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**Women Helping Women in Agricultural Economics?  
Same-Gender Mentoring and Early Career Research Productivity for Agricultural  
Economics Ph.D.s**

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Female faculty remain a distinct minority in agricultural economics departments, especially within the top programs. For instance, during the academic year of 2001 only 12 percent of the faculty within Perry's (1999) top 6 Ph.D. granting agricultural economics programs were female and only 7 percent of those female faculty were full professors (Hilmer and Hilmer, 2003). Given such statistics, methods to better encourage women to pursue an academic career in agricultural economics and to excel once they land an academic job have become important concerns for members of the profession.<sup>1</sup> One commonly proposed method for fostering the growth of female scholars is the pairing of female Ph.D. students to female dissertation advisors. It has been argued that such mentoring arrangements may benefit female students by providing role-models that "can help them navigate their careers and guide them in successfully combining full-time careers with satisfying personal and family lives (Schlegel, 2000)." Perry (1996) surveys a sample of graduate students in an effort to understand the role of mentoring in agricultural economics and finds that female graduate students expect to produce fewer journal articles, presented papers, and other publications upon completion of their degrees. In considering the underlying cause of the diminished expectations for female students, Perry proposes two alternative explanations. The first is that the most productive researchers within the profession are predominantly male and thus because such faculty members are generally more likely to take on male advisees (for a number of possible reasons), female graduate students are left with less productive faculty as their advisors. The second is that due to affirmative action, female Ph.D.s are in greater demand in the job market and therefore male Ph.D.s. realize that if they are to be successful job-seekers they must distinguish themselves from their female counterparts by working with highly-demanded advisors. Whatever the reason, the above

discussion suggests that female graduate students who might, *ceteris paribus*, desire to work with a female advisor are often forced to either: (1) choose to work with a female advisor who possesses a lower research profile than a significant fraction of her male counterparts or (2) choose to work with a male advisor who is likely more prominent in terms of research reputation but who may lack the potential benefits of a same-gender mentor. The fact that female students desiring to work with female advisors may be forced to make the former decision is an important concern in light of recent research indicating that students working with higher ranked faculty are significantly more likely to publish more total articles (Hilmer and Hilmer, 2006) than otherwise similar students working with lower or unranked faculty. While the above concern might intuitively seem plausible, assessing whether it actually exists is fundamentally an empirical concern. Surprisingly, despite the likely widespread interest in the subject matter, we are only aware of one study, Perry (1996), that considers the role of same-gender mentoring in agricultural economics and that study only examines how mentoring affects *expected* publications.

This paper is the first to empirically examine the degree to which student outcomes differ across gender-mentorship configurations for agricultural economics Ph.D. recipients. We analyze a sample of 1,526 individuals from top Ph.D.-granting agricultural economics programs between 1987 and 2000. We empirically assess the degree to which a student's gender-based mentorship configuration affects his or her early career productivity. To isolate this effect, we estimate productivity functions that control for the student's gender-based mentorship configuration, the reputation rank of his or her Ph.D. program, the relative productivity rank of a student's dissertation advisor, and other individual characteristics using a Negative Binomial regression model. We find that female students working with male advisors average statistically

fewer total publications and publications in top agricultural economics journals in their early careers than otherwise similar students.

## Data

This study utilizes a first-of-its-kind data set that matches agricultural and resource economics Ph.D.s to the gender of their dissertation advisors, graduate programs, dissertation fields, sex, domestic/international status, initial job placements and peer-reviewed publication histories. In 1987, the *Dissertation Abstracts* database (published by ProQuest Information and Learning) started including the name of the student's dissertation advisor for the majority of dissertations accepted at accredited North American educational institutions. From this, we collect information on 1,526 dissertations filed in agricultural and resource economics fields between 1987 and 2000 for students graduating from top Ph.D.-granting agricultural economics programs. We restrict our sample to top programs because they are the most likely to value research productivity and we define top programs as those 22 with good enough reputations to be ranked by Perry. We define unique program tiers based on whether a program's average reputation rank was greater than 4 (*tier 1*), between 3 and 4 (*tier 2*), or less than 3 (*tier 3*).<sup>2</sup> While it is clear why we start with 1987 degree recipients, we cut off our time frame in 2000 to allow sufficient time for students to start their publishing careers. Finally, to make sure that we only include students writing on agricultural and resource economics topics, we cross-reference our list with the "Ph.D. Recipients Annual List" published each December in the *American Journal of Agricultural Economics*, meaning that students are only included in our sample if they are included in the AJAE list.

