



The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.

Are returns to research quality lower in agricultural economics than in economics?*

John Gibson  and Ethan Burton-McKenzie[†]

We compare effects of research quality and quantity on the salary of academics in agricultural economics and economics departments of the same universities. Agricultural economists get a significantly lower payoff to research quality, whether measured by quality-weighted journal articles (based on nine different weighting schemes) or by citations. Instead, salary depends on the quantity of journal articles, while article counts have no independent effect on economist salaries. These differences in the reward structure for research are not due to either the extension focus of agricultural economists or to disciplinary differences in publishing with students and instead may reflect institutional factors that govern incentives within universities. One-third of academics in the agricultural economics departments studied here have doctoral training in economics; the very different disciplinary reward structures may cause frustration for these faculty due to the muted returns to research quality that agricultural economics departments seem to offer.

Key words: academic salary, citations, journal rankings, research quality.

1. Introduction

Agricultural economics and economics are closely related disciplines. In many regions, including Australasia, a declining economic share for agriculture sees agricultural economists absorbed into economics departments. However, disciplinary norms still often follow those in the United States, where most land-grant universities maintain separate agricultural economics departments. These separate departments allow comparisons of the reward structure for research, and it appears that the payoff from publishing in the highest ranked journals in economics exceeds that in agricultural economics (Hilmer *et al.* 2012) [hereafter, HHL].

These reward structures have implications for academics and departments. The openness of agricultural economics departments to hiring economists, who have norms about top-ranked journals (Card and DellaVigna 2013), may create expectations about impacts of publishing in top-ranked journals, or from having highly cited papers, that are not met by the more muted

* We are grateful to heads of department for providing information on staffing lists, and to three anonymous referees, Paul Glewwe, Mark Partridge and AAEA conference participants for helpful comments. All remaining errors are those of the authors.

[†] John Gibson (email: jkgibson@waikato.ac.nz) is a Professor and Ethan Burton-McKenzie was a graduate student in the Department of Economics, University of Waikato, Hamilton, New Zealand.

rewards for quality in agricultural economics. Tensions over the quantity of research publications may also arise if rewards in agricultural economics tilt towards having lots of articles that may be in less highly ranked journals, or that individually have few citations, while faculty trained in economics departments may expect to publish fewer articles.

In this paper, we relate salary of 300 academics in agricultural economics and economics departments of the same universities (Illinois, Michigan State, Minnesota, Ohio State, Purdue, and Wisconsin) to their lifetime publications of almost 7000 journal articles in over 750 different journals, and to the 150,000 citations to those articles.¹ To ensure robust results, we use nine journal weighting schemes to measure research quality, and adjust for the length, page size and co-authorship of each article. We also consider citations and the *h*-index for each academic as another way to measure research quality.² We build on the analysis of HHL, who use a larger sample but less comprehensive methods of just counting articles within various tiers of journals. Problems with the counting approach include the following: journals in a tier are treated as equal quality despite within-tier variation; the tiers are dated and do not reflect newer journals; and tier counts ignore relevant information captured by quality-weighted journal pages (Gibson 2014). Using the journal of publication to proxy for quality also ignores the growing emphasis on citations, which may measure actual research impact while the prestige of the journal that publishes an article simply shows that, in the opinion of an editor and a few referees chosen by that editor, the research was expected to have an impact (Liebowitz 2014).

In our sample, agricultural economists have a significantly lower payoff to measures of research quality and a higher return to quantity than do economists. These differences are on top of a level effect, of salaries in agricultural economics being one-quarter lower than salaries in economics after controlling for demographics (gender, experience, seniority) and location. However, the quite distinctive reward schedules mean that agricultural economists are not further penalised for their much lower productivity in terms of research quality. Thus, even though the agricultural economists are cited only half as much as the economists, and have quality-weighted journal output just one-third to one-twentieth as high, they do not appear to be paid according to these quality metrics. Thus, the pay gap after adjusting for productivity is much the same as when productivity is not controlled for.

The paper proceeds as follows: Section 2 describes the sample and Section 3 covers the various ways we measure research quality; Section 4

¹ It is a convenient shorthand to refer to these six departments as 'agricultural economics' although only Purdue uses that exact name with the others all including something else (and Minnesota omitting 'agricultural' entirely).

² The *h*-index is the largest *h* such that an academic has published *h* articles with at least *h* citations (Hirsch 2005).

has the empirical methods and the results of the salary regressions; and Section 5 discusses the implications and concludes the paper.

2. Sample and data description

The starting sample frame was the top 15 agricultural economics departments listed in Research Papers in Economics (RePEc). We then excluded any that were not universities (e.g. IFPRI), and were not in the United States or were private (Cornell), for whom public salary data are unavailable. We also excluded combined economics and agricultural economics departments (Iowa State). If public disclosure databases for state workers did not show fulltime versus fractional status (California and Maryland), we also excluded them.

For universities satisfying our selection criteria (Illinois, Michigan State, Minnesota, Ohio State, Purdue and Wisconsin), we gathered 2013 salary data for fulltime faculty. We also checked salary information in earlier years to check whether the values for 2013 were outliers (perhaps reflecting some one-off supplementary compensation). We excluded faculty with major administrative duties, with primarily teaching appointments or with majority extension positions, leaving a sample of almost 300 academics split equally between those in agricultural economics departments and those in economics departments.

