, pariticularly 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 highs 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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Table 1 Descriptive Statistics for the Combined Sample: Economics and Agricultural/Applied Economics Ph.D. Granting Departments (Year=2017/2016)

	Full sample (No = 2868)		Female sample (No = 519)		Male sample (No = 2349)	
Characteristics	Mean	Std. D.	Mean	Std. D.	Mean	Std. D.
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 2 Female Distribution on Key Variables for the Combined Sample: Economics and Agricultural/Applied Economics Ph.D. Granting Departments

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

Table 3 Descriptive Statistics for 133 U.S. Economics Doctoral Granting Departments (Year=2017)

	Full sample (No = 3206)		Female sample (No = 601)		Male sample (No = 2605)	
Characteristics	Mean	Std. D.	Mean	Std. D.	Mean	Std. D.
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	47
Public	0.61	0.49	0.64	0.48	0.60	0.49

Table 4 Female Distribution on Key Variables 133 U.S. Economics Doctoral Granting Departments (Year=2017)

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

Table 5 Descriptive Statistics for 32 U.S. Doctoral Granting Departments in Agricultural Economics (Year=2016)

Characteristics	*Full sample (No =737)*		*Female sample (No = 142)*		*Male sample (No = 595)*	
	Mean	*Std. D.*	*Mean*	*Std. D.*	*Mean*	*Std. D.*
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	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 6 Female Distribution on Key Variables for 32 U.S. Doctoral Granting Departments in Agricultural Economics (Year=2016)

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

Table 7 Ordered Probit Estimation of Ranks, Combined Sample (Dependent Variable: Rank)

	All		Female		Male	
	b(se)	b(se)	b(se)	b(se)	b(se)	b(se)
Female	**0.132***	**0.124***				
	(0.058)	(0.058)				
Dual Career Policy		0.085		0.037	**0.146***	
		(0.057)		(0.107)		(0.072)
On-Campus Child Facilities	0.118	0.076	0.050	0.001	0.116	0.081
	(0.073)	(0.072)	(0.159)	(0.156)	(0.084)	(0.083)
Union	0.079	**0.118***	0.156	**0.214***	0.044	0.069
	(0.057)	(0.055)	(0.107)	(0.104)	(0.070)	(0.068)
NSF Advance	**0.179****		**0.244***		0.110	
	(0.062)		(0.110)		(0.080)	
Average annual publications	**0.843*****	**0.843*****	**0.711*****	**0.702*****	**0.947*****	**0.943*****
	(0.065)	(0.065)	(0.096)	(0.096)	(0.096)	(0.096)
Experience	**0.219*****	**0.219*****	**0.240*****	**0.239*****	**0.349*****	**0.351*****
	(0.018)	(0.018)	(0.013)	(0.013)	(0.015)	(0.015)
Experience^2	**-0.002*****	**-0.002*****	**-0.002*****	**-0.002*****	**-0.005*****	**-0.005*****
	0.000	0.000	(0.000)	(0.000)	0.000	0.000
Current job at top 50 ranked universities	**0.309*****	**0.300*****	0.135	0.141	**0.451*****	**0.425*****
	(0.061)	(0.061)	(0.116)	(0.116)	(0.077)	(0.078)
Public	-0.044	-0.070	-0.150	-0.193	-0.039	**-0.74****
	(0.070)	(0.070)	(0.145)	(0.142)	(0.083)	(0.085)
Agricultural/Applied Economics	-0.129	-0.080	-0.140	-0.080	-0.118	-0.084
	(0.076)	(0.072)	(0.118)	(0.112)	(0.131)	(0.124)
cut1	**2.930*****	**2.908*****	**2.834*****	**2.752*****	**3.960*****	**3.995*****
	(0.164)	(0.168)	(0.230)	(0.234)	(0.197)	(0.201)
cut2	**4.699*****	**4.674*****	**4.770*****	**4.768*****	**4.738*****	**4.735*****
	(0.205)	(0.208)	(0.300)	(0.305)	(0.267)	(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
PseudoR^2	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 8 SUR Estimation Results for Percentage of Economics and Agricultural/Applied Female Faculty by Rank (combined sample)

