

## The Path to an Economics PhD

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### Abstract

We examine the pre-graduate school characteristics of American PhD students graduating from the top 50 American economics programs. Attending a highly ranked undergraduate institution is strongly associated with graduating from a highly ranked PhD program, as is research assistant experience between undergraduate and graduate school. Having a master's degree is not, with the exception of students from unranked undergraduate institutions. Without research assistant experience, women graduate from lower ranked PhD programs than do men. Students who major or minor in both economics and math graduate from significantly better PhD programs than do students who major or minor in economics but not math.

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Academic economists are particularly interested in the training of economics PhDs. This interest begins at the undergraduate level, where academics often advise undergraduates considering a career in economics. To provide statistical evidence on the path to an economics PhD, we connect graduation outcomes for American PhD candidates, defined as candidates who completed their undergraduate degree in the United States, graduating from the top 50 economics PhD programs ranked according to US News (2013) on the 2016-17 job market with their observable pre-PhD characteristics.

We find candidates with research assistant (RA) experience – those with experience as a research assistant in academia, government, economic consulting or the Federal Reserve – are more likely to graduate from a top 50 PhD program, while having a master’s degree is not associated with graduating from a top 50 PhD program. With regards to undergraduate field of study, students who major or minor in both economics and math or who neither major nor minor in economics graduate from significantly better PhD programs than do students who major or minor in economics but not math. As evidence of gender disparity, women are significantly more likely to graduate from a lower ranked PhD program than men, although this is less true for women with RA experience. Candidates from undergraduate liberal arts colleges and national universities tend to graduate from similarly ranked PhD programs. Unsurprisingly, candidates from highly ranked undergraduate institutions are far more likely to graduate from a higher ranked PhD program.<sup>2</sup>

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<sup>2</sup> We use “highly-ranked” in the colloquial sense in which department with ranking number 1 is highly-ranked and department with ranking number 50 has a lower ranking.

It is important to note that our findings are conditional on success in rather than admission to a top 50 economics PhD program. This is important in that we cannot determine whether, for instance, working as an RA before graduate school also increases an applicant's chances of gaining admission to a top economics PhD program, or teaches them skills that help them succeed once they are in the program. Although advice to those interested in getting a PhD in economics is usually phrased in terms of admission, presumably the real goal is getting the PhD. To achieve this goal, it is most useful to look at the pre-PhD characteristics of successful PhD candidates.

The closest research to ours is Stock and Siegfried (2015). (For an overview of research in the field we recommend Stock and Siegfried (2014).) While much of their article examines general trends in the production of economics PhDs, the authors also examine the characteristics of students entering 27 economics PhD programs in 2002. Because the paths to graduate school between American and international students often differ, we intentionally focus on the former while Stock and Siegfried include both groups in their analysis. One advantage of Stock and Siegfried's sample, though, is that they have data on GRE scores. But despite differences in our sampling frames, our results largely align. We find similar effects on graduate school ranking for students attending higher ranked undergraduate institutions and no difference in graduate school ranking for students with otherwise observably equal backgrounds completing their undergraduate at a top 50 liberal arts college rather than a national university.