The salary data came from public disclosure databases whose sources varied but in most cases a leading newspaper in each state would provide a 'front-end' search engine so that people could examine their taxpayer dollars at work. For example, for Wisconsin the Milwaukee *Journal Sentinel* (<http://www.jsonline.com/watchdog/dataondemand/>) was used. The salary data are annual totals, and while the databases show if someone has a fractional appointment, they do not indicate if they are paid on a 9-month or an 11-month contract basis. Agricultural economics traditionally offers 11-month contracts, but there is some switching to 9-month contracts to better match the usual arrangement for economists. We consider differences in contract length as part of the *level* effect of working in one department or the other while our main focus is the marginal effects on salary of various indicators of research quantity and quality.³

The average salary is \$128 000 in agricultural economics and \$183 000 in economics (Table 1).⁴ Years of experience are similar with a mean of 20.3 for economics and 20.9 for agricultural economics. Composition in terms of professorial rank is also similar; 57 per cent of the agricultural economists and the economists are Professors. One-fifth of the agricultural economists and 15 per cent of the economists are female. Almost no faculty in economics

³ We control for level differences with an intercept dummy variable for agricultural economics departments.

⁴ The gap in average salary is only slightly lower, at \$48,000, if we control for type of PhD, gender, seniority and experience, and university location. The similarity to the raw gap reflects the balance in terms of these covariates.

Table 1 Summary statistics

Variable	Economists		Agricultural economists		Description
	Mean	SD	Mean	SD	
Average salary	\$182,886	\$70,792	\$128,496	\$32,368	Academic year base salary in 2013
Experience	20.33	12.66	20.89	11.18	Years since the academic gained their PhD
Seniority	14.18	11.01	16.38	11.09	Years spent working at the current university
Male	0.853	0.355	0.793	0.406	Academic is a male
PhD in Economics	0.967	0.180	0.303	0.461	Academic obtained PhD from an economics department
Research productivity indicators					
Number of articles	20.97	20.96	25.71	23.02	Career articles (in EconLit, RePEc, or Web of Science)
Number of pages	178.32	173.32	131.42	135.99	Size-adjusted and co-author-adjusted pages from articles published in career
Citations to articles	648.29	1146.61	384.82	908.77	Total WoS citations to those articles to end of 2013
<i>h</i> -index	8.70	7.41	7.94	6.18	Academic has <i>h</i> articles with <i>h</i> or more citations
Quality-weighted, size-adjusted and co-author-adjusted journal output using journal weights from†					
MSF	109.36	113.91	39.94	55.14	Mason, Steagall and Fabritius reputational ranking
CLm	85.42	88.98	24.72	30.38	Combes-Linnemer medium convexity weights
CLh	57.54	62.58	8.17	11.78	Combes-Linnemer high convexity weights
RePEc	48.41	51.96	10.80	16.04	RePEc Simple Impact Factor
Coupé	29.72	30.80	10.44	13.70	Average of 2-year impact factors for 1994–2000
K&Y_all	29.11	33.20	3.15	6.71	Kodrzycki and Yu eigenvector ranks, cites from all journals
K&Y_econ	27.12	30.74	2.95	6.27	Kodrzycki and Yu ranks, cites just from econ journals
KMS	30.35	31.65	2.99	6.18	Kalaitzidakis, Mamuneas and Stengos eigenvector weights
LP	31.30	36.25	1.44	3.59	Laband and Piette eigenvector weights

Notes: The statistics are for articles (with pagination) produced over the career until the end of 2013. *N* = 145 for agricultural economists and *N* = 150 for economists. †The journal weights are in their raw format, which differ in terms of the maximum and minimum values, and also their variability, with the coefficient of variation of the weights across journals ranging from 1.6 to 5.7.

departments have a PhD in agricultural economics (or in anything but economics), but 30 per cent of the faculty in agricultural economics departments have a PhD in economics. Amongst younger agricultural economics faculty, with 10 years or less experience, 38 per cent have an economics PhD. Thus, academics with doctoral training in economics are likely to be a rising share of the faculty in agricultural economics departments.

3. Measures of the quantity and quality of research

Our measures of research productivity are based on lifetime articles published (with pagination) to the end of 2013. The articles were found by searching *EconLit*, RePEc, *Web of Science* (WoS) and curriculum vitae. In total, there were almost 7000 refereed articles in over 750 different academic journals, and 150,000 citations to these articles. The citations also end in 2013 and are from WoS, which is the most established citations database. Some journals published in were not covered by WoS at the time (noting that coverage rises over time), so the salary equations include an indicator for the proportion of articles in journals not in WoS.