Individual-specific, peer-reviewed publication data as of December 2004 are collected from *Econlit*, where we limit our analysis to peer reviewed articles. To quantify research productivity in peer-reviewed journals we consider several traditional metrics. Perry defines the top four agricultural and resource economics journals (henceforth referred to as “core” journals) in terms of Social Science Citation Index citations per article as the *American Journal of Agricultural Economics*, the *Journal of Environmental Economics and Management*, *Land Economics*, and the *Journal of Agricultural Economics*.<sup>3</sup> Beilock and Polopolus demonstrate the importance of regional journal citations for agricultural and resource economists (henceforth referred to as “regional” journals).<sup>4</sup> Accordingly, we consider three separate categories of articles: (1) total peer-reviewed articles, (2) articles published in one of the four “core” agricultural and resource economics journals, and (3) articles published in one of the “regional” agricultural and resource economics journals. Finally, as is standard in the literature (Moore, Newman, and Turnbull, 1998), we exclude replies, comments, and other errata from our publication counts, as we only want to account for original research.<sup>5</sup>

We observe 430 faculty members directing at least one dissertation during our time-frame. To compare students by the relative research productivity of their advisors, we quantify the advisors’ relative standing (for his or her own research) by constructing a “Hall of Fame” similar to that constructed by Coupe (2003) for the top 1000 global economists. The weighted average we calculate is based on the total number of articles and author-weighted pages published in all peer-reviewed journals, core agricultural and resource economics journals, and top 36 economics journals and can be found in the technical appendix of Hilmer and Hilmer (2006). We define an advisor as either being ranked among the top 100 (“elite” advisors), ranked between 101 and 300 (“middle” advisors), or ranked between 301 and 430 (“bottom”

advisors). Please see the technical appendix (Hilmer and Hilmer 2006) for a listing of all elite advisors. Finally, we control for the students initial job type by including a dummy variable indicating whether we could identify the student's first postgraduation job as being with a U.S. academic program.

## **Descriptive Analysis**

Table 1 provides summary statistics on the gender composition of our data set. Slightly less than 19 percent of the Ph.D. recipients in our sample are female. These data are somewhat less than population projections of 23.5% for 2001-2002 contained in Stock and Watson (2006) but more than the 15% in 1989-1999 that Zepeda, Marchant and Chang (1993) reported. Female students appear to be more likely to attend Tier 1 programs than lower tier programs. This is consistent with the findings of Zepeda, Marchant and Chang (1993) that females are more likely to attend higher ranked programs. Female students are most likely to work with either an elite or bottom ranked advisor and less likely to work with a middle advisor. Looking now at the gender distribution of advisors, women were disproportionately underrepresented as only 4 percent of advisors are female within the sample period. At 6 percent, female advisors are most likely to be on faculty at a Tier 3 school followed by 4 percent at Tier 1 schools. Only 2 percent of female advisors are classified as elite while 5 percent are in the middle ranked category and 6 percent in the bottom category of all advisors in our data set. These numbers suggest that female students are severely limited in their access to female mentors and extremely limited if a female student desires to work with an elite advisor.

The bottom panel of Table 1 presents summary student-advisor gender configurations for our students. Overall, roughly 7 percent of our female students chose to work with a female

dissertation advisor while nearly 93 percent chose to work with a male dissertation advisor. The fact that such a small percentage of our female students work with female advisors is not surprising, given the above-mentioned lack of potential female advisors within all programs. Most same gender mentoring for females occurs at Tier 3 programs, with 12% of the female students work with female advisors. The pattern is similar across advisor ranks, with 4 percent of female students having elite advisors, as opposed to 6 and 15 percent of female students being advised by middle and bottom faculty, respectively. Together, these data might suggest that supply effects are driving the decisions of many high potential women to work with male advisors.