Independent variable	Assistant Professor		Associate Professor		Full Professor	
	b(se)	b(se)	b(se)	b(se)	b(se)	b(se)
On-campus child care	3.93	2.21	-3.56	-3.05	**-4.02*** **	-3.99
	(2.08)	(1.93)	(2.04)	(1.92)	(1.21)	(1.24)
Union	**-3.09***	0.09	0.59	-0.40	-1.60	**-1.83***
	(1.47)	(1.20)	(1.52)	(1.51)	(0.91)	(0.85)
NSF ADVANCE	**4.29****		**-8.16*****		-1.10	
	(1.52)		(1.66)		(0.94)	
Dual Career Policy		**-3.080***		**6.40*****		0.89
		(1.42)		(1.58)		(0.94)
Current job at top 50 ranked departments	**-11.90*****	**-10.99*****	0.07	-2.06	**-5.306*****	**-5.10*****
	(1.44)	(1.94)	(1.57)	(1.68)	(0.80)	(0.86)
Agricultural/Applied Economics	**6.05*****	**10.77*****	**27.64*****	**24.69*****	**29.86*****	**29.51*****
	(1.69)	(1.48)	(1.47)	(2.04)	(0.99)	(1.00)
Public school	**-8.08*****	**-5.42*****	**-8.34*****	**-8.94*****	**-3.69*****	**-3.77*****
	(1.91)	(1.48)	(1.93)	(2.04)	(0.99)	(1.00)
Constant	**38.83*****	**39.313*****	**37.79*****	**33.35*****	**29.70*****	**29.07*****
	(2.54)	(2.23)	(2.21)	(2.15)	(1.33)	(1.25)

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

Table 9 Ordered Probit Estimates of Ranks for the Economics Ph.D. Granting Departments (Year=2017)

	All		*Female*		*Male*	
	M1	*M2*	*M1*	*M2*	*M1*	*M2*
	b(se)	*b(se)*	*b(se)*	*b(se)*	*b(se)*	*b(se)*
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)
Experience^2	**-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
PseudoR^2	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

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

Table 10 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***	2.78	0.66	0.23	**1.28***	**1.41***
	(1.98)	(1.89)	(1.78)	(1.71)	(0.61)	(0.62)
NSF ADVANCE	**7.89*****		-1.90		**1.71*****	
	(1.69)		(1.61)		(0.53)	
Dual Career Policy		-1.26		**6.52*****		**-2.68*****
		(1.61)		(1.58)		(0.60)
Current job at top 50 ranked departments	**-12.89*****	**-12.24****	-2.43	**-4.48****	**-3.35*****	**-2.60*****
	(1.66)	(1.34)	(1.56)	(1.63)	(0.63)	(0.65)
Public school	**-7.55*****	**-3.80***	-3.02	**-4.37****	0.94	**1.54***
	(2.05)	(1.57)	(1.78)	(1.85)	(0.67)	(0.72)
Union	-2.15		-1.41	-1.64	-0.13	0.29
	(1.69)		(1.49)	(1.46)	(0.62)	(0.60)
Constant	**32.75*****	**35.06*****	**25.86*****	**23.07*****	**12.77*****	**13.99*****
	(2.23)	(2.44)	(1.99)	(1.91)	(0.71)	(0.72)

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

Table 11 Ordered Probit Estimation, Dependent Variable Rank Agricultural/Applied Economics