To properly measure lifetime research, journal weights are needed to convert output in different journals to a constant quality. Weights differ in terms of coverage – the proportion of articles an academic publishes that are in journals with nonzero weights, and in terms of the rank elasticity – the rate that weights decline for lower ranked journals. These two attributes for the nine sets of journal weights we use are shown in Figure 1, with full descriptions of the weights in Gibson *et al.* (2014). Some of the most inclusive weights, counting 90 per cent of economist output and 70 per cent of agricultural economist output are from Combes and Linnemer (CLm, CLh)



Figure 1 Attributes of the journal weighting schemes.

and from RePEc, while the MSF, Coupé and LP weights count the lowest shares of output. Amongst journals that are counted, the MSF weights treat journals almost equally, while CLh, K&Y, KMS and LP strongly penalise the lower ranked journals.

The pages for each article are multiplied by each set of weights, adjusting for the number of authors and for the size of the typical page in that journal:

$$\begin{aligned} &\text{Article Pages} \times \text{Size Correction} \times (1/\text{number of authors}) \\ &\quad \times \text{Journal Assessment Weight.} \end{aligned}$$

The lifetime sum of quality-weighted, size-adjusted and co-author-adjusted pages shows overall quality-adjusted research output. Conditional on this, the count of journal articles should mainly capture the quantity dimension of research.⁵ One can also think of quality as augmenting quantity; for example, our median journal weighting scheme puts a weight on the *American Journal of Agricultural Economics* (*AJAE*) that is three times the weight on the *Australian Journal of Agricultural and Resource Economics* (*AJARE*). Thus, an academic who publishes only in the *AJAE* is effectively publishing three times as much as one publishing the same number of size-adjusted per capita pages in *AJARE*.

The journal weights have an economics focus so may not fairly assess research quality of agricultural economists. For example, the *AJAE* gets an average of 15 per cent of the weight of the top-ranked journal (usually the *American Economic Review* [*AER*]). If we raised that weight, under the argument that publishing in leading agricultural economics journals should be, for an agricultural economist, the same as for an economist publishing in leading economics journals, it would be to tantamount to assuming the results that we want to estimate, and is inconsistent with what HHL found. Moreover, even if the weights were felt to predispose us to finding a lower return to research quality for agricultural economists than for economists, there is no reason for the same potential bias to occur when we use citations to measure research quality since it is unclear why the citations database – WoS – would favour one discipline over another.

The agricultural economists published an average of 26 articles, yielding 131 per capita *AER*-sized journal pages (Table 1). When quality-weighted this output ranges from an average of 1.4 pages with LP weights (which heavily down-weight lower ranked journals) to 39.9 pages using MSF weights (the least discriminating). The quality-weighted journal output of the average economist ranged from 31 pages using LP weights to 109 pages with the least discriminating MSF weights. Thus, the quality-adjusted per capita research output of the economists might be three times that of the agricultural

⁵ Gibson (2014) finds salary of University of California economists is affected by quality-adjusted pages and by the count of journal articles. These are two separate dimensions of research productivity even though most studies just use one or the other measure.

economists, if using the less discriminating journal weights, but could be as high as 10–20 times that of the agricultural economists if using the most discriminating weights.

The lifetime citations for each agricultural economist average 385 and for economists they average 650. The average *h*-index is 8 for the agricultural economists and 9 for the economists; recall this index counts articles starting from the most cited and ending with the last article whose citations equal or exceed that count. The citations measures indicate less of a productivity advantage for the economists over the agricultural economists compared to what the quality-adjusted journal output measures indicate. This is partly because citations are not calculated on a per capita basis (so the greater co-authorship by agricultural economists is not penalised). The existing evidence is that the labour market does not discount citations for co-authorship (Hilmer *et al.* 2015), in contrast to co-author discounting of articles where the ‘ $1/n$ rule’ cannot be rejected (Gibson *et al.* 2014).

4. Results

In recent studies with similar data from other universities the effects of seniority and experience on log salary are found to be best modelled as quadratics, there is evidence of a salary premium for males, there is no evidence that field of PhD study or rank of the PhD-granting department matters, and the location effects are highly significant (Gibson 2014).⁶ These variables had similar effects on the logarithm of salary for the subsamples of agricultural economists and of economists, in unreported initial regressions. Thus, in testing for disciplinary differences in the returns to research quality and quantity, we use regressions where the other relevant covariates (experience, seniority, gender, location) are constrained to have common effects for the two subsamples. These regressions include an *AgEcon* intercept dummy to account for the lower average salary of the agricultural economists and that dummy is interacted with each of the research productivity measures to test for disciplinary differences in the reward structures for research.

Our first approach is to include the lifetime count of published journal articles in the salary regressions, as a quantity-oriented measure, and to then test whether, conditional on that total, salary returns to quality-adjusted journal output differ between agricultural economists and economists. Since quantity is already controlled for, quality-adjusted journal output should mainly capture the quality dimension of research. The results are reported in Table 2, with each column representing a separate regression where a different set of journal weights is used to construct the quality-adjusted

⁶ These location effects capture not only cost of living differences but also university reputation and other amenities. The literature that estimates earnings functions for academic economists covers many of these patterns in greater depth and is recently reviewed in Hamermesh and Pfann (2012).