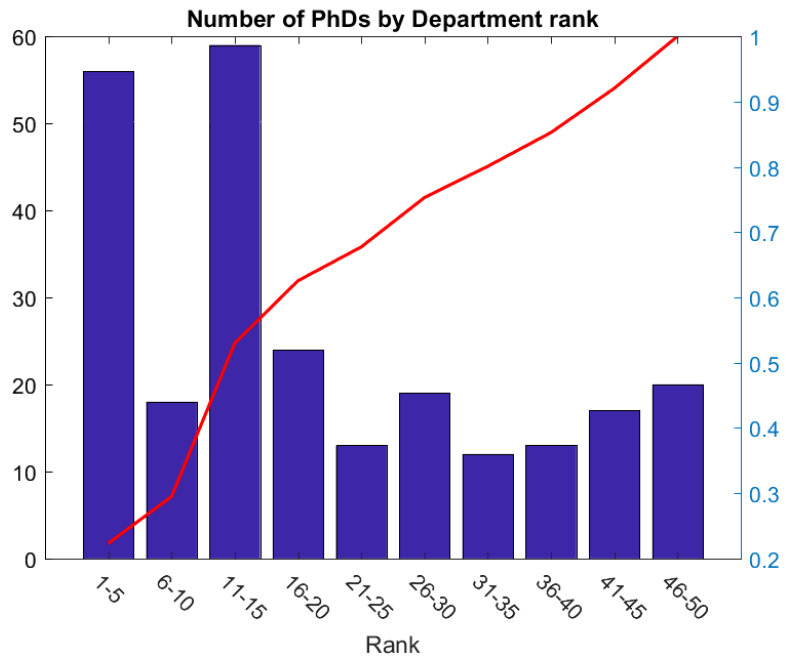
## I. Data

Our data consists of a census of all American economics PhD candidates posting curricula vitae for the 2016-17 job market from the top 50 economics PhD programs. The “top 50” programs are defined using the *U.S. News & World Report* 2013 ranking of economics PhD programs (U.S. News & World Reports 2016), which is the ranking closest to the point at which most candidates in our sample applied to graduate school. Because it is likely almost all candidates post curricula vitae, our sample is nearly exhaustive of the drawn population. Since only 60% of entering students complete their PhD in economics Stock, Siegfried (2014), our sample is selective towards successful candidates rather than all PhD entrants.

Before considering the association between candidate characteristics and PhD program ranking, it is useful to examine the raw data. The 50 programs in our sample account for approximately 60% of all new PhDs on the market.<sup>3</sup> Figure 1 shows the production of American PhDs, with counts on the left axis and the cumulative percentage on the right. The production of PhDs is not evenly spread among program rankings: the top five programs account for roughly one-fifth of the production of all 50, and the top 15 account for roughly half.

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<sup>3</sup> The 2016 CSWEP census of all U.S. PhD granting programs reports 1,056 job candidates on the market for the previous year. (CSWEP 2016).



Number of PhDs produced in 2016-17 by department ranking binned in groups of five, left axis.

Cumulative fraction of PhDs produced in 2016-17, right axis.

Figure 1

<b>Variable Name</b>	<b>Mean</b>	<b>St. Dev.</b>	<b>Observations</b>
PhD Program Ranking	19.56	0.53	251
Top 15 Program	0.53	0.50	251
Undergraduate Institution			
Combined Ranking	35.78	34.60	232
National University Ranking	36.75	34.86	175
Liberal Arts College Ranking	32.79	33.92	57
Ranked Over 140	0.01	0.09	251
Unranked	0.08	0.27	251
Female	0.25	0.43	251
Undergraduate Major/Minor			
Economics	0.44	0.50	247
Math	0.09	0.29	247
Economics and Math	0.43	0.50	247
Other	0.04	0.21	247
RA Experience	0.39	0.49	251
Master's Degree	0.14	0.35	251
American	0.40	0.49	630

Table 1

Basic data descriptives are presented in Table 1. Of the 251 PhD candidates 25% are women, compared to 34% in 2003-04 Stock, Finegan, Siegfried (2006), which includes

international students. Candidates with a master's degree, defined to exclude master's degrees from the institution granting the candidate's PhD, comprise roughly 14% of the sample, significantly lower than the 46% American plus international figure reported in Stock, Finegan, Siegfried (2006) for all incoming graduate students.<sup>4</sup> Five percent of candidates have a master's degree in a field other than economics, with three percent in another mathematical field, i.e. math, statistics or physics.

Almost 40% of the sample has RA experience, where we only include RA experience after completing an undergraduate degree and before beginning graduate school. Undergraduate majors and minors are concentrated almost entirely in economics and math (96%). Roughly equal fractions report a major or minor in economics or in both economics and math (a double major, a joint major, or a major in one field and minor in the other). Just over nine percent report a math major or minor without an economics major or minor, and only four percent of the roughly 98% of the sample who report a major or minor do not report a major or minor in economics or math.

