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PhD Attainment of Graduates of Selective Private Academic Institutions

Abstract

[Excerpt] It is therefore important to understand the forces that have caused a decline in the PhD attainment rate of American college graduates. The fraction of bachelor's recipients who go on to receive PhDs nationwide is influenced by many factors, including high school graduation rates, college enrollment rates of high school graduates, college graduation rates for college enrollees, the distribution of undergraduate majors, and the academic backgrounds of college students. PhD attainment also depends upon changes in the economic rewards to pursuing PhD study relative to entering the workforce or pursuing study for other professional occupations, such as law, medicine, and business.

In this article we focus on a homogeneous set of thirty-one highly selective private colleges and universities. The academic aptitudes and preparations of students attending these institutions are among the highest in the nation, and historically students from these institutions have been much more likely to go on to PhD study than the average college graduate nationwide; therefore, the behavior of students from these institutions is of special interest.

Keywords

graduate students, PhD, private universities, college graduates

Disciplines

Education | Higher Education | Labor Economics | Labor Relations

Comments

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**PHD ATTAINMENT OF GRADUATES
OF SELECTIVE PRIVATE
ACADEMIC INSTITUTIONS**

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INTRODUCTION

Projections of growing college enrollments combined with large numbers of American college and university professors approaching retirement ages have led to concerns about the source of the next generation of academics. Although the uncapping of mandatory retirement and the financial problems of public and private universities have led many colleges and universities to substitute part-time and full-time non-tenure-track faculty for tenure-track faculty, the demand for full-time tenure-track faculty is likely to be high in the future.¹

In spite of growing enrollments, the numbers of American-citizen college graduates receiving PhDs has remained roughly constant over the last thirty years (Hoffer et al. 2005, table 11). The fraction of American-citizen college graduates who ultimately receive PhDs rose from .042 for 1954 bachelor's recipients to .070 for 1962 bachelor's recipients. The fraction then plummeted over the next decade, falling to .026 for 1973 bachelor's recipients, and has been relatively stable since then, fluctuating between .025 and .028 (Groen and Rizzo 2004, figure 4).

Virtually all of the growth of PhD production in the United States during the last thirty years has come from the growth of students from foreign nations receiving PhDs in the United States (Hoffer et al. 2005, table 11).

1. Ehrenberg and Zhang (2005) present data on the growing usage of non-tenure-track faculty and analyze the forces that have created this growth.

However, actions taken in the United States in the aftermath of the September 11, 2001, terrorist attacks and the growth of research universities and support for scientific research around the world raise doubts that the United States can count on a continual increasing flow of foreign PhD students and a continual desire of those students who receive PhDs in the United States to seek employment in the United States (Ehrenberg 2005).

It is therefore important to understand the forces that have caused a decline in the PhD attainment rate of American college graduates. The fraction of bachelor's recipients who go on to receive PhDs nationwide is influenced by many factors, including high school graduation rates, college enrollment rates of high school graduates, college graduation rates for college enrollees, the distribution of undergraduate majors, and the academic backgrounds of college students. PhD attainment also depends upon changes in the economic rewards to pursuing PhD study relative to entering the workforce or pursuing study for other professional occupations, such as law, medicine, and business.

In this article we focus on a homogeneous set of thirty-one highly selective private colleges and universities. The academic aptitudes and preparations of students attending these institutions are among the highest in the nation, and historically students from these institutions have been much more likely to go on to PhD study than the average college graduate nationwide; therefore, the behavior of students from these institutions is of special interest.