Table 2 Salary regressions with article counts and quality-adjusted journal output

	MSF	CLm	CLh	RePEc	Coupé	K&Y_all	K&Y_econ	KMS	LP
Seniority (years)	-0.021** (3.93)	-0.023** (4.40)	-0.023** (4.45)	-0.023** (4.55)	-0.023** (4.28)	-0.023** (4.53)	-0.024** (4.56)	-0.023** (4.42)	-0.022** (4.32)
Seniority squared ($\div 100$)	0.024 + (1.85)	0.030* (2.30)	0.030* (2.34)	0.032* (2.53)	0.029* (2.30)	0.031* (2.42)	0.032* (2.48)	0.031* (2.39)	0.028* (2.21)
Experience (years)	0.033** (6.21)	0.033** (6.52)	0.033** (6.78)	0.034** (6.73)	0.033** (6.59)	0.034** (6.93)	0.034** (6.92)	0.033** (6.91)	0.033** (6.83)
Experience squared ($\div 100$)	-0.044** (3.79)	-0.046** (4.04)	-0.047** (4.25)	-0.048** (4.36)	-0.048** (4.34)	-0.048** (4.50)	-0.049** (4.52)	-0.048** (4.45)	-0.047** (4.33)
Male	0.101** (3.93)	0.095** (3.74)	0.093** (3.63)	0.093** (3.68)	0.097** (3.85)	0.094** (3.66)	0.094** (3.66)	0.090** (3.53)	0.093** (3.53)
Ag Econ dummy intercept	-0.246** (7.41)	-0.237** (7.16)	-0.233** (7.28)	-0.235** (7.31)	-0.234** (7.30)	-0.234** (7.35)	-0.232** (7.35)	-0.222** (7.24)	-0.228** (7.26)
Number of journal articles	0.038* (2.10)	0.024 (1.34)	0.031* (2.11)	0.024 (1.53)	0.024 (1.51)	0.041** (3.01)	0.040** (2.94)	0.036** (2.79)	0.043** (3.13)
Number \times Ag Econ	0.023 (1.13)	0.037 + (1.81)	0.022 (1.42)	0.029 + (1.70)	0.030 + (1.70)	0.007 (0.52)	0.009 (0.65)	0.013 (0.96)	0.003 (0.23)
Quality-adjusted pages	0.009* (2.25)	0.016** (3.05)	0.022** (4.11)	0.029** (4.25)	0.048** (4.20)	0.036** (3.79)	0.041** (4.21)	0.042** (5.10)	0.033** (4.36)
Quality \times Ag Econ	-0.019** (3.51)	-0.033** (3.66)	-0.053** (3.24)	-0.048** (3.58)	-0.071** (3.85)	-0.072** (3.09)	-0.080** (3.15)	-0.086** (3.12)	-0.089** (2.30)
R^2	0.674	0.684	0.688	0.691	0.686	0.686	0.688	0.689	0.687
F-test (interactions = 0)	12.17**	7.87**	5.30**	6.71**	8.59**	5.13**	5.22**	4.93**	2.70 +

Notes: The dependent variable is ln (salary). The intercept and fixed effects for each university (with Illinois as the base category) are not reported. $N = 295$, robust t statistics in parentheses, +significant at 10%, *significant at 5%, **significant at 1%. The F -test of interactions is for the null hypothesis that the coefficients on Number \times Ag Econ and Quality \times Ag Econ are jointly zero but does not test that the Ag Econ intercept dummy is zero.

research measure. While our interest is not in the demographic effects, we report their coefficients but for reasons of space do not report the location effects.⁷

There is clear evidence of a lower return to quality-adjusted research output for the agricultural economists. In all nine salary equations, the interaction of the quality variable with the dummy variable for the agricultural economics departments is negatively signed and statistically significant at the one per cent level (or at the five per cent level, if using LP weights). Since the dependent variable is in logarithms, and the level effect of lower average salaries in agricultural economics departments is already controlled for, we interpret this interaction effect as showing a smaller proportionate increase in salary from an increase in quality-adjusted research, conditional on the total number of articles published, for the agricultural economists than for the economists.

There is some evidence that the agricultural economists get a higher return to quantity of research outputs.⁸ In salary equations using the CLm, RePEc and Coupé weights, the interaction term from crossing the dummy variable for agricultural economics departments with the number of journal articles published is positive and statistically significant (at the ten per cent level). The quality-adjusted stock of total research output is held constant so this represents the return to restructuring a publication portfolio in a more quantity-oriented way by publishing more articles.

Although not our main focus, we briefly comment on results for the other variables in Table 2. Conditional on overall years of experience and the salary premium from being more experienced, academic salaries fall at a diminishing rate the longer one spends at the current university (which is here called *Seniority*); this widely reported pattern is discussed by Ransom (1993). On the other hand, conditional on seniority, salary rises at a diminishing rate with overall experience, which is measured by the years since the PhD. The last pattern amongst the demographic variables is that, conditional on experience and seniority, and on location in terms of the department and university where employed, and also holding constant the various measures of research productivity, there appears to be a salary premium for male academics of about ten per cent and this is statistically significant at the one per cent level in all nine equations.

Someone in an agricultural economics department with the sample mean characteristics and research record in terms of the number of articles and the quality-weighted journal output, would expect salary to be from \$35 000 to

⁷ These were largest for Wisconsin, where conditional salaries were over 20 per cent higher than for the reference category (Illinois).