We use the *U.S. News & World Report* 2012-2013 undergraduate rankings, which correspond roughly to the year the candidates began graduate school. These rankings are separate for national universities and liberal arts colleges. We merge the two lists by simple combination, e.g. there may be two schools assigned a given ranking, one from the national university list and one from the liberal arts list.

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<sup>4</sup> Note that between the time students in our sample matriculated and the time they graduated, several economics programs in the top 50 opened new master's programs that included preparation for PhD programs as one of their stated objectives.

Comparing rankings between PhD programs and undergraduate institutions requires some caution, beginning with the reminder that rankings are ordinal. Average undergraduate rankings are lower than average PhD rankings, but this is in part an artifact of looking only at the top 50 PhD programs. Given the very large number of undergraduate institutions in the country, it is clear from Table 1 that the candidates in our sample generally attended very highly ranked undergraduate institutions. Candidates who attended ranked undergraduate institutions comprise over 90% of the sample. Among the candidates who attended ranked undergraduate institutions, approximately a quarter attended a liberal arts college.

## **II. The relationships between candidate characteristics and graduate school ranking**

We now examine the relationship between PhD candidate characteristics and graduate school ranking. We begin with variables largely outside candidates' control during their undergraduate years, namely the ranking of the institution granting their undergraduate degree. Then we consider variables in candidates' control during their undergraduate years, namely their major and/or minor. Finally, we look at variables in candidates' control after their undergraduate years before enrolling in graduate school, namely working as a research assistant or getting a master's degree. We also examine the relationship between gender and graduate school ranking.

First, the obvious caution about interpreting the results as causal. Some of the correlations may simply reflect screening, e.g. students from higher ranked undergraduate institutions have higher innate ability. Observable characteristics may also be correlated with characteristics



graduate schools observe that do not appear in our data. Keeping these cautions in mind, note that many of the correlations are very strong.

The relationship between the rankings of undergraduate institutions and PhD programs is strong and essentially linear. Figure 2 shows a scatter diagram with both linear regression and nearest neighbor fit. The coefficient of the linear regression is 0.127, implying that attending an undergraduate institution ranked one standard deviation (34.6) better corresponds to graduating from a PhD program ranked four or five better places higher. Coming from an unranked undergraduate program lowers the predicted graduate ranking by 23 places. In fact, we observe no students in the top 15 PhD programs from unranked undergraduate schools. While the nearest neighbor fit suggests a flattening or reversal of the relationship for undergraduate institutions ranked below 140, and while we report a piecewise linear fit for the sake of completeness, there are only two candidates from undergraduate institutions ranked below 140, so one should not take this as serious evidence of a different relationship at lower ranks.

Controlling for undergraduate ranking, female candidates graduate from PhD programs ranked three or four rankings worse than male candidates, though the  $p$ -value on the gender effect is only 0.07. There is no interesting interaction between gender and undergraduate ranking.

As shown in Table 2, we find no noticeable difference between the effect of liberal arts and national university rankings. Further, the estimated relationship between attending a liberal arts college and PhD program ranking is modest, two places, and not statistically significant.