	All		*Female*		*Male*	
	M1	*M2*	*M1*	*M2*	*M1*	*M2*
	b(se)	*b(se)*	*b(se)*	*b(se)*	*b(se)*	*b(se)*
Female	-0.012	-0.003				
	(0.152)	(0.152)				
Dual Career Policy		-0.033		0.188	-0.104	
		(0.160)		(0.359)		(0.182)
On-Campus Child Facilities	-0.276	-0.054	**-5.091*** **	**-4.785*** **	0.227	0.471
	(0.915)	(0.917)	(0.491)	(0.513)	(1.151)	(1.158)
NSF Advance	**0.289***		0.424		0.252	
	(0.137)		(0.312)		(0.150)	
Union	0.097	0.156	0.012	0.163	0.107	0.139
	0.134	0.131	0.316	0.286	0.147	0.146
Extension	0.092	0.090	0.112	0.092	0.127	0.126
	(0.141)	(0.142)	(0.348)	(0.370)	(0.153)	(0.153)
Average annual publications	**0.548*** **	**0.542*** **	**0.638*** **	**0.641*** **	**0.531*** **	**0.524*** **
	(0.101)	(0.102)	(0.177)	(0.175)	(0.116)	(0.116)
Experience	**0.373*** **	**0.370*** **	**0.419*** **	**0.409*** **	**0.366*** **	**0.365*** **
	(0.033)	(0.033)	(0.055)	(0.059)	(0.041)	(0.041)
Experience2	**-0.005*** **	**-0.005*** **	**-0.006*** **	**-0.006*** **	**-0.005*** **	**-0.005*** **
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Current job at top 50 ranked universities	-0.170	-0.257	-0.222	-0.331	-0.143	-0.218
	(0.160)	(0.150)	(0.343)	(0.298)	(0.180)	(0.171)
Urban	-0.032	-0.078	0.038	-0.007	-0.089	-0.133
	(0.126)	(0.128)	(0.281)	(0.274)	(0.145)	(0.148)
Public	0.157	-0.091	0.350	0.034	0.133	-0.088
	(0.310)	(0.279)	(0.546)	(0.418)	(0.377)	(0.350)
cut1	**3.680*** **	**3.463*** **	-0.230	-0.347	**3.960** **	**3.753** **
	(0.997)	(0.994)	(0.774)	(0.798)	(1.251)	(1.245)
cut2	**5.671*** **	**5.442 *** **	1.465	1.317	**6.096*** **	**5.885*** **
	(1.044)	(1.045)	(0.868)	(0.923)	(1.326)	(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 12 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*** **	**40.47*** **	---	---	**-16.13*** **	**-13.28*** **
	(5.37)	(5.77)	---	---	(1.14)	(1.24)
NSF ADVANCE	**8.22***		**6.04** **		**2.381** **	
	(3.95)		(2.12)		(0.85)	
Union	-0.87	01.00	2.64	3.00	**-2.46** **	**-2.06***
	(3.63)	(3.74)	(2.20)	(2.54)	(0.78)	(0.80)
Dual Career Policy		0.00		-3.49		-1.22
		(4.05)		(3.01)		(0.94)
Extension	-3.30	-3.30	**4.87** **	**4.72***	-0.340	-0.64
	(4.21)	(4.33)	(1.83)	(1.91)	(0.72)	(0.73)
Current job at top 50 ranked universities	**11.00***	**8.46***	**18.03*** **	**16.21*** **	**-2.56***	**-3.39*** **
	(4.41)	(4.04)	(2.84)	(2.92)	(1.12)	(0.99)
School in urban area	**-11.79** **	**-10.91***	**-15.49*** **	**-16.97*** **	**-1.93***	**-2.54** **
	(4.23)	(4.44)	(3.01)	(3.07)	(0.92)	(0.88)
Public school	5.86	-2.61	**24.20*** **	**19.22*** **	**9.613*** **	**7.55*** **
	(4.93)	(3.59)	(4.78)	(4.70)	(1.12)	(1.01)
Constant	-5.00	1.61	-1.50	9.93	**21.46*** **	**23.17*** **
	(6.14)	(5.65)	(4.32)	(5.07)	(1.37)	(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

APPENDIX

Appendix A. Variables Definition and Sources

Variable	Description
Gender[a]	1if 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 Juraqulova 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	Rensselear 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		