

The Search for Economics Talent: Doctoral Completion and Research Productivity

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Economists hold an annual talent search in which students from around the world apply to doctoral programs and economics departments. Top economics PhD programs seek candidates with the preparation, aptitude, drive, and creativity to become academic professionals whose research will advance the frontiers of the discipline. Admission committee members must judge students' potential economic talent based on the evidence provided in the application folders, which includes standardized test scores, course selection and grades, quality of the undergraduate institution, fellow economists' evaluations, and other relevant information. Due to the nonobservability of important characteristics, the admission committee's task of matching opportunity with talent constitutes a signaling problem, as modeled by Michael A. Spence (1973).

What information, then, credibly signals otherwise unobservable economics talent? Viewing quantitative Graduate Record Examination (GRE) scores as a proxy for ability, Ronald G. Ehrenberg and Panagiotis G. Mavros (1995) found that these scores failed to predict PhD completion or time-to-degree for 25 years of economics PhD students at Cornell University. Attributing that result to a poor proxy for ability, they recommended obtaining a richer set of information about a student's "true ability" by using, for example, the quality of applicants' undergraduate institution, information from letters of recommendation, and the graduate committee's ranking.

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In this article, we test whether three principal signals of economics talent available to admission committees—GRE scores, the identity of reference letter writers, and the quality of baccalaureate schools—predict either PhD completion or research productivity 17 years later.¹ Our dataset, a summary of the information contained in all 344 application files to a top-five economics PhD program in 1989, includes demographic variables, undergraduate institution, information on prior graduate degrees, GRE scores, and the names of letters of reference writers. Unfortunately, the application file summaries available to us did not include the transcripts or the contents of the letters of reference. Thus, we evaluate whether the quality of the undergraduate institution (irrespective of major, GPA, or course selection) and the prominence of the letter writers (regardless of their assessment of the applicant) correlate with important long-run career outcomes. In addition, we test the efficacy of the admission committee's subjective rating of each candidate. This rating encapsulates the characteristics noted above, as well as additional information not available to us such as course selection, grades, academic honors received, and the content of the letters of reference.

Our analysis breaks new ground in several ways. Since we estimate the relationship between degree completion and the selection criteria for *all applicants*, our analysis constitutes the sole predictive validity study of economics PhD completion.² In addition, we test whether some basic types of information function as effective signals of applicants' career success. Two of the signals of potential economics talent—the identity of letter writers and admission committee

¹ Alan B. Krueger and Wu (2000) estimated initial job placement using these same data.

² Existing studies examine degree completion for matriculants (Ehrenberg and Mavros 1995) and time-to-degree for completers (Ehrenberg and Mavros 1995; John J. Siegfried and Wendy A. Stock 2001).

TABLE 1—SUMMARY STATISTIC OF KEY VARIABLES

Variable	Entire sample (N = 344)		Complete files (N = 259)		Completed PhD; Complete files (N = 174)	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Completed PhD	0.66	0.48	0.67	0.47	1.00	0.00
Publications	3.01	5.39	3.08	5.42	4.55	6.01
At least one publication	0.48	0.50	0.49	0.50	0.70	0.46
Quality-adjusted publications	0.51	1.42	0.53	1.44	0.79	1.69
Top-4 publications	0.26	0.95	0.26	0.94	0.39	1.13
At least one top 4 publication	0.12	0.32	0.12	0.33	0.18	0.38
Quantitative GRE	742.50	62.50	740.60	64.50	752.30	55.50
Verbal GRE	568.60	123.10	571.40	123.00	580.90	120.60
Female	0.26	0.44	0.27	0.44	0.28	0.45
Age 25+	0.51	0.50	0.47	0.50	0.45	0.50
Prior graduate degree	0.40	0.49	0.37	0.48	0.39	0.49
Foreign undergrad	0.52	0.50	0.49	0.50	0.53	0.50
Elite liberal arts undergrad	0.07	0.26	0.08	0.27	0.07	0.25
Elite research univ. undergrad	0.17	0.38	0.19	0.39	0.18	0.39
Reference group 1	0.11	0.32	0.12	0.33	0.16	0.36
Reference group 2	0.18	0.38	0.17	0.38	0.20	0.40
Committee ratings (0-18)	7.17	4.24	7.39	4.38	8.35	4.32

Notes: Data are derived from applicants to a top-5 economics PhD program in 1989. Publication data derived from ECONLIT search engine.

rankings—have not been used previously with any other dataset.