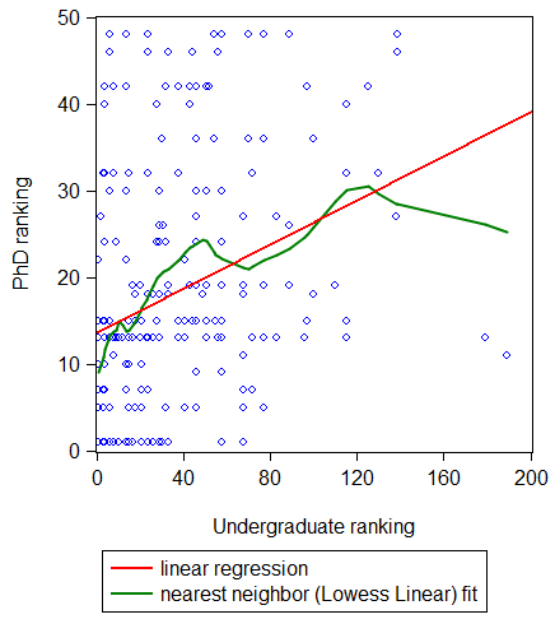


Figure 2

Variable Name	PhD Ranking	PhD Ranking	PhD Ranking	PhD Ranking	PhD Ranking
Constant	13.56*** (1.30)	12.67*** (1.24)	12.58*** (1.24)	12.74*** (1.24)	12.06*** (1.24)
Undergraduate Institution					
Combined Ranking	0.13*** (0.03)	0.16*** (0.03)	0.13*** (0.03)	0.12*** (0.03)	0.13*** (0.04)
Unranked	23.49*** (2.22)	24.38*** (2.19)	23.51*** (2.20)	23.54*** (2.71)	24.09*** (2.37)
Attended Liberal Arts College					2.18 (2.85)
Liberal Arts College					-0.01 (0.05)
Ranked Over 140		-14.24*** (2.84)			
$I_{UG>140} \times (UG - 140)$		-0.36*** (0.03)			
Female			3.67* (2.04)	2.84 (3.30)	3.44* (2.07)
Female Interaction					
Combined Ranking				0.03 (0.07)	
Unranked				0.08 (4.55)	
Observations	251	251	251	251	251
$R^2$	0.20	0.23	0.21	0.22	0.22

Table 2

We turn now to the relationship between undergraduate major and/or minor and graduate school ranking. Figure 3 shows that candidates who majored or minored in economics but not math or in both economics and math are distributed nearly evenly across PhD department

rankings. Table 3 shows that candidates who majored or minored in math but not economics graduate from PhD programs 5 rankings better than candidates who majored or minored in economics but not math. (One may hope that the advantage of being a math major over having studied economics plus math indicates selection rather than causation.) There is modest evidence in the second column of Table 3 that women get twice the advantage that men get from majoring or minoring in math.

