

Features and Information

In this section, the *Journal of Economic Education* publishes survey articles, international and institutional comparisons, and analytical studies on the economics curriculum, instructional materials, practices in teaching, and academic economics.

WILLIAM WALSTAD, Section Editor

The Undergraduate Origins of PhD Economists

John J. Siegfried and Wendy A. Stock

Abstract: The authors document the types of undergraduate colleges and universities attended by those who earned a doctorate in economics from an American university from 1966 through 2003. They examine relationships between type of undergraduate institution and attrition and time-to-degree in PhD programs. The total number of new economics PhDs awarded to U.S. citizens has declined precipitously over the past 30 years. Concurrently, the number of new economics doctorates who hold undergraduate degrees from U.S. universities has fallen by half, from a high of about 800 in 1972 to about 400 in 2003. Among those who have earned undergraduate degrees from American institutions, the mix of schools attended by the doctorates has remained relatively stable, with about 55 percent of those who earn a PhD in economics each year holding their bachelor's degree from a university that offers a PhD in economics and a bit more than 10 percent holding a bachelors degree from a selective liberal arts college. Currently, 18 of the 25 American undergraduate institutions that send the largest percentage of their graduating classes on to earn a PhD in economics are liberal arts colleges. Graduates of liberal arts colleges also have shorter time-to-degree and higher verbal Graduate Record Exam (GRE) scores than other economics PhD students.

Keywords: economics education, PhD economists, undergraduate degrees

JEL codes: A11, A14, A22

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The number of PhDs awarded in economics by U.S. universities has remained between 850 and 1,150 per year since 1970. The number of U.S. citizens earning a PhD in economics from an American university, however, has declined steadily for three decades, falling from a peak of 852 in 1973 to a low of 396 in 2003. It appears that fewer than 300 U.S. citizens will earn a PhD in economics from a U.S. university in 2008 and 2009, a level comparable to that last seen during the Eisenhower administration. In stark contrast, the total number of PhDs awarded by U.S. universities to U.S. citizens and permanent residents across *all* academic disciplines more than doubled from 1966 to 2000 (Groen and Rizzo 2004, Table 1), and the number awarded in all of the *social sciences* (including economics) increased by a factor of 2.5.

This precipitous decline in both the number and fraction of U.S. economics PhDs earned by U.S. citizens has several implications. First, because only about half of the international students who earn a PhD in economics from an American university remain in the United States to work, the declining proportion of U.S. citizens among new economics PhDs has steadily reduced the labor supply of PhDs in economics to American colleges, universities, business firms, and government agencies, whereas the demand for them has been growing. New job listings in *Job Openings for Economists* have increased from 1,613 in 1997 to 2,101 in 2003, whereas the annual crop of new PhDs produced has declined from about 950 to about 850.

Second, domestic and foreign economics PhD students have different interests. A sample of about 800 economists who earned PhDs in 1996–97 and 2001–2 (Siegfried and Stock 1999, 2004) revealed notable differences between domestic and foreign PhD student field choices. U.S. citizens constitute at least 55 percent of new PhDs in economic history, agricultural economics, labor economics, law and economics, public economics, industrial organization, and health, education, and welfare economics. In contrast, fewer than 40 percent of specialists in international economics, mathematical and quantitative methods, macro and monetary economics, and microeconomic theory are U.S. citizens. As the mix of new graduates shifts toward relatively fewer domestic students, the stock of professional economists' skills may shift away from applied micro policy and toward international economics, mathematical and quantitative methods, and micro and macro theory, changing the nature of what economists do.

Third, current trends indicate that the future number of international PhD graduates may be insufficient to fill domestic job openings in the United States. First-time international graduate student enrollments declined for three consecutive years after September 11, 2001, and international graduate student applications declined by 33 percent from 2003 to 2005 (Brown and Doulis 2005). Increased competition for PhD students from universities in Europe, Asia, and Australia accounts for some of the decline in interest by international students. Difficulties securing visas for study in the United States and recent diminished perceptions of the United States abroad have exacerbated the disappearance of international applicants to PhD programs.