⁸ If journal articles are not adjusted for co-authors, there are significant (at the 5% level) effects of a higher return to the number of journal articles in agricultural economics compared to economics in five equations (using MSF, CLm, CLh, RePEc and Coupé weights). The average *F*-test for the interaction terms without adjusting for the number of co-authors is 6.55 compared to 6.51 in Table 2. Thus, the results are robust to co-author adjustment.

\$72 000 lower than an equivalent person located in an economics department of the same university. The estimated gap is always smallest at Purdue, where it ranges from \$35 000 using RePEc weights to \$41 000 using MSF weights, and is always largest at Wisconsin where it varies from \$62 000 (using RePEc) to \$72 000 (using LP weights). The simple average of this gap over the six universities ranges from \$45 000 using RePEc weights to \$53 000 using LP weights.⁹

The approach used in Table 2, of considering the count of articles as a quantity measure, is not the only way to decompose research output into quantity and quality dimensions. Consider someone who is totally unaware of the rankings or prestige of the various journals; such a person might consider 100 pages in the *AJARE* to be the same as 100 pages in the *AJAE* and the same as 100 pages in the *AER* (leaving aside the adjustments for physical size of pages in each journal). Thus, a pure quantity measure of research output can be formed by working with the lifetime sum of per capita *unweighted* journal pages, which effectively says that ‘all journals are equal’. To measure research quality one could subtract this sum from the quality-weighted sum of journal pages. This gives a non-negative measure of quality since a page in a higher ranked journal is equivalent to (much) more than one page in a lower ranked journal. The issue in implementing this is that none of the journal weighting schemes cover the entire universe of journals so assumptions have to be made about how to incorporate the excluded journals.

Our first approach to excluded journals is to give them the weight of the lowest nonzero weighted journal in each weighting scheme. We then made all weights relative to that lowest value; in some cases this resulted in very large values (e.g. a weight of 10 000 given to the *AER* under the re-based KMS weights). The results using this approach are reported in Panel A of Table 3, and they support the patterns seen in Table 2. Specifically, there is a statistically significantly higher return to research quantity for agricultural economists than for economists in five of the salary equations, and a significantly lower return to quality for agricultural economists compared with economists in all nine of the equations. The hypothesis that these interaction terms for disciplinary differences in rewards to research are jointly zero is soundly rejected (at the one per cent level in six of the equations and at the five per cent level in the other three).

The second approach to dealing with the excluded journals is one that also limits the range of scales used by the different weighting schemes. We re-index the weights by giving the top-ranked journal an index weight of 100 and then

⁹ Since the models are semi-logarithmic, Duan's (1983) smearing estimator is used to calculate predicted salary in dollar terms for these comparisons. It may seem surprising that the conditional salary gap is similar to the raw gap, given the much lower quality-adjusted research output of the agricultural economists shown in Table 1. The reason is that the payment structure in agricultural economics only weakly rewards (or penalises low) research quality.

Table 3 Salary regressions with alternative quality–quantity decompositions of research output

Journal weighting scheme for calculating quality-adjusted journal output over lifetime comes from									
	MSF	CLm	CLh	RePEc	Coupé	K&Y_all	K&Y_econ	KMS	LP
A. Excluded journals are given the lowest nonzero weight, and indexed as lowest = 1									
Ag Econ intercept dummy	−0.232** (6.18)	−0.218** (5.82)	−0.210** (5.77)	−0.217** (6.10)	−0.212** (6.12)	−0.212** (6.07)	−0.211** (6.08)	−0.194** (5.76)	−0.204** (5.85)
Quantity (unweighted pages)	0.554 (0.18)	−0.830 (0.33)	1.978 (0.92)	−0.245 (0.10)	0.378 (0.15)	3.855 + (1.88)	3.559 + (1.76)	3.625* (1.98)	4.251* (2.22)
Quantity × Ag Econ (weight−unweight)	11.634** (3.09)	9.159** (2.64)	5.555* (2.13)	7.574** (2.71)	6.816* (2.37)	2.947 (1.29)	3.334 (1.48)	3.373 (1.57)	1.894 (0.92)
Quality × Ag Econ (weight−unweight)	8.864* (2.51)	1.063** (4.15)	0.051** (4.41)	0.022** (4.77)	1.008** (4.37)	0.004** (3.23)	0.004** (3.63)	0.002** (4.44)	0.033** (3.88)
Quality × Ag Econ	−23.461** (4.33)	−1.931** (2.83)	−0.122** (2.69)	−0.033** (4.09)	−1.390** (3.94)	−0.008** (3.76)	−0.009** (3.85)	−0.004** (3.13)	−0.104* (2.55)
R ²	0.664	0.668	0.671	0.674	0.669	0.667	0.669	0.673	0.669
F-test (interactions = 0)	10.62**	4.14*	3.70*	8.49**	8.54**	7.56**	7.72**	4.91**	3.26*
B. Weights are indexed as top-ranked journal = 100, and index +1 is used so as to include all journals									
Ag Econ intercept dummy	−0.234** (6.32)	−0.219** (5.85)	−0.210** (5.78)	−0.217** (6.10)	−0.213** (6.13)	−0.212** (6.07)	−0.211** (6.08)	−0.194** (5.76)	−0.204** (5.85)
Quantity (unweighted pages)	0.023 (0.62)	−0.015 (0.56)	0.019 (0.90)	−0.003 (0.11)	−0.002 (0.06)	0.039 + (1.88)	0.036 + (1.75)	0.036* (1.98)	0.042* (2.20)
Quantity × Ag Econ	0.108* (2.50)	0.110** (2.80)	0.057* (2.15)	0.076** (2.72)	0.077* (2.53)	0.030 (1.29)	0.033 (1.48)	0.034 (1.57)	0.019 (0.94)
Quality (weight−unweight)	0.001 + (1.70)	0.002** (4.06)	0.002** (4.40)	0.004** (4.77)	0.006** (4.32)	0.004** (3.23)	0.004** (3.63)	0.004** (4.44)	0.003** (3.88)
Quality × Ag Econ	−0.003** (3.71)	−0.004** (2.99)	−0.006** (2.70)	−0.006** (4.09)	−0.008** (3.96)	−0.008** (3.76)	−0.009** (3.85)	−0.010** (3.13)	−0.010* (2.56)
R ²	0.658	0.668	0.671	0.674	0.669	0.667	0.669	0.673	0.669
F-test (interactions = 0)	9.88**	4.56*	3.73*	8.48**	8.59**	7.56**	7.72**	4.91**	3.29*