I. Doctoral Program Completion and Publication Outcomes

By July 2006, 17 years after applying to one of the top-five economics doctoral programs, 226 of the 344 applicants (66 percent) had completed a PhD in economics or a closely related field such as business economics or public policy. Table 1 shows summary statistics of key variables for the entire applicant pool, for a sample of 259 whose files included nonmissing information for all variables used in the analysis, and for a sample of 174 doctoral recipients with complete file information. The 20 percent attrition rate of the students who matriculated in this top-five program and the 36 percent rate at Cornell University from 1964 to 1978 (Ehrenberg and Mavros 1995) suggest that a significant number of applicants probably enrolled in a doctoral program but subsequently dropped out. Most of the individuals who received a PhD would have had somewhere between 10 and 13 years in their respective jobs, so those who pursued academic careers would have either received or been denied tenure by this point.

In addition to predicting PhD completion, we also look at long-run research productivity,

as measured by publication data derived from the EconLit database in July 2006. The mean number of refereed journal publications for those who completed a PhD and had complete application data is 4.5, 50 percent higher than the overall sample mean of 3 articles. Because of the skewed distribution of publications (many individuals having zero), our analysis also uses a dichotomous variable equal to one if the individual has at least one peer-reviewed journal publication. Among doctorates with complete file data, 70 percent were published. To see which individuals eventually published in one of the discipline's leading journals, we also estimate the probability of publishing at least one article in the *American Economic Review* (*AER*, excluding *Papers and Proceedings*), *Quarterly Journal of Economics* (*QJE*), *Journal of Political Economy* (*JPE*), or *Econometrica* (*EMA*). Only 18 percent (31 individuals) of doctorates with complete application files did so. Finally, we calculate a quality-adjusted number of total publications using Laband-Piette's pages-adjusted index.³ The mean quality-adjusted number of publications is

³ The Laband-Piette index, a "long-term" impact factor (five years) that gives higher weight to citations from better journals, values an article in the *AER* as 100, in *Economic Inquiry* as 4.7, and in the *JPE* as 52.

0.79 for doctorates with complete records (with a maximum slightly over 12).

From summaries of the applicants' admissions files, we have the following information: applicants' quantitative and verbal GRE scores (analytical and subject scores were available for only some applicants), country of origin, age, gender, and whether an individual had a prior graduate degree. We coded the quality of two categories of undergraduate institutions: the top-30 liberal arts colleges (according to James E. Hartley and Michael D. Robinson 1997) and the top-20 global economics programs (according to Pantelis Kalaitzidakis, Theofanis P. Mamuneas, and Thanasis Stengos 2003).⁴ For the sample size used to estimate research productivity ($n = 174$), 7 percent received their baccalaureates from an elite liberal arts college and 18 percent graduated from a top global economics department. To code the identity of letter writers, we use Krueger and Wu's (2000) mutually exclusive subjective quality groupings. Reference group 1 includes at least one top research economist (i.e., a well-known and respected researcher). Reference group 2 contains at least one active economist (i.e., an economist who had prominently published in the not too distant past) and reference group 3 includes all others. Among doctorates with complete records, 16 percent had a reference group 1 letter writer and 14 percent had a writer categorized as reference group 2. Finally, two members of the admissions committee read 85 percent of the application folders (293) and ranked the candidates on a scale of 0 to 9, for a variable range of 0 to 18.

II. Ex Ante Determinants of the Variation in PhD Completion

Since a third of the applicant pool did not complete a PhD, we use probit analysis to estimate what ex ante information contained in student application files predicts doctoral degree completion (where the dependent variable is equal to one if an individual obtained a doctorate by July 2006). The marginal effects of these probit results are shown in Table 2, column 1. Foreign applicants, those with high quantitative

and verbal GRE scores, and those with a letter of reference from a top economist or an active researcher were significantly more likely to complete a PhD. The probability of achieving a doctorate increased by 24 percent if an applicant had a prominent letter writer, by 15 percent if an active researcher wrote a letter, by 8 percent for a 50-point increase in an applicant's GRE quantitative score (at the mean of 740), and by 3 percent for a 50-point increase in the GRE verbal scores (at the mean of 571), respectively. Meanwhile, foreign-based undergraduates are 19 percent more likely than US-based undergraduates to have completed a doctorate, but the quality of undergraduate institutions does not affect PhD completion.