While the summary analysis above focuses on the Ph.D. student's choice of dissertation advisor, it is potentially informative to consider the student-advisor match from the advisor side. In total, we observe 29 women lead-supervising at least one dissertation during our timeframe. Overall, 31 percent of the students these women advise are female. Among the 399 men we observe lead-supervising at least one dissertation during our timeframe, 82 percent of the advisees are male and 18 percent are female.

Table 2 considers how gender-based mentoring might affect a student's future research productivity. The average number of publications listed in *Econlit* is 2.98 total articles, .67 core articles and .5 regional articles. Turning to the gender-based mentorship configurations, females working with male advisors on average tend to publish fewer total and core articles, with females working with females come in a close second with total articles. The highest number of total and core publications is men working with female advisors and males working with male advisors coming in second.

## Empirical Results

The summary statistics suggest that there are potentially important differences in the relative supplies of potential male and female advisors across program and advisor rankings. Given recent evidence linking program and advisor rankings to student Ph.D. student outcomes, Hilmer and Hilmer (2006) it is reasonable to think that such relative supply differences are, at least in part, driving observed differences in the first job types and early career research productivity of male and female graduate students. Our goal in the empirical work below is to estimate whether such observed differences in measurable student outcomes are driven by systematic differences in the relative supplies. The next step in our analysis is to empirically assess the degree to which a student's gender-based mentorship configuration affects his or her early career productivity. To isolate this effect, we estimate productivity functions for both total and core articles published that control for the student's gender-based mentorship configuration, the reputation rank of his or her Ph.D. program, the relative productivity rank of a student's dissertation advisor, and other individual characteristics. Following standard form, our estimation equations can be written as

$$P_i = B_0 + B_1 M_i + B_2 Q_i + B_3 A_i + B_4 X_i + \varepsilon_i \quad (1)$$

where  $M_i$  is a series of dummy variables indicating a student's gender-based mentorship configuration,  $Q_i$  is the tier of the student's Ph.D. program with tier 3 as the omitted category,  $A_i$  is the rank of the student's dissertation advisor with unranked as the omitted category,  $X_i$  is a vector of individual characteristics, and  $\varepsilon_i$  is an error term. The individual characteristics we consider are whether the student is international, the field in which the student's dissertation is

filed, and the number of years since the student received his or her Ph.D. An important estimation concern is that our productivity measures are truncated at 0 due to the fact that many students have not published and OLS estimation would result in biased and inconsistent parameters estimates. Truncated count data models are normally estimated as either a Poisson or a Negative Binomial, both of which account for the skewed distributions of the dependent variables (Cameron and Trivedi, 1998). Because our data fail tests of overdispersion for both of our productivity measures, we estimate each of our productivity functions with the Negative Binomial regression model.<sup>6</sup>

Table 3 presents results that have been converted to marginal effects. The first column suggests that female students with male advisors publish statistically fewer total articles than male students with male advisors and that the estimated shortfall is approximately 1.06 articles. In addition, female students with male advisors are estimated to publish .5 fewer core articles than male students with male advisors.

The remaining columns in table 3 add our controls for program and advisor rank and for whether the student's first job was research-oriented. The controls are nearly all statistically significant, with the exception of tier 2 relative to tier 3 students and middle advisors relative to bottom advisors. The significance of tier of school and advisor rank returns once we control for if the student has a domestic academic job. It appears that the primary factors affecting the likelihood of publishing at all or in core journals are attending a tier 1 program, accepting a research-oriented first job, or working with a star or ranked advisor. Once we add controls for the relative productivity rank of the student's advisor and the tier of school a student attend, the estimated negative relative impact of being a female student working with a male advisor decreases by nearly 20 percent, all else equal.

## **Conclusions**

This paper asks whether there are systematic differences in early career research productivity of economics Ph.D. recipients depending on their gender-based relationships with their advisors.