Numerous decisions affect the annual number of new economics PhDs. Because most PhD economists major in economics as undergraduates (Siegfried and Stock 2004), students must first be attracted to principles of economics and their interest nurtured sufficiently so that the successful ones choose to major in economics

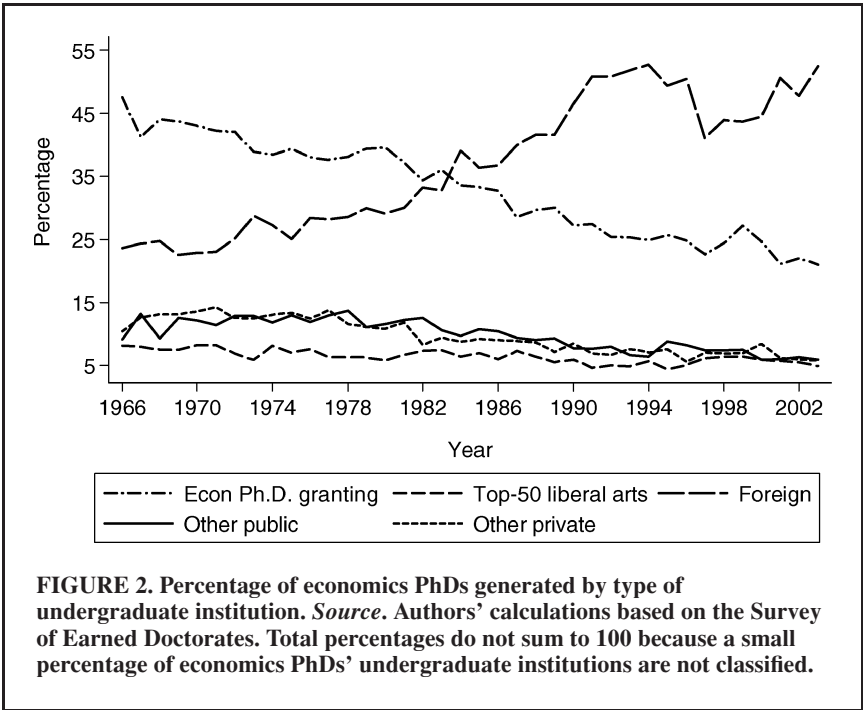
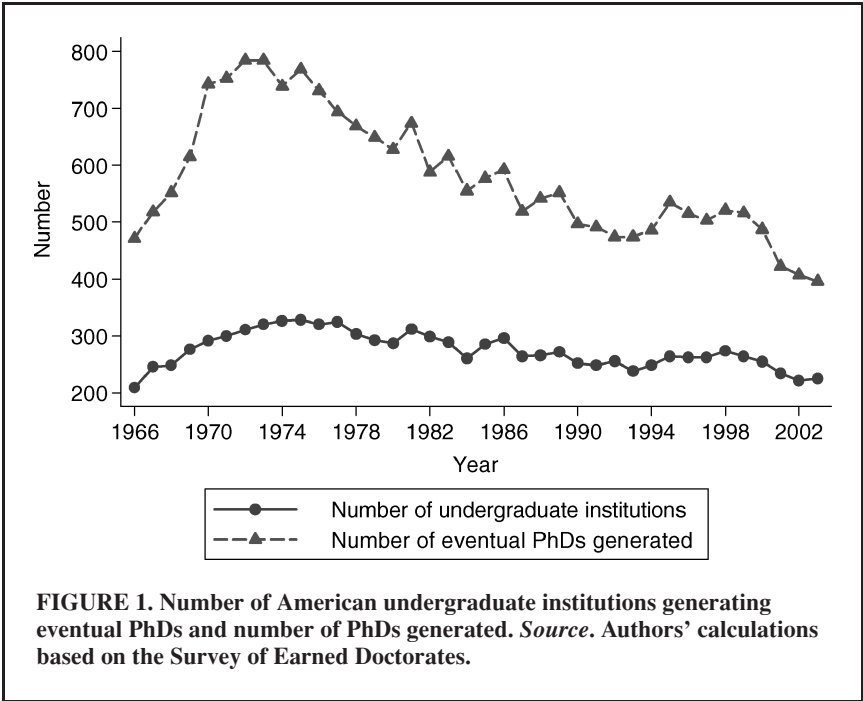
(Lemke et al. 2005). Graduates then must apply to an economics PhD program, and at least one program must admit them and, to indicate a realistic expectation that they can complete the degree, offer them financial aid. They then must enroll, persist in the program, learn skills useful to prospective employers, and complete their degree requirements sufficiently quickly to take advantage of career opportunities.