Notes: The dependent variable is ln (salary). each regression also has quadratics in experience and seniority, a dummy variable for males, and fixed effects for each university. $N = 295$, robust t statistics in parentheses, +significant at 10%, *significant at 5%, **significant at 1%. The F -test of interactions is for the null hypothesis that the coefficients on Quantity × Ag Econ and Quality × Ag Econ are jointly zero but does not test that the Ag Econ intercept dummy is zero.

add one to the weight for all journals, including the excluded journals who were implicitly given a weight of zero in the original weighting scheme. Thus, the range of transformed weights varies over the interval from 1 to 101. The results using this approach are in Panel B of Table 3, and they also support the patterns seen in Table 2. Five equations have positive and significant Quantity \times Ag Econ interaction terms, and all nine equations have negative and statistically significant Quality \times Ag Econ interaction terms. Thus, if quality is defined as augmented quantity, the evidence again points to a different reward structure in agricultural economics, with much smaller returns to research quality and larger returns to research quantity than what economists experience.

4.1 Using Citations to Measure Research Quality

In unreported regressions, we considered various citations metrics in order to find the best-fitting to use in the testing for disciplinary differences. First, we considered total citations (in thousands) to the journal articles published up until the end of 2013. The salary of economists is 11 per cent higher for every 1000 citations but for agricultural economists salary is just five per cent higher (the six-point gap is statistically significant at the one per cent level). Second, economist salary rises by 2.5 per cent for every one point increase in the h -index, but the agricultural economists only get paid 1.5 per cent more for every one point increase in their h -index (the difference is statistically significant, with $t = 3.34$). We also considered variants of the h -index that put more weight on highly cited papers (based on Ellison 2013) but found that the original h -index provides the best fit.

We report models that jointly consider article counts, quality-adjusted journal output and the h -index for citations in Table 4. For all nine equations, with the different journal weights, the regression models indicate that the agricultural economists get a significantly lower return to quality-weighted journal output and to the h -index for citations, and a higher return to the number of journal articles, compared to the returns that economists get. The joint test of zero terms on the three interaction variables, for the number of articles, the quality-adjusted journal output and the h -index is statistically significant at the one per cent level in eight equations and at the five per cent level in the last equation. These results in Table 4 provide very clear evidence of significant differences in the returns to research quantity and quality for academics in agricultural economics departments compared to those in economics departments.

5. Discussion and conclusions

The results reported here add to the small literature that examines differences in the rewards for research in the closely related disciplines of agricultural economics and economics. The salary of economists varies with quality-

Table 4 Salary regressions with article counts, quality-adjusted journal output and the *h*-index for lifetime citations