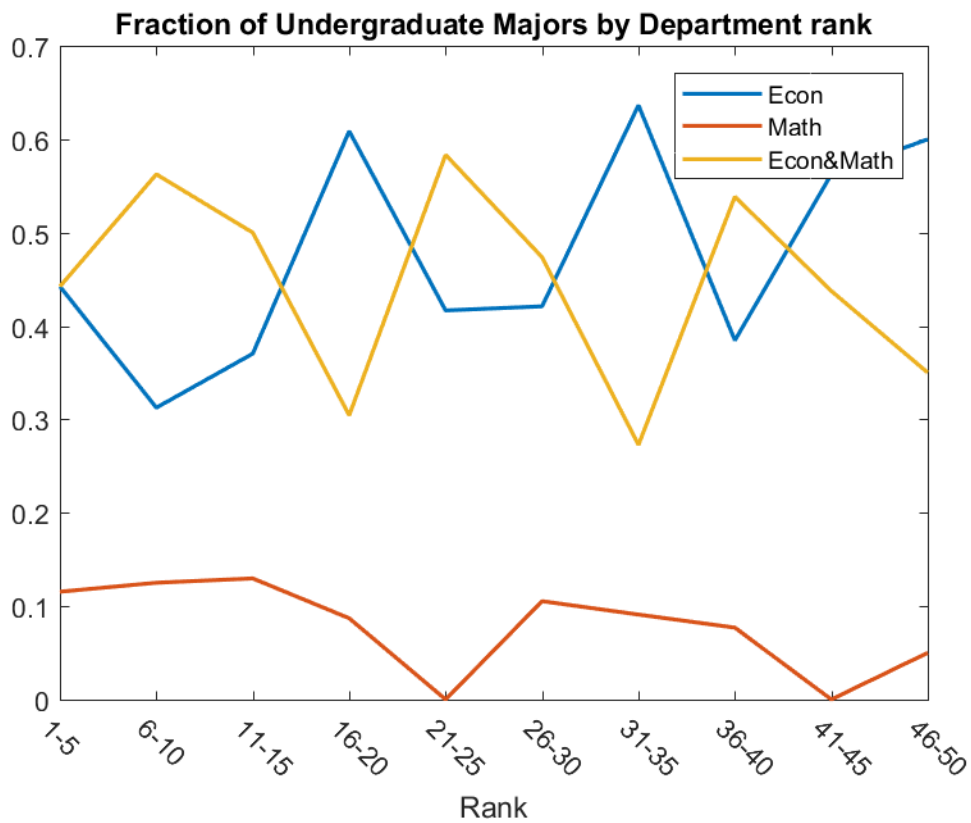


Figure 3

Stock and Siegfried provide estimates of the relationship between PhD program ranking and undergraduate major and gender on the probability of attending a top 15 program and on the marginal effect at the data mean. We provide linear probability model estimates for comparison in the rightmost three columns of Table 3. (As a reminder, their sample includes

international students but has the advantage of controlling for GRE scores.) Our point estimates for the relationship between PhD program ranking and major choice are quite similar. Stock and Siegfried find a positive interaction between majoring in economics and being female. We find the same sign on the interaction but not a significant effect. For the top 15 programs, however, we do find that candidates who majored or minored in both economics and math have some advantage over those majoring or minoring in economics but not math, although the effect is much smaller for women.

Variable Name	PhD Ranking	PhD Ranking	Top 15 Program	Top 15 Program	Top 15 Program
Constant	14.26*** (1.72)	14.20*** (1.73)	0.67*** (0.06)	0.64*** (0.07)	0.44*** (0.03)
Undergraduate Institution					
Combined Ranking	0.13*** (0.03)	0.13*** (0.03)	0.004*** (.001)	0.004*** (.001)	
Unranked	23.16*** (2.19)	23.13*** (2.19)	-0.70*** (0.05)	-0.66*** (0.06)	
Undergraduate Major/Minor					
Math	-5.83** (2.88)	-5.25* (3.13)	0.22* (0.12)	0.21* (0.13)	
Economics and Math	-2.36 (1.79)	-2.36 (1.79)	0.12* (0.06)	0.18** (0.07)	
Other	-0.58 (3.78)	-0.56 (3.79)	0.09 (0.15)	0.13 (0.17)	
Female	3.54* (2.05)	3.78* (2.13)	-0.097 (0.07)	-0.12 (0.36)	
Female Interactions					
Economics				0.13 (0.37)	
Math		-5.95 (3.67)		0.42 (0.38)	
Economics and Math				-0.11 (0.38)	
American					0.09** (0.04)
Observations	247	247	247	247	630
R <sup>2</sup>	0.23	0.23	0.20	0.21	0.01

Table 3

Upon graduation, undergraduates interested in getting a PhD in economics can choose to work as a research assistant or to pursue a master's degree. Figure 4 shows the fraction of PhD candidates with RA experience and the fraction with a master's degree for each of the 10 PhD program ranking bins. 90% confidence intervals are also given, computed using the binomial distribution. At the upper end of the top 50, RA experience is much more common than having a master's degree. In the top five programs roughly three-fifths of American candidates have RA experience, while only one-tenth have a master's degree, starkly contrasting with the 38% figure reported in Stock, Finegan, Siegfried (2006) for all incoming graduate students holding any graduate degree. The difference presumably reflects international students being much more likely than Americans to have a master's degree. At the lower end the difference between the fraction with RA experience and a master's degree is not great.