We find that female students who work with male advisors average fewer early career publications than male students working with male advisors. The estimated shortfall is reduced by nearly 20 percent once controls for the relative reputation of the student's Ph.D. program and the relative research productivity of the student's dissertation advisor are added. One of the most striking findings is contained in the summary statistics. Of the 430 advisors in the top 22 Ph.D. granting programs, only 31 of them are women. This result suggests that female students desiring to work with female advisors are significantly disadvantaged by the relative lack of female agricultural economists who advise students. Couple the lack of women advisors with the results that suggest that women who work with male advisors are less productive than men working with male advisors, we find an enormous need for women mentors in agricultural economics.

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<sup>1</sup> There are several notable instances as to the scientific community’s commitment to the concept of same-gender mentoring translating into significant government funding. For example, the Committee on the Status of Women in the Economics Profession (CSWEP) was established in 1971 by the American Economic Association to “monitor the status of women in the profession and formulate activities to improve their status (CSWEP Annual Report, 2004)” and has twice received funding from the National Science Foundation to “implement and evaluate a series of mentoring workshops for junior economists, focusing especially on issues relevant to women economists at the beginning of their careers.” Moreover, for the current fiscal year, the National Science Foundation has pledged \$10 million to its *ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers* program. In the past, a large percentage of these funds have been devoted to same-gender mentoring programs. For example, since the early 1990s, the NSF has funded mentoring programs run by the Association for Women in Science, the Committee on the Status of Women in the Economics Profession, and the Committee on the Status of Women in Computing Research, among others. The latter organization alone has received more than \$3 million in funding for its mentorship program since 1994. At the same time, MentorNet, a nonprofit e-mentoring network that addresses the retention and success of those in engineering, science and mathematics created in 1997 with funding from IBM currently has nearly 15,000 active members.

<sup>2</sup> Those reputation are based on a five point scale, where “a ranking of 5 indicated an excellent program, 4 corresponded to an above average program, 3 being average, 2 below average, and 1 being a poor program.” Tier 1 programs are UC Berkeley, UC Davis, Maryland,

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Iowa State, NC State, and Minnesota. Tier 2 programs are Wisconsin, Purdue, Cornell, Texas A&M, Michigan State, Illinois, Ohio State, and Oregon State. Tier 3 programs are Virginia Tech, Penn State, Kansas State, Florida, Missouri, Oklahoma State, Washington State, and Georgia.

<sup>3</sup> Perry chooses these four journals because according to the Social Science Citation Index (SSCI) they are the only journals to have citation rates close to or higher than the citation rate for the *AJAE*.

<sup>4</sup> In their study, Beilock and Polopolus (1988) identify as regional journals the *Western Journal of Agricultural Economics* (now the *Journal of Agricultural and Resource Economics*), the *Southern Journal of Agricultural Economics* (now the *Journal of Agricultural and Applied Economics*), the *Northeastern Journal of Agricultural Economics* (now the *Agricultural and Resource Economics Review*), the *Northcentral Journal of Agricultural Economics*, and the *Canadian Journal of Agricultural Economics*. In this study we do likewise.

<sup>5</sup> An additional concern is the fact that “an article is not an article.” To account for differences in article length and author configuration, we also examine differences in the total number of author-weighted pages published in each journal. The author-weighted results, however, do not differ significantly from the unweighted, number of article results and thus for the sake of brevity we do not include them here.

<sup>6</sup> A well-known problem with the Poisson distribution is the presumed equality of the conditional mean and variance functions (equidisperion). If this assumption is violated the Negative Binomial is considered the more appropriate distribution, as it accounts for the skewness of the data without requiring equality between the conditional mean and variance.

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**Table 1.** Summary Statistics for Students and Advisors By Gender

	Total	Program Tier			Advisor Rank		
		Tier 1	Tier 2	Tier 3	Elite	Middle	Bottom
<u>Students:</u>							
Females	.1881	.2117	.1830	.1618	.1956	.1719	.2078
Males	.8119	.7883	.8160	.8382	.8044	.8281	.7922
<u>Advisors:</u>							
Females	.0496	.0436	.0241	.0612	.0189	.0472	.0649
Males	.9504	.9564	.9759	.9388	.9811	.9528	.9351