	Journal weighting scheme for calculating quality-adjusted journal output over lifetime comes from								
	MSF	CLm	CLh	RePEc	Coupé	K&Y_all	K&Y_econ	KMS	LP
Ag Econ intercept dummy	-0.205** (5.87)	-0.207** (6.13)	-0.208** (6.29)	-0.213** (6.42)	-0.214** (6.38)	-0.209** (6.33)	-0.209** (6.34)	-0.200** (6.13)	-0.205** (6.28)
Number of journal articles	-0.010 (0.44)	-0.019 (0.79)	-0.009 (0.40)	-0.010 (0.44)	-0.008 (0.34)	-0.003 (0.12)	-0.002 (0.09)	-0.006 (0.25)	0.000 (0.02)
Number × Ag Econ	0.077** (2.80)	0.080** (2.88)	0.063* (2.39)	0.063* (2.41)	0.060* (2.34)	0.051 + (1.96)	0.050 + (1.96)	0.054* (2.11)	0.045 + (1.75)
Quality-adjusted journal output	0.005 + (1.82)	0.012** (2.63)	0.016** (3.21)	0.022** (3.27)	0.033** (2.92)	0.027** (2.98)	0.031** (3.26)	0.032** (3.39)	0.024** (3.18)
Quality × Ag Econ	-0.015** (3.10)	-0.028** (3.13)	-0.047** (2.83)	-0.041** (3.06)	-0.057** (3.01)	-0.063** (2.70)	-0.070** (2.77)	-0.075** (2.66)	-0.081* (2.03)
<i>h</i> -index for citations	0.022** (3.48)	0.019** (2.99)	0.018** (2.69)	0.016* (2.42)	0.016* (2.39)	0.018** (2.70)	0.017** (2.62)	0.018* (2.57)	0.017** (2.77)
<i>h</i> -index × Ag Econ	-0.023** (2.94)	-0.018* (2.37)	-0.016* (2.08)	-0.015 + (1.88)	-0.015 + (1.76)	-0.017* (2.05)	-0.016* (1.98)	-0.016 + (1.94)	-0.016* (2.07)
<i>R</i> ²	0.690	0.6956	0.698	0.698	0.693	0.696	0.697	0.698	0.695
<i>F</i> -test (interactions = 0)	8.34**	6.32**	4.83**	5.60**	7.07**	5.36**	5.22**	4.66**	3.72*

Notes: The dependent variable is ln (salary) and each regression also has quadratics in experience and seniority, a dummy variable for males, the proportion of articles not in WoS, and fixed effects for each university. *N* = 295, robust *t* statistics in parentheses, +significant at 10%, *significant at 5%, ** significant at 1%. The *F*-test of interactions is for the null hypothesis that the coefficients on Number × Ag Econ, Quality × Ag Econ and the *h*-index × Ag Econ are jointly zero but does not test that the Ag Econ intercept dummy is zero.

adjusted lifetime output in refereed journals (using nine different sets of journal quality weights), and with citations. In contrast, agricultural economists have significantly lower returns to these indicators of research quality and instead face salary structures that vary with how often their research appears in refereed journals.

Our evidence is from sample of large, well-regarded, public universities in nearby states. The somewhat homogeneous sample and comprehensive data on aspects of research productivity provide well-fitting models that explain about 70% of wage variation.¹⁰ Thus, the regressions should give a good testing ground for comparing rewards for research quantity and quality in economics and agricultural economics without having too much risk of bias due to omitted variables. In terms of external validity, many agricultural economists in other settings, including in Australasia, are likely to follow the research strategies that are rewarded in these sorts of universities since there is a professional leadership role of academics in the United States.

Our comprehensive productivity data take more effort to gather than just counting articles in a few tiers of journals, so discussing the additional insights gained is appropriate. A problem with the tiers approach for the current sample is that using the six tiers of journals of HHL makes no difference compared with using a simple count of all articles.¹¹ If counts of articles in each of these six tiers are used in salary regressions for the economist subsample, along with the *h*-index and quality-weighted journal output, the hypothesis that the coefficients on the count variables are jointly zero is never rejected (the *P*-values range from 0.102 to 0.288 across the equations based on each of the nine sets of quality weights, with an average *P*-value of 0.19). In contrast, journal quality and citations are always jointly significant predictors of salary in the economics departments, with *P*-values that range from 0.005 to 0.015 (and average 0.009).

While agricultural economists do appear to be paid by the count of articles published, in the current sample there is no benefit in disaggregating that count by journal tiers. Specifically, if the total count of journal articles is used in a salary equation for agricultural economists, then adding counts for five of the six journal tiers (with one excluded to avoid perfect collinearity with the total counts) provides no additional explanatory power. The hypothesis that article counts in the five journal tiers can be excluded from the model is not rejected ($P = 0.60$). In other words, at the universities studied here, pay for agricultural economists varies on a simple count of articles (with tier counts adding no information), while for economists, it varies with citations

¹⁰ In contrast, HHL explain 55–64 per cent of salary variation with their most comprehensive models.

¹¹ The first tier was top five economics journals, the second tier was 31 other journals listed by Scott and Mitias (1996), the third tier was remaining economics journals, the fourth tier was four core journals in agricultural economics, the fifth tier was seven regional journals in agricultural economics, and the last tier was other agricultural economics journals.

and with quality-weighted journal output and counts of articles have no predictive power.

Where do these differences in the reward structure come from? In all six universities studied here, the agricultural economics department is in a separate College from the economics department. While economics is usually in a College of Arts and Sciences, or Liberal Arts or Social Sciences (only at Purdue is economics in a Management School), agricultural economics is always in a College of Agriculture or of Agriculture and Natural Resources or the Environment. The other departments in the colleges where agricultural economics is located are staffed by scientists, who tend to write short papers with lots of authors and, as a result, tend to quickly generate a long curriculum vitae. This is not a conducive environment for adopting research norms from economics, which prioritise a few articles in highly ranked journals.¹² If decisions about salary advancement have to get past college-level gatekeepers, who may not know the difference between the *AER* and the *AJAE* and who may just count articles, a quantity-oriented publication strategy may be sensible. In contrast, economists may claim that methodological rigour and their valuable outside options justify much higher rewards for research than those offered to other social scientists within their colleges.