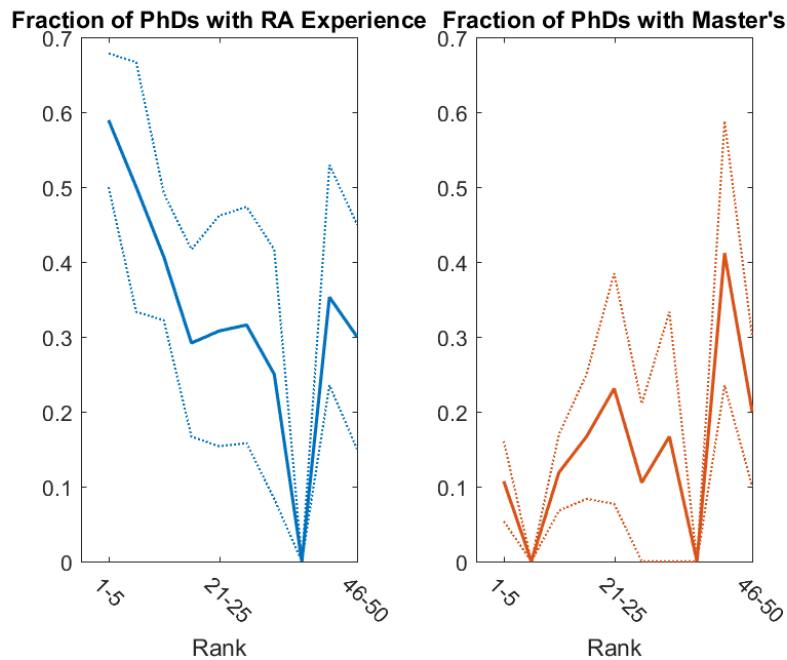


Figure 4

Table 4 gives regression results for PhD program ranking on dummies for a candidate having RA experience or having a master's degree, along with other controls. A raw estimate suggests RA experience is associated with an almost seven PhD program ranking improvement. As evidence this is not entirely causal, however, we find controlling for undergraduate ranking in column 3 reduces this ranking improvement to roughly three or four.



Variable Name	PhD Ranking	PhD Ranking	PhD Ranking	PhD Ranking
Constant	20.54*** (1.27)	14.37*** (1.72)	13.96*** (1.72)	14.55*** (1.77)
RA Experience	-7.48*** (1.80)	-3.67** (1.84)	-2.09 (1.99)	-4.27** (1.91)
Master's Degree	5.81** (2.77)	2.94 (2.84)	2.11 (3.35)	3.73 (3.16)
Undergraduate Institution				
Combined Ranking		0.11*** (0.03)	0.11*** (0.03)	0.10*** (0.03)
Unranked		21.39*** (2.60)	21.01*** (2.65)	21.41*** (2.66)
Female	4.49** (2.08)	4.16** (2.01)	6.50** (2.83)	4.57** (2.02)
Female Interactions				
RA Experience			-5.88 (4.02)	
Master's Degree			2.87 (6.06)	
Unranked Interactions				
RA Experience				15.61*** (3.10)
Master's Degree				-10.97** (4.60)
Observations	251	251	251	251
$R^2$	0.09	0.23	0.24	0.24

Table 4

A higher fraction of women in the sample have RA experience than men: 50% versus 35%. (The difference is statistically significant.) We also find suggestive, but not statistically significant, evidence that women benefit much more from RA experience than men.

In general, we find no significant benefit in terms of graduate program ranking associated with having a master's degree. The exception is, conditional on graduating from an unranked undergraduate institution, having a master's degree predicts a very large improvement in PhD program ranking. Curiously, conditional on attending an unranked undergraduate institution, we find that RA experience predicts a noticeably worse PhD ranking. While both of these latter findings are strongly statistically significant, note they are based on 3 and 5 observations, respectively, and therefore warrant caution in their interpretation.

### **III. The relationships between candidate characteristics and experience between undergraduate and graduate school**

What are the characteristics of the top 50 American PhD candidates with RA experience or a master's degree? Of those with RA experience, over half attended undergraduate institutions ranked in the top 15, and roughly 90% in the top 50. For comparison, only 40% of Americans in our sample attended a top 15 undergraduate institution, and only three-fourths a top 50. The median undergraduate ranking for students with a master's degree is 31. The 90<sup>th</sup> percentile attended unranked undergraduate institutions.