The colleges and universities in our sample are listed in Appendix table 1. These institutions, which are members of the Consortium on Financing Higher Education (COFHE), produce a relatively large fraction of future PhDs. COFHE institutions accounted for 3.2 percent of BA degrees² obtained in the United States from 1967 to 1992; however, their BA graduates accounted for 10.2 percent of PhDs awarded from 1976 to 2002 to students with BAs from U.S. institutions (authors' calculations). In addition, COFHE institutions are representative of highly selective institutions nationwide.³ One way to demonstrate this is to compare the set of COFHE institutions to rankings of colleges and universities published by *U.S. News and World Report*. Virtually all of the COFHE member institutions were ranked among the top 25 national universities or liberal arts colleges in the 2003 rankings (*U.S. News and World Report* 2002). In particular, of the eighteen universities in COFHE, seventeen were ranked among the top twenty-five national universities. Of the

2. Throughout this article, we follow the common practice of using BA to refer to the broad class of baccalaureate or bachelor's level degrees, including the AB, BA, and BS degrees.

3. Schapiro, O'Malley, and Litten (1991) have previously examined the reported intentions of graduating seniors from these institutions in 1982, 1984, and 1991 to pursue any graduate degree in arts and sciences in the following year and found that high-ability students, as well as those attending single-sex women's colleges and liberal arts colleges, were more likely to intend to pursue graduate study.

thirteen colleges in COFHE, twelve were ranked among the top twenty-five liberal arts colleges.

MEASURING PHD ATTAINMENT

Conceptually, the measure of PhD attainment in our analysis is the fraction of BA graduates from an undergraduate institution in a given year that eventually earn a PhD. We approximate this variable using the ratio $P(i, t + 9)/B(i, t)$. The denominator is the number of bachelor's degrees awarded by institution i in year t . The numerator is the number of PhDs granted nine years later (year $t + 9$) to students who received bachelor's degrees from institution i . We call this ratio the "PhD attainment ratio." We use a nine-year lag because the median total time to doctoral degree from receipt of bachelor's degree was approximately nine years for PhDs awarded during our sample period to students with BA degrees from COFHE institutions.⁴

The PhD attainment ratio likely contains some measurement error with respect to our conceptual measure of PhD attainment because most PhDs are not earned exactly nine years after BA receipt. However, it is highly correlated with an alternative measure of the ratio in which the numerator is an average of PhDs earned by an institution's BA graduates in the years following BA receipt, where each year is weighted by the share of PhDs earned by BA graduates of COFHE institutions k years after BA receipt. Furthermore, when we use the alternative measure in the analysis, the results are qualitatively similar to the ones we present.⁵

Figure 1 presents information on the PhD attainment of graduates of COFHE institutions for undergraduate degree years from 1967 to 1993 (the corresponding PhD-degree-granting years are 1976 to 2002).⁶ We construct the figure by first computing the PhD attainment ratio for each institution in each year, using publicly available data on the number of undergraduate degrees granted annually by each institution and the number of PhDs received by graduates of the institution.⁷ We then construct the weighted (by graduating class size) average of the ratios across institutions for each year; the figure contains the three-year moving averages of these weighted averages.

4. This figure is based on a special tabulation of the Survey of Earned Doctorates by the National Opinion Research Center (NORC).

5. The raw correlation between the alternative and original versions of the ratio is 0.95. A disadvantage of the alternative version is that it requires more than nine years of PhD data for a given BA cohort and therefore limits the range of BA cohorts that we can use in our analysis (relative to the original version).

6. Throughout the article, year t refers to the academic year ending in calendar year t .

7. The data on undergraduate degrees come from the Earned Degrees Conferred Survey (U.S. Department of Education) and the PhD degree data come from the Survey of Earned Doctorates (National Science Foundation). Both are available from the National Science Foundation's WebCaspar database (<http://caspar.nsf.gov>).