	Total	Program Tier			Advisor Rank		
		Tier 1	Tier 2	Tier 3	Elite	Middle	Bottom
<u>Female Students With:</u>							
Female Advisors	.0669	.0811	.0265	.1167	.0351	.0555	.1452
Male Advisors	.9331	.9189	.9735	.8833	.9649	.9444	.8549
<u>Male Students With:</u>							
Female Advisors	.0338	.0336	.0236	.0506	.0149	.0454	.0447
Male Advisors	.9662	.9664	.9764	.9494	.9851	.9545	.9553

**Table 2.** Summary Productivity Statistics By Mentor Configuration

	Total Articles	Core Articles	Regional Articles
All Students	2.9758 (5.7591)	.6658 (1.7812)	.5236 (1.5544)
<u>Mentorship Configuration:</u> (Advisor-Student)			
Female-Female	2.1052 (2.8066)	.5789 (1.2164)	.3158 (.4776)
Male-Female	2.0075 (3.2322)	.4906 (1.0840)	.2642 (.7675)
Female-Male	3.5476 (5.8108)	1.3333 (3.4688)	.2619 (.5868)
Male-Male	3.1833 (6.1918)	.6825 (1.8219)	.5933 (1.7045)

Note: Standard deviations are in parentheses.

**Table 3.** Marginal Effects for Negative Binomial Regressions for Female Mentorship

	Total Articles	Core Articles	Total Articles	Core Articles	Total Articles	Core Articles	Total Articles	Core Articles	Total Articles	Core Articles
<u>Mentor Configuration:</u> (Advisor-Student)										
Female-Female	-.7203 (.5694)	.0891 (.5321)	-.8541 (.6155)	-.0579 (.1828)	-.5862 (.6869)	.0309 (.2170)	-.8920** (.4448)	-.0806 (.1324)	-.6996 (.4991)	-.0184 (.1563)
Male-Female	-1.0618** (.2206)	-.4899** (.1686)	-1.127** (.2017)	-.2091 (.0465)	-1.0491** (.1968)	-.2011** (.0430)	-.9410** (.1620)	-.1694** (.0378)	-.8978** (.1591)	-.1652** (.0357)
Female-Male	.0260 (.5656)	.1819 (.3423)	-.0392 (.6087)	.0433 (.1504)	.1453 (.6333)	.0657 (.1488)	-.4869 (.3839)	-.0550 (.0910)	-.3619 (.4029)	-.0353 (.0930)
<u>Program Rank:</u>										
Tier 1	---	---	2.9285** (.4181)	.8259** (.1289)	1.887** (.3846)	.4839** (.1051)	2.2004** (.3144)	.5583** (.0919)	1.5385** (.3021)	.3409** (.0800)
Tier 2	---	---	1.5057** (.31207)	.2804** (.0821)	1.2786 (.2958)	.2180** (.0751)	1.2683** (.2484)	.2119** (.0656)	1.1362** (.2398)	.1661** (.0614)
<u>Advisor Rank:</u>										
Elite	---	---	---	---	1.9169** (.3812)	.4370** (.0987)	---	---	1.3978** (.2947)	.3330** (.0783)
Middle	---	---	---	---	.8105 (.2921)	.1109 (.0732)	---	---	.7071** (.2356)	.1091* (.0617)
<u>Student's First Job:</u>										
Research Position	---	---	---	---	---	---	4.1374** (.4347)	.7425** (.0959)	3.9269** (.4144)	.6747** (.0883)
pseudo-R	.0236	.0581	.0351	.0807	.0403	.0989	.0679	.1294	.0722	.1393
Log Likelihood	-3141.7	-1452.6	-3104.8	-1408.1	-3088.1	-1389.7	-2999.3	-1342.7	-2,855.5	-1,327.4
Alpha	2.2054 (.1107)	3.0769 (.2702)	2.0400 (.1048)	2.4776 (.2311)	1.9633 (.1022)	2.251 (.2172)	1.5948 (.0888)	1.7106 (.1804)	1.5475 (.0869)	1.594 (.1722)

Notes: The reported results also include controls for number of years since Ph.D., if the student is international, and the Ph.D. student's field \* and \*\* denote statistical significance at 10% and 5% respectively.