Figure 5 plots RA experience (left) and having a master's degree (right) against undergraduate institution ranking. Candidates who attended highly ranked undergraduate institutions are much more likely to have RA experience. In contrast, the fraction with a master's degree falls as we consider candidates from more highly ranked undergraduate

institutions. If the two observations with the lowest undergraduate ranking were omitted, however, the relationship between undergraduate ranking and having a master's degree would be nearly flat.

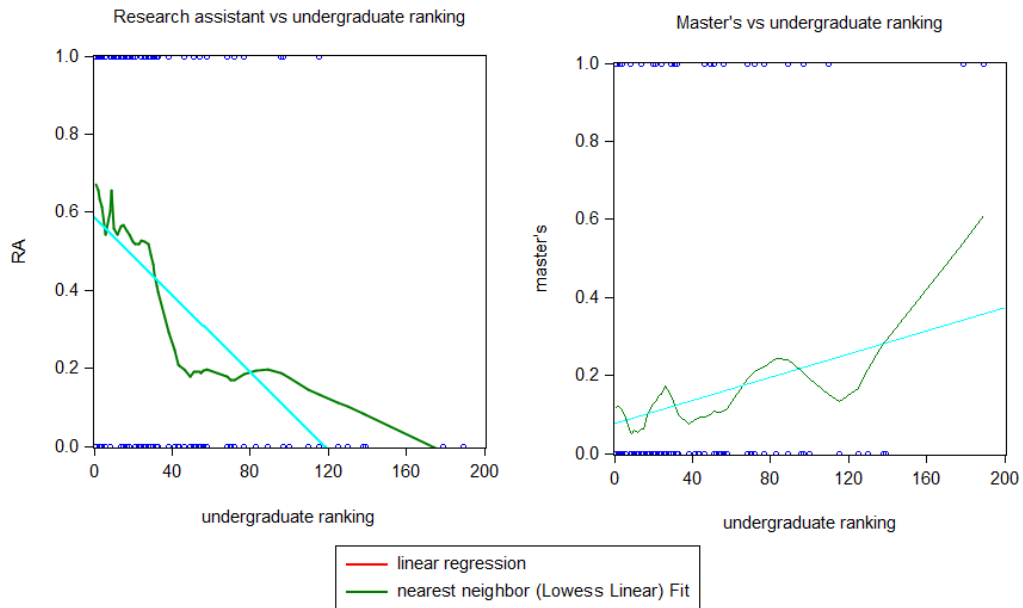


Figure 5

Linear probability models for having RA experience and/or having a master's degree are reported in Table 5. RA experience is strongly associated with undergraduate institution ranking. At the top five schools 60% of undergraduates who eventually graduate from top 50 PhD programs work as an RA between degrees. In contrast we found no RAs from undergraduate institutions ranked below 120 in our sample, although there are only seven candidates in our sample who attended an undergraduate institution ranked below 120. Candidates who attended a liberal arts college, especially a highly ranked one, are more likely to have RA experience, while candidates from unranked undergraduate institutions are much less likely to have RA experience. Interestingly, those majoring or minoring in both economics

and math are moderately less likely to have RA experience than are students majoring or minoring in economics but not math. Such candidates might have seemed especially qualified for competitive RA positions, though perhaps they are perceived by advisors as being in less need of RA experience.

The right side of Table 5 presents linear probability models for having a master's degree. There is evidence that candidates from unranked undergraduate institutions are more likely to have a master's degree. Neither gender nor attending a liberal arts college has any noticeable effect. The coefficient on "other major" is large and significant, suggesting that for these candidates earning a master's degree may have been an important step towards graduate school.