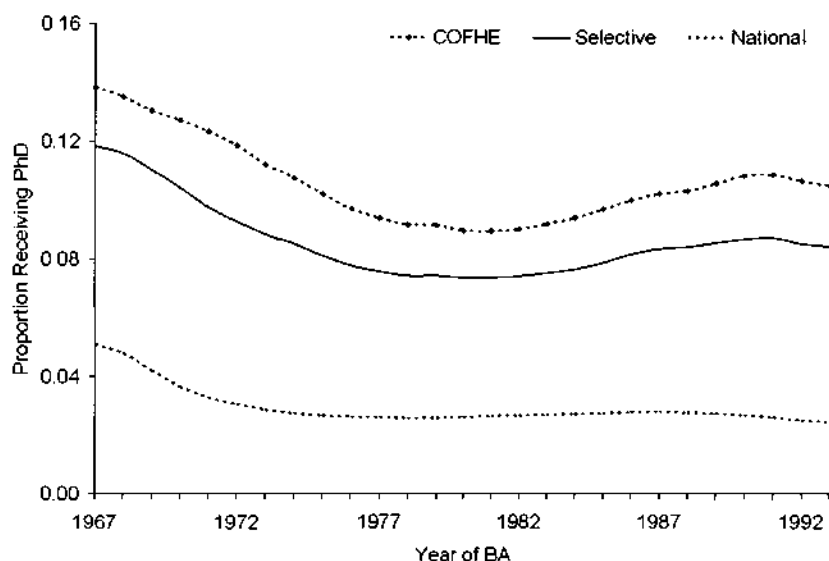


Figure 1. PhD Attainment of BA Graduates by Institution Type

Notes: The "COFHE" series refers to BA graduates of COFHE institutions. The "Selective" series refers to BA graduates of institutions ranked among the top twenty-five national universities or top twenty-five liberal arts colleges by *U.S. News and World Report* (*U.S. News and World Report* 2002). The "National" series refers to BA graduates of all U.S. undergraduate institutions.

Sources: PhD data are from the Survey of Earned Doctorates. BA data are from the Earned Degrees Conferred Survey.

According to this measure, PhD attainment at COFHE institutions was .138 for graduates in 1967, fell to .090 in 1980, and increased gradually to .105 for the class graduating in 1993. Overall, the change from 1967 to 1993 represents a nearly 25 percent drop in the fraction of graduates from these institutions who obtained PhDs.

For comparison purposes, figure 1 also includes rates of PhD attainment for all U.S. undergraduate institutions and for the top twenty-five national universities and liberal arts colleges according to the 2003 *U.S. News and World Report* rankings. The PhD attainment rate for COFHE institutions as a whole exceeded the national average by a considerable margin—roughly six to nine percentage points—over the period. In addition, it exceeded the PhD attainment rates for institutions in the *U.S. News and World Report* rankings by about two percentage points over the period. The time patterns in PhD attainment rates for the three groups of institutions are roughly similar.

Figure 2 looks within the overall group of thirty-one COFHE institutions and shows the time pattern of PhD attainment rates for four subgroups of institutions: Ivy League universities, other universities, liberal arts colleges, and traditionally single-sex women's colleges. (The institutions are listed within

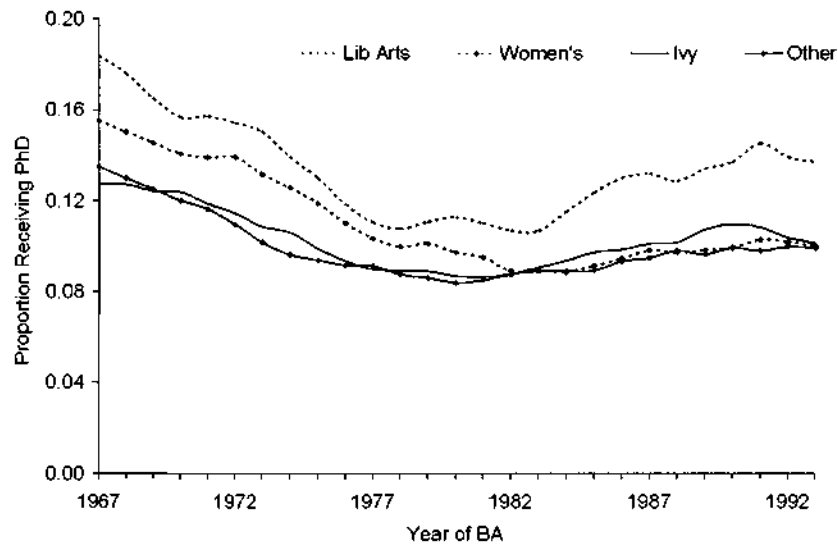


Figure 2. PhD Attainment of BA Graduates by Subgroups of COFHE Institutions

Note: Subgroups of COFHE institutions are liberal arts colleges, women's colleges, Ivy League universities, and other universities.