Elsewhere, we have addressed several steps in this progression. We have examined the exposure of college students to introductory economics (Siegfried 2000), trends in undergraduate degrees awarded in economics (Siegfried and Round 2001), the time required to earn an economics PhD (Siegfried and Stock 2001; Stock and Siegfried 2006), the job market for new PhDs (Siegfried and Stock 1999, 2001, 2004; Stock and Siegfried 2001; Stock and Alston 2000; Stock, Alston, and Milkman 2000), and the match between economists' PhD training and their subsequent job requirements (Stock and Hansen 2004). We also have examined the matriculation and attrition decisions of admitted and enrolled PhD students (Finegan, Siegfried, and Stock 2006; Stock, Finegan, and Siegfried 2006). A remaining gap in our research about this process concerns the decision of undergraduates to apply for admission to a graduate program in economics. Part of this decision necessarily depends on the character of their undergraduate education. In this article, we present information on the characteristics of undergraduate institutions of economics PhDs and examine relationships between those characteristics and attributes of the PhD production process, including attrition and time-to-degree.

UNDERGRADUATE ORIGINS OF ECONOMICS PhDs

In Figure 1, we trace the number of economics PhD degrees awarded by U.S. universities each year to students who earned a bachelor's degree in the United States for the period 1966–2003. Because some foreign students earn undergraduate degrees at American colleges and universities and some domestic students earn bachelor's degrees overseas, the pattern in Figure 1 tracks, but is not identical to, the number of PhD degrees awarded to U.S. citizens by U.S. universities each year.¹ The number of American undergraduate institution-trained (AUIT) PhDs peaked at close to 800 in the early 1970s, before beginning a steady decline of about 1 percentage point per year for three decades.²

The distribution of types of undergraduate institutions attended by individuals awarded a PhD in economics by American universities each year from 1966 through 2003 is reported in Figure 2. The flat and declining lines in the figure represent four different types of U.S. baccalaureate institutions: (1) those that also offer a PhD in economics; (2) those in *U.S. News & World Report's* top-50 ranked selective private liberal arts colleges in 2004,³ plus Dartmouth, Miami of Ohio, Richmond, Trinity University, Tufts, and William and Mary (which are highly selective institutions that have few graduate programs but are not classified as private liberal arts colleges); (3) other public institutions; and (4) other private colleges and universities. The increasing line represents economics PhDs awarded to graduates who did not do their undergraduate work in the United States. The combined AUIT share of PhDs is equal to one minus the share of those who studied overseas as undergraduates. It declines sharply over time. Because there were about 1,050



PhDs awarded in economics by American universities in both 1972 and 2002, a comparison between those two years is illustrative. The 800 or so AUIT economics PhDs graduating in 1972 comprise about 75 percent of the total number of economics PhD degrees awarded in that year. By 2002, the AUIT share of new PhDs had dropped to slightly below 40 percent, or about 420 PhDs.