III. Ex Ante Determinants of the Variation in Research Productivity

To probe the predictors of refereed publications, we regress three measures of research productivity on the set of application file variables. Given the lumpy nature of the distribution of publications (30 percent of doctorates with complete file information have no publications), our first regression uses a probit model where the dependent variable is equal to one if an individual has published at least one peer-reviewed journal article. The marginal effects shown in column 4 of Table 2 indicate that higher probabilities of publishing are significantly associated with both higher quantitative GRE scores and the prominence of one's reference writers. Specifically, having a prolific and well-known reference writer corresponds to an increase of 23 percent in the probability of publishing at least one journal article, and having a reference writer who actively publishes increases the probability of publishing at least one article by 18 percent, *ceteris paribus*. A 50-point increase in the quantitative GRE score (from a mean value of 740) corresponds to an increase of 7 percent in the likelihood of publishing.

Might having a prominent or active letter writer merely proxy for the quality of undergraduate institutions? The data show that graduating from a top global economics department correlates moderately with having a letter from a reference 1 writer (correlation coefficient of 0.49). The significance of reference writers holds for regressions that exclude top research

⁴ We obtained essentially the same result coding just the top ten for each category.

universities and liberal arts colleges, however. Furthermore, regressions that use other systems of ranking undergraduate schools show similar results. Perhaps, then, our results suggest a partial explanation for the positive relationship between prestige of an undergraduate institution and quality of the graduate school attended (e.g., Eric Eide, Dominic J. Brewer, and Ehrenberg 1998; Liang Zhang 2005) since attending an elite undergraduate school increases one's likelihood of having a prominent reference writer.

Analysis of two quality-based measures of research productivity reveals different influences. Only foreign undergraduates exhibited a greater likelihood of publishing in at least one of the four elite general interest journals (*AER*, *QJE*, *JPE*, and *EMA*), while all other variables are statistically insignificant in this regression (see column 7). GRE quantitative scores and the status of letter writers are significantly related to the quality-adjusted index of the number of publications (based on tobit regressions using Laband-Piette's index in column 10).

IV. Do Admission Committee Ratings of Applicants Have Predictive Value?

The results from our data show that, taken alone, the sum of the subjective ratings of admissions committee members is a strong predictor of doctoral completion and all three measures of publishing (see columns 2, 5, 8, and 11 of Table 2). In each instance, the subjective ratings are significant at the 1 percent level and meaningful in magnitude. For instance, a one-standard-deviation increase in the committee's subjective ratings (4.3 on a scale of 18) increases the probability of doctoral completion by 16 percent, publishing at least one peer-reviewed article by 15 percent, and publishing in one of the leading journals by 9 percent.

When we combine the admissions committee members' subjective ratings along with the rest of the application data, many coefficients change significance and magnitude compared with the estimations using only applicant file data. For example, including subjective ratings in the PhD completion model does not affect the magnitude or significance of the foreign baccalaureate and reference 1 coefficients, but verbal GRE scores lose significance while quantitative GRE scores and the indicator variable for reference 2 writ-

ers become less significant (from 5 percent to 10 percent) and smaller in magnitude (compare columns 1 and 3 of Table 2). Thus, the sum of ratings apparently incorporates the predictive role of some but not other variables.

Note that the pseudo *R*-squared values for the doctoral completion regressions using admissions file information only, subjective ratings only, and both sets of information are 0.102, 0.073, and 0.145, respectively (columns 1–3, Table 2). The same pattern occurs for the regressions involving publishing at least one article and publishing at least one top article. A regression using a purely statistical model without human ratings has better predictive power than a regression using human ratings alone, but combining both types of information yields superior predictions. Thus, these results suggest that admission committees should use both types of information to identify economics talent, which is consistent with the idea that admissions committee rankings offer valuable information about the "true ability" of applicants (as suggested by Ehrenberg and Mavros 1995).

The noneffect of including subjective ratings on foreign undergraduates' probabilities of doctoral completion and publishing in a top journal implies that non-US bachelors have an acute signaling problem. As evidence, note the stark differences between US and foreign bachelors, respectively. Forty-two versus 16 percent had reference group 1 or 2 letter writers, 14 versus less than 1 percent graduated from a top research university, and of those who ultimately published in the four premier economics journals, 80 versus 20 percent had letter writers categorized as reference group 1 or 2. Apparently, the signals used by economics PhD admission committees provide little help identifying economics talent for those educated outside US borders. This constitutes a considerable problem since non-US citizens received 68 percent of the economics doctorates awarded in 2003 (T. B. Hoffer et al. 2005, 98).