Sources: PhD data are from the Survey of Earned Doctorates. BA data are from the Earned Degrees Conferred Survey.

these subgroups in Appendix table 1.) Liberal arts colleges stand out from the other subgroups in this comparison: their PhD attainment rate is consistently higher over the period and has increased more rapidly since the early 1980s than for the other subgroups. The time patterns for the other subgroups are roughly similar.

The broad similarity in these time patterns suggests that there are some common forces that are influencing changes in PhD attainment at all of the COFHE institutions. These forces include things like the relative attractiveness of PhD study and other advanced study. However, institution-specific forces may also matter. When one ranks the thirty-one institutions in a given year by the PhD attainment ratio and then looks at the correlation between any two years during the period in the institutional rankings, one finds that the correlation is high but not equal to one.⁸ Hence, our objectives in this article are to understand what institution-specific forces have influenced changes in PhD attainment for graduates of COFHE institutions and to highlight the implications of our results for public and institutional policies.

8. The average correlation between the rankings of institutions for any two years in our study is .826, and the correlation between the first year and last year in our study is .770. An analysis-of-variance confirms the importance of institutional and time effects. Overall, institution accounts for 72 percent of the variance in the ratio, and time accounts for 12 percent.

Table 1. Descriptive Statistics for the Explanatory Variables

	Mean	Std. Dev.
<i>Major</i>		
Percent engineering and computer science	10.98	11.49
Percent humanities	26.50	12.40
Percent life sciences	12.14	4.81
Percent physical sciences and math	7.41	4.49
Percent social sciences	29.33	9.75
Percent other majors	13.63	11.44
<i>Gender</i>		
Percent female	42.50	20.68
<i>Race/Ethnicity</i>		
Percent Asian	5.72	3.63
Percent black	4.84	1.50
Percent Hispanic	2.72	1.68
Percent white	83.45	6.11
Percent temporary resident	3.34	2.29
<i>Test Scores</i>		
Average math SAT score	654.75	31.41
Average verbal SAT score	606.17	27.98
<i>Financial Aid</i>		
Percent receiving grant aid	40.91	7.89
Median family income of grant recipients	\$42,508	\$3,935
Typical self-help package	\$3,872	\$699

Notes: The unit of observation is an institution-year. The means are weighted by graduating class size. Dollar amounts are in 1988 dollars. For the race/ethnicity variables, Percent white includes the percent of BA graduates who reported an "other" race or did not report their race, which is less than 0.50 percent on average.

Sources: Data on the distribution of BA graduates by major, gender, and race/ethnicity are from the Earned Degrees Conferred Survey. Data on test scores and financial aid are from COFHE.

ANALYTICAL APPROACH

We investigate the factors in PhD attainment by estimating a linear probability model in which the dependent variable is the PhD attainment ratio. The ratio is specified to depend upon the distribution of fields in which the graduating seniors majored, the demographic distribution of the graduating seniors, the average SAT scores of the graduating seniors, and a set of financial variables, which we discuss below. The data span BA degree years 1967 to 1993, so we have 837 (27 years \times 31 institutions) institution-year observations.⁹ Descriptive statistics for the explanatory variables used in our analysis appear in table 1.

The data on undergraduate degrees include information on the field distribution of graduates by major and the gender distribution of graduates for all years and on the racial/ethnic distribution of graduates starting in 1978. COFHE provided information on the average SAT scores of entering students.

9. We report the linear probability model estimates because they are easy to interpret; results from a more theoretically appropriate log odds ratio model are very similar (Ehrenberg, Groen, and Nagowski 2005).

The verbal SAT data start with the class that entered in the fall of 1977 (1981 BA completion cohort) and the math SAT data start with the class that entered in the fall of 1984 (1988 BA completion cohort). Hence, our SAT data correspond to the period of time after the large decline in PhD attainment rates in the sample occurred.