The shares of AUIT (not total) PhDs accounted for by each of the four domestic subcategories are shown by decade in Table 1. They are relatively constant over time, a pattern similar to that observed in science and engineering more generally (Freeman, Jin, and Shen 2004, Table 3). The only noticeable shift has been a moderate increase in the share of new PhD economists coming from selective private liberal arts colleges. Almost 70 percent of AUIT economics PhDs is accounted for by a combination of the roughly 120 universities that offer a PhD in economics and the top-50 liberal arts colleges. Together this group of institutions accounts for less than 12 percent of the nation's four-year colleges and universities but about 69 percent of all undergraduate degrees earned. It is not surprising that the dominance of higher quality undergraduate institutions in producing future PhDs is not limited to economics but also occurs in most other disciplines (Zhang 2004, 17).

Figures 1 through 5 illustrate other changes in the pattern of U.S. undergraduate alma maters of new American economics doctorates over the past 36 years. As shown in the bottom line of Figure 1, the number of different undergraduate institutions generating each new AUIT PhD cohort has declined by 30 percent, from about 320 institutions during the mid-1970s to 220 institutions in 2003. As Figure 3 illustrates, the typical number of new AUIT PhDs generated per undergraduate institution has declined from about 2.5 in 1972 to less than 1.8 in 2003.

Figure 4 illustrates three-year moving averages of the share of AUIT PhDs accounted for by the 10 undergraduate alma maters generating the most new economics PhDs in each year. This average share declined from a high of 20 percent

TABLE 1. Shares of AUIT PhDs Generated, by Institution Type

Institution type	Period			
	1970	1980	1990	2000
Econ PhD granting	0.56	0.56	0.56	0.55
Top-50 liberal arts	0.10	0.10	0.11	0.14
Other public	0.16	0.18	0.17	0.16
Other private	0.18	0.16	0.16	0.16

Note. AUIT = American undergraduate institution trained. Cells present the number of PhDs generated by each institution type during the period divided by the total number of PhDs generated by all four types of institutions during the period. The periods are defined as: 1970 = 1967–1973, 1980 = 1977–1983, 1990 = 1987–1993, 2000 = 1997–2003.

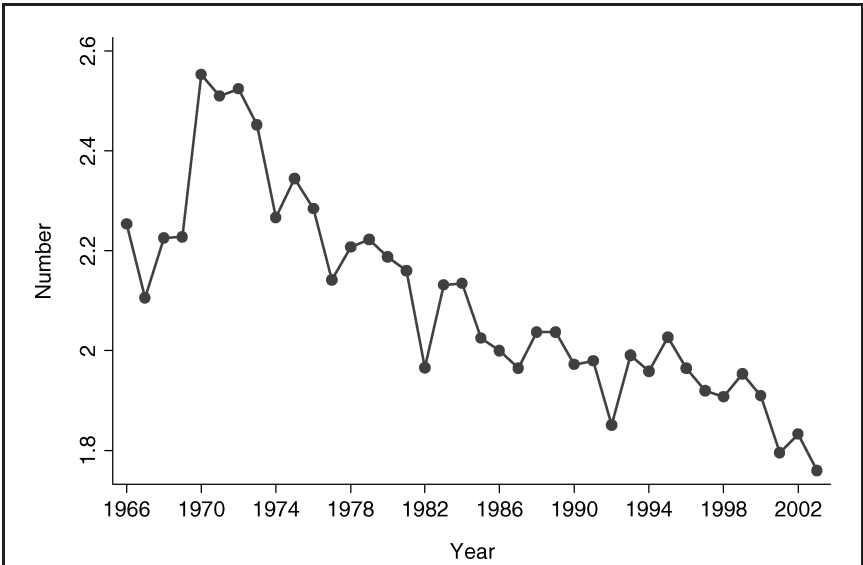


FIGURE 3. Number of PhDs generated per undergraduate institution. *Source.* Authors' calculations based on the Survey of Earned Doctorates.