V. Summary

Economics departments seek candidates with the preparation, aptitude, drive, and creativity to succeed in their programs and become successful economists. Here, we identify two credible signals to admission committees of otherwise

TABLE 2—PREDICTING DEGREE COMPLETION AND RESEARCH PRODUCTIVITY
PROBIT AND TOBIT ANALYSIS

	Completed PhD		At least one publication			At least one top-4 publication			Weighted publication index			
	(Probit)		(Probit)			(Probit)			(Tobit)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Quantitive GRE/100	0.152*** (0.064)		0.092* (0.053)	0.001** (0.001)		0.074 (0.071)	-0.084 (0.062)		0.025 (0.065)	1.059** (0.452)		0.494 (0.468)
Verbal GRE/100	0.064** (0.031)		0.030 (0.031)	-0.000 (0.000)		-0.021 (0.035)	0.021 (0.028)		0.009 (0.029)	0.118 (0.216)		-0.030 (0.216)
Female	0.089 (0.070)		0.070 (0.070)	0.008 (0.088)		0.015 (0.088)	-0.038 (0.068)		-0.029 (0.068)	-0.187 (0.521)		-0.176 (0.512)
Age 25 +	0.002 (0.065)		0.037 (0.066)	-0.102 (0.077)		-0.079 (0.077)	-0.094 (0.060)		-0.076 (0.060)	-0.499 (0.460)		-0.313 (0.454)
Foreign undergrad	0.194** (0.082)		0.192** (0.082)	0.096 (0.102)		0.112 (0.102)	0.174** (0.083)		0.174** (0.081)	0.259 (0.617)		0.351 (0.604)
Elite lib. arts	-0.031 (0.127)		-0.003 (0.123)	0.035 (0.152)		0.061 (0.144)	0.197 (0.188)		0.202 (0.192)	-0.434 (0.960)		-0.315 (0.942)
Elite research univ.	-0.129 (0.107)		-0.125 (0.108)	0.008 (0.132)		0.032 (0.132)	0.044 (0.119)		0.063 (0.123)	0.069 (0.755)		0.338 (0.742)
Reference group 1	0.239*** (0.070)		0.205*** (0.079)	0.231*** (0.084)		0.178* (0.103)	0.098 (0.122)		0.007 (0.103)	1.261* (0.732)		0.547 (0.745)
Reference group 2	0.147** (0.070)		0.132* (0.071)	0.183** (0.074)		0.166** (0.076)	0.160 (0.098)		0.112 (0.094)	0.964* (0.570)		0.710 (0.561)
Committee ratings		0.037*** (0.007)	0.031*** (0.009)		0.036*** (0.009)	0.028*** (0.010)		0.022*** (0.006)	0.020** (0.008)		0.242*** (0.049)	0.191*** (0.059)
Pseudo R-squared	0.108	0.085	0.146	0.094	0.084	0.129	0.084	0.071	0.124	0.039	0.046	0.058
Observations	259	259	259	174	174	174	174	174	174	174	174	174

Note: Standard errors in parentheses.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

unobservable economics talent. According to our analysis, demonstrated quantitative ability and the prominence of letter writers, but *not* the prestige of the undergraduate institutions, strongly predict PhD completion and research productivity 17 years later.

While the richness of our data allows us to examine new relationships and include variables not previously used, we recognize some limitations of this study. The sample is taken from applicants to a particular top-five economics PhD program in one year, 1989, and is not representative of all economics PhD applicants, since these individuals either enrolled in, or aspired to enroll in, an elite program. Finally, the idiosyncratic nature of two key indicator variables—the quality of letter of reference writers and the admission committees' ratings of the applicants—suggests that caution be used in generalizing our results. Caveats aside, however, the economics PhD talent search deserves greater scrutiny both due to the high-stakes nature of the admissions decision and because selecting applicants for such a long training period is important for the efficient allocation of valuable student, faculty, and school resources. Future work should analyze the role of the content of reference letters, the personal statement, and course choice, as well as any other information about academic honors, theses, or fellowship awards.⁵

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⁵ Wayne A. Grove, Donald D. Dutkowsky, and Andrew Grodner (forthcoming) find that prior math and economics courses and information from the personal statement predict economics PhD completion.