Decisions to enroll in PhD programs may well be influenced by the financial background of graduating students and the magnitudes of their loan burdens. Prior research indicates that there has been a growing dispersion of endowment wealth among private colleges and universities (Ehrenberg 2003). One manifestation of this growing dispersion in endowment wealth was a growing dispersion in the typical self-help packages (loans and academic-year work expectations) across the institutions in our sample during the mid-1990s and early twenty-first century (however, the period our sample covers ended before this occurred). This change, coupled with changes over time in the share of students receiving grant aid and the median income levels of the families from which these students come at each institution, may thus influence the fraction of each institution's graduates going on to PhD study. COFHE provided information on typical self-help packages, the share of entering students receiving grant aid, and median family income of grant recipients, by institution, for entering first-year classes starting in fall 1985 (fall 1986 for median family income of grant recipients); thus, we have this information for the classes that graduated in 1989 and thereafter.¹⁰

Our specification includes both year and institutional fixed effects. Year fixed effects capture all omitted variables that vary over time (such as the economic returns to PhD study and alternative options) and that influence PhD attainment of graduating seniors at all of these institutions similarly. Institutional fixed effects capture the effects of omitted variables that do not vary over time and that influence PhD attainment across institutions (e.g., the long-term trends that can persist at an institution due to institutional culture, peer effects, or faculty-student interactions). Therefore, the estimated coefficients from this model indicate, after controlling for all omitted year and institutional effects, how changes in the included explanatory variables influence PhD attainment of graduates from these institutions.

EMPIRICAL FINDINGS

Table 2 presents coefficient estimates for our model of the share of an institution's graduates who go on to receive PhDs. Turning first to the field

10. We constructed an alternative set of financial variables using data from the federal Pell Grant program. When we substitute these variables for the institutional aid variables in our model, the results are qualitatively similar (Ehrenberg, Groen, and Nagowski 2005).

Table 2. Regression Results for Factors Related to PhD Attainment

	Coefficient	t-statistic
<i>Major</i>		
Percent engineering and computer science	-0.0012*	-3.64
Percent humanities	-0.0016*	-4.35
Percent life sciences	-0.0012*	-3.40
Percent physical sciences and math	—	
Percent social sciences	-0.0015*	-4.21
Percent other majors	-0.0013*	-3.83
<i>Gender</i>		
Percent female	0.0003*	3.08
<i>Race/Ethnicity</i>		
Percent Asian	-0.0009*	-2.42
Percent black	0.0015*	2.53
Percent Hispanic	0.0001	0.19
Percent white	—	
Percent temporary resident	0.0001	0.15
<i>Test Scores</i>		
Average math SAT score/10	0.0021*	4.43
Average verbal SAT score/10	-0.0018*	-3.72
<i>Financial Aid</i>		
Percent receiving grant aid	-0.0008*	-4.63
Median family income of grant recipients (\$1,000s)	0.0005	1.28
Typical self-help package (\$1,000s)	-0.0044*	-2.20
Constant	0.2971*	6.80
R-squared	0.8817	
Sample size	837	
Mean of dependent variable (PhD attainment ratio)	0.1047	

Notes: The table reports coefficient estimates for a linear probability model with institution-year observations weighted by graduating class size. In addition to the variables listed in the table, the model also includes time fixed effects and institution fixed effects.

* Significantly different from zero at the 5% level.

Sources: PhD data are from the Survey of Earned Doctorates. Data on BA degrees and the distribution of BA graduates by major, gender, and race/ethnicity are from the Earned Degrees Conferred Survey. Data on test scores and financial aid are from COFHE.

distribution of graduating seniors, an increase in the share of graduating seniors majoring in any field other than the physical sciences (the omitted category) is associated with a decrease in the share of an institution's graduates going on to receive PhDs. The fields with the largest difference relative to the physical sciences are the humanities and the social sciences.