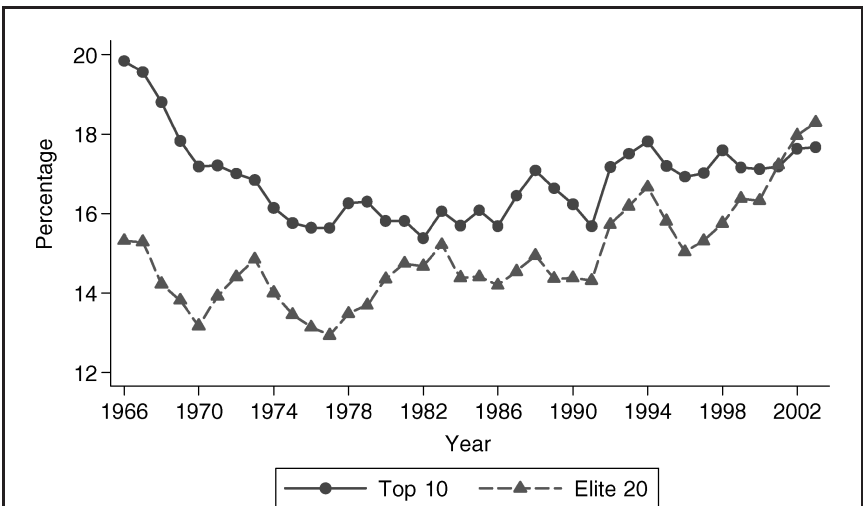


FIGURE 4. Percentage of American undergraduate institution-trained economics PhDs generated by the top-10 and elite-20 PhD-generating institutions (three-year moving averages). *Source.* Authors' calculations based on the Survey of Earned Doctorates. The top-10 schools may change each year. The elite-20 institutions are Amherst, Brown, Chicago, Colgate, Columbia, Cornell, Dartmouth, Grinnell, Harvard, Haverford, Oberlin, Pennsylvania, Princeton, Stanford, Swarthmore, Vassar, Wellesley, Wesleyan, Williams, and Yale.

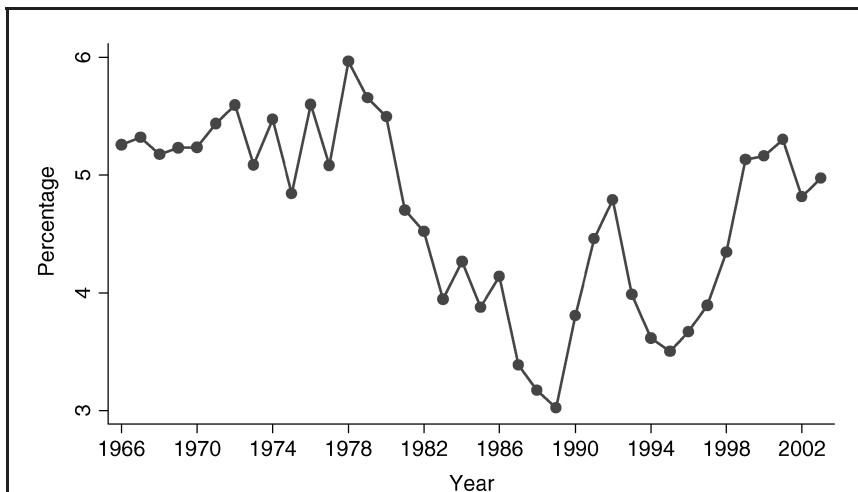


FIGURE 5. Percentage of American undergraduate institution-trained economics PhDs generated by engineering schools (three-year moving averages). Source. Authors' calculations based on the Survey of Earned Doctorates. The Engineering schools are Cal Poly-San Luis Obispo, Cal Tech, Carnegie Mellon, Case Western Reserve, Cooper Union, Georgia Tech, Harvey Mudd College, Illinois Tech, Michigan Tech, MIT, Purdue University, Rensselaer, Rice, Rose Institute of Technology, Stevens Institute of Technology, Texas A&M, U.S. Air Force, Military, or Naval Academies, and Virginia Tech.