Another possible source of these disciplinary differences is norms about publishing with doctoral students. The faculty in agricultural economics co-author more, with the average article having three authors compared to two for the economists. Some of this may be co-authoring with students, where a publication strategy might be to seek out lower ranked journals that offer faster decisions, given the time frame for completing a PhD. This explanation should not be pushed too far because co-authoring with students seems quite common in both economics and agricultural economics at these universities. We examined vita of 137 job market candidates (from 2015 to 2016) from these 12 departments, looking for articles, conference papers and working papers that were co-authored with one or more of their doctoral committee; 60 per cent of the agricultural economics students and 45 per cent of the economics students had such items. This does not indicate particularly sharp difference in disciplinary norms about publishing with students.

Another disciplinary difference is the extension focus of agricultural economists. We omitted anyone with a majority of their appointment having an extension focus, but 31 other agricultural economists had fractional extension appointments. If we omit these 31 fractional extension academics from the sample, the pattern of lower returns to quality and higher returns to quantity for the agricultural economists is maintained. For example, in

¹² If attention is restricted to the subsample with a PhD in economics ($N = 189$), the patterns in Table 4 are repeated, with an average F -test for the *AgEcon* interaction effects of 5.53 (cf. 5.68 in Table 4). The difference in returns for academics with the same training lends support to the institutional rules explanation.

regressions like those in Table 4, but without the 31 fractional extension academics, the average (maximum) P -value for zero interaction effects between indicators of research quality or quantity and being in an agricultural economics department is 0.006 (0.03) compared with 0.002 (0.01) when the fractional extension academics were included. The interaction effects for the higher return to the quantity of articles average 0.050, for the lower return to quality-adjusted journal output they average -0.050 , and they average -0.014 for the lower return to the h -index for citations. If the full sample with fractional extension academics is used, the average interaction effects are almost the same, at 0.058 for quantity, -0.053 for quality-weighted output and -0.017 for the h -index.

Somewhat related to the question of the extension focus is the fact that the agricultural economists are less mobile than the economists, with 2 years longer in the current position for similar years of total experience. There are more places of employment for academic economists compared to agricultural economists, which may explain this lower mobility. A rational response would be for agricultural economists to focus more on location-specific knowledge, which may not publish as well or generate as many citations. In contrast, local institutional knowledge is less needed by economists who are more highly mobile; this contrast has previously been noted by Frey and Eichenberger (1993) in a discussion of research strategies for European economists and something of the same phenomena may apply to the agricultural economists.

If agricultural economics and economics were unrelated disciplines, the differing rewards for research might be interesting but need not cause any practical concern. In fact, the disciplinary boundary is permeable, in one direction, with a flow of PhD graduates from economics program into agricultural economics departments. About one-third of faculty in the agricultural economics departments we study had a PhD from an economics department, with a higher share for younger faculty. Since the reward structure for research varies so much between agricultural economics and economics, if younger agricultural economics faculty with doctoral training in economics bring with them the publishing norms from economics, they may become frustrated by the muted returns to research quality that agricultural economics departments seem to offer.

References

- Card, D. and DellaVigna, S. (2013). Nine facts about top journals in economics, *Journal of Economic Literature* 51(1), 144–161.
- Duan, N. (1983). Smearing estimate: a nonparametric retransformation method, *Journal of the American Statistical Association* 78(383), 605–610.
- Ellison, G. (2013). How does the market use citation data? The Hirsch index in economics, *American Economic Journal: Applied Economics* 5(3), 63–90.
- Frey, B. and Eichenberger, R. (1993). American and European economics and economists, *The Journal of Economic Perspectives* 7(4), 185–193.

- Gibson, J. (2014). Returns to articles versus pages in academic publishing: do salary-setters show 'article illusion'?, *Economics Letters* 125(3), 343–346.
- Gibson, J., Anderson, D. and Tressler, J. (2014). Which journal rankings best explain academic salaries? Evidence from the University of California, *Economic Inquiry* 52(4), 1322–1340.
- Hamermesh, D. and Pfann, G. (2012). Reputation and earnings: the roles of quality and quantity in academe, *Economic Inquiry* 50(1), 1–16.
- Hilmer, C., Hilmer, M. and Lusk, J. (2012). A comparison of salary structures between economics and agricultural economics departments, *Applied Economic Perspectives and Policy* 34(3), 489–514.
- Hilmer, M., Ransom, M. and Hilmer, C. (2015). Fame and the fortune of academic economists: how the market rewards influential research in economics, *Southern Economic Journal* 82(2), 430–452.
- Hirsch, J. (2005). An index to quantify an individual's scientific research output, *Proceedings of the National Academy of Sciences of the United States of America* 102(46), 16569–72.
- Liebowitz, S. (2014). Willful blindness: the inefficient reward structure in academic research, *Economic Inquiry* 52(4), 1267–1283.
- Ransom, M. (1993). Seniority and monopsony in the academic labor market, *American Economic Review* 83(1), 221–233.
- Scott, L. and Mitias, P. (1996). Trends in rankings of economics departments in the U.S.: an update, *Economic Inquiry* 34(3), 378–400.