Stereotypes regarding demographic differences do not appear to hold at these institutions. In particular, holding other variables constant, an increase in either the share of female graduates or the share of black graduates in the class is each associated with higher, not lower, PhD attainment.¹¹ Similarly,

11. Cole and Barber (2003) similarly find that black undergraduates at selective private academic institutions are not less likely than white undergraduates of similar academic backgrounds to express interest in going on for PhDs and careers as professors.

an increase in the share of Asian American graduates in the class is associated with lower PhD attainment.

In terms of test scores, an increase in the average math SAT score at an institution is associated with a greater share of the institution's graduates going on to receive PhDs, but an increase in the average verbal SAT score at an institution is associated with a smaller share of the institution's graduates going on to receive PhDs. The latter result, which is somewhat puzzling, persists even when we drop the average math SAT score from the model.

Turning to the financial variables, an increase in either the share of students at an institution receiving institutional grant aid or the size of typical self-help packages is associated with decreasing PhD attainment of graduates of the institution. By contrast, changes in the median family income levels of grant recipients are not associated with changes in PhD attainment.

IMPLICATIONS FOR POLICY

Currently, about 3 percent of American college graduates go on to earn a PhD. By contrast, about 10 percent of graduates of the highly selective private colleges and universities considered in this article go on to earn a PhD. In this article, we examine the factors behind PhD attainment rates using institutional-level data on graduates of these institutions. Our analysis reveals several factors that both influence PhD attainment and may be affected by public or institutional policies.

First, we find that a larger fraction of students receiving institutional grant aid and larger aid packages are associated with a lower share of an institution's graduates going on to receive PhDs. Inasmuch as grant aid at these institutions is primarily need-based, this finding suggests that students from lower-income and lower-middle-income families are less likely to go on for PhDs than students from higher-income families. Nettles and Millett (2006) surveyed 9,000 doctoral students and found that two-thirds of them had no undergraduate debt. Although students from lower-income and lower-middle-income families may be less likely to go on for PhDs for reasons other than debt (for example, because of their backgrounds they may have different career aspirations than their classmates prior to college entry), taken together these findings suggest that forgiving the undergraduate debt of students entering PhD programs in fields such as science and engineering that are deemed to be of national importance may encourage top students from these selective institutions to enroll in PhD programs.

Second, our results suggest that the continual underrepresentation of people of color among PhD programs is not due to racial differences in the propensity of graduates of these selective institutions to go on to PhD study. We find

that increasing the share of black graduates from an institution faster than the average institution in the group increases the fraction of the institution's graduates that go on to earn PhDs, whereas increasing the share of Hispanic graduates faster than the average institution in the group did not change the fraction. Given that the PhD attainment rate is higher at COFHE institutions than at most other institutions, increasing the numbers of talented black and Hispanic students who attend these selective private institutions may well increase the numbers of black and Hispanic students going on for PhDs nationwide (Cole and Barber 2003). Although it is possible that increasing the numbers of black and Hispanic students at these institutions would simply draw students with high propensities to go on for PhDs from other institutions, thereby having no net effect on the supply of underrepresented-minority PhDs, research has shown that attendance at a selective private institution enhances students' propensities of attending graduate school at major research universities (Eide, Brewer, and Ehrenberg 1998).

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Appendix Table 1. Colleges and Universities in the Sample

<i>Ivy League Universities</i>	<i>Liberal Arts Colleges</i>
Brown University	Amherst College
Columbia University	Carleton College
Cornell University	Oberlin College
Dartmouth College	Pomona College
Harvard University	Swarthmore College
Princeton University	Trinity College
University of Pennsylvania	Williams College
Yale University	Wesleyan University
<i>Other Universities</i>	<i>Women's Colleges</i>
Duke University	Barnard College
Georgetown University	Bryn Mawr College
Johns Hopkins University	Mount Holyoke College
Massachusetts Institute of Technology	Smith College
Northwestern University	Wellesley College
Rice University	
University of Rochester	
University of Chicago	
Stanford University	
Washington University in St. Louis	