Variable Name	RA Exp.	RA Exp.	RA Exp.	Master's Degree	Master's Degree	Master's Degree
Constant	0.55*** (0.05)	0.50*** (0.06)	0.57*** (0.06)	0.07** (0.04)	0.08* (0.04)	0.05 (0.05)
Undergraduate Institution						
Combined Ranking	-0.01*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)	0.001* (0.001)	0.001 (0.001)	0.002** (0.001)
Unranked	-0.43*** (0.10)	-0.37*** (0.10)	-0.38*** (0.10)	0.19* (0.11)	0.18 (0.11)	0.23** (0.11)
Attended LAC		0.21** (0.10)	0.25*** (0.10)		-0.04 (0.06)	-0.01 (0.06)
LAC Ranking		-0.003 (0.002)	-0.004* (0.002)		0.0002 (0.002)	-0.001 (0.06)
Female	0.14** (0.07)	0.13* (0.07)	0.12* (0.07)	0.01 (0.05)	0.01 (0.05)	0.02 (0.05)
Undergraduate Major/Minor						
Math			-0.007 (0.10)			0.10 (0.09)
Economics and Math			-0.16*** (0.06)			-0.06 (0.04)
Other			-0.25* (0.14)			0.54*** (0.15)
Observations	251	251	247	251	251	247
$R^2$	0.15	0.17	0.20	0.03	0.03	0.17

Table 5

While we focus on American candidates, we briefly examine the distribution of American versus international candidates. The distribution of American candidates by program ranking is shown in Figure 6. While 41% of PhDs go to Americans, the fraction of Americans by program

varies from all to none. Americans comprise a modestly higher fraction of the candidates at the upper end of the top 50. Returning to Table 3, in column 4 we find evidence that candidates completing their undergraduate degree outside America are ten percent less likely to gain admission to a top 15 PhD program. This result is nearly identical to Stock and Siegfried’s estimate for international students coming from non-English speaking countries.

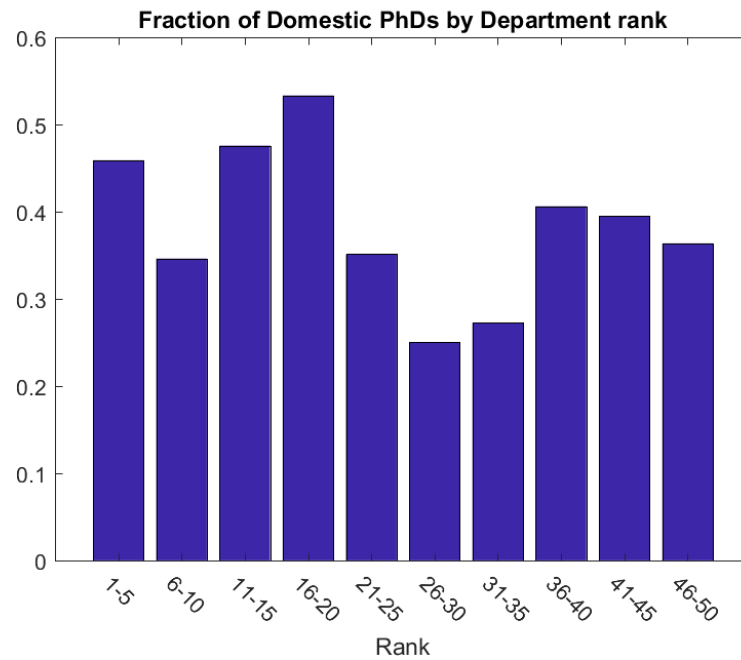


Figure 6

#### IV. Discussion

Our examination of graduating PhD candidates affirms what is probably the received wisdom: candidates graduating from highly ranked PhD programs are more likely to come from highly ranked undergraduate institutions and have RA experience prior to entering a PhD program. With the exception of students from unranked undergraduate institutions, having a master’s degree is not associated with graduating from a more highly ranked PhD program.

Without RA experience, females do considerably worse than males from otherwise similar backgrounds, though females are also more likely to have RA experience. Ironically, majoring or minoring in economics (and not math) is associated with graduating from a worse ranked PhD program than any other major or minor combination, i.e. economics and math, math without economics, and neither math nor economics. Repeating the earlier caveat about causality, it nonetheless seems reasonable to suggest that for students at ranked American undergraduate institutions gaining RA experience is worthwhile while pursuing a master's degree is probably not.

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