during the early 1970s, was fairly flat at about 16 percent during the 1980s, and has since risen back to about 18 percent. The three-year moving average share of AUIT PhDs accounted for by a fixed set of 20 historically elite colleges and universities (defined as the 8 Ivy League universities, plus Amherst, Chicago, Colgate, Grinnell, Haverford, Oberlin, Stanford, Swarthmore, Vassar, Wellesley, Wesleyan, and Williams⁴) has risen from about 14 percent in the 1970s to 18 percent in 2003.

Figure 5 tracks three-year moving averages of the share of new economics PhDs whose undergraduate study was completed at a set of 20 predominantly engineering colleges.⁵ Both the number and share of PhDs who attended these engineering schools as undergraduates peaked during the 1970s, a reasonable time-to-degree lag from the undergraduate science and engineering enrollment peak stimulated during the post-Sputnik era by the National Defense Education Act. The number of former students at engineering schools who became economists declined markedly after 1980, falling from a range of 30–50 per year in the 1970s to a range of 15–25 in the 1980s. It has since recovered, with these schools generating about 5 percent of AUIT economics PhDs in 2003.

In general, there has been relatively little change in the identity of the undergraduate alma maters of new AUIT PhDs in economics since 1975. Because of the sharp decline in the total number of AUIT economics PhDs, however, the absolute number of new economics PhDs coming from each category of undergraduate

institution has declined substantially. The share of new AUIT economics PhDs who graduated from an elite liberal arts college (Table 1) has increased only because their absolute number has declined relatively slower than the other three categories.

The 25 worldwide undergraduate alma maters that generated the most U.S. economics PhDs during 1997–2002 are reported in Table 2.⁶ The relative importance of several foreign universities that award undergraduate degrees to individuals who eventually earn an economics PhD in the United States is obvious. Worldwide, Seoul National University in Korea not only tops Harvard as the leading incubator of future U.S. economics PhDs but does so by a factor of more than two. During 1997–2002, 6 of the top 10 undergraduate alma maters of new U.S.-trained PhD economists were foreign universities—2 from South Korea and 1 each from China, India, Italy, and Taiwan. On average, 27 bachelor’s graduates of Seoul

TABLE 2. Top Worldwide Sources of Eventual Economics PhDs, 1997–2002

University name	Country	Number of eventual PhDs generated during 1997–2002 ^a
Seoul National University	Korea	162
Harvard University	USA	74
National Taiwan University	Taiwan	63
University of Delhi	India	61
University of California, Berkeley	USA	54
Universita Commerciale “Luigi Bocconi”	Italy	45
Yonsei University	Korea	44
Stanford University	USA	40
Beijing University	China	36
Cornell University	USA	33
Korea University	Korea	33
Fudan University	China	32
Tokyo University	Japan	32
University of Michigan	USA	32
Yale University	USA	32
MIT	USA	30
Middle East Technical University	Turkey	30
Princeton University	USA	30
University of Wisconsin–Madison	USA	30
Swarthmore College	USA	29
University of Pennsylvania	USA	28
College of William and Mary	USA	26
Es. Superior de Comercio “Carloss Pellegrini”	Argentina	26
University of Calcutta	India	26
Instituto Tecnológico Autónoma de México	Mexico	24
University of Maryland	USA	24

Source. Survey of Earned Doctorates.

^aThe number of economists who earned their PhD during 1997–2002 ($N = 5,133$) and who listed the school as their undergraduate university.

National University earn a PhD in economics from a U.S. university each year, along with 7 from Yonsei University and 6 from Korea University, both also located in Seoul. Based on a dropout rate of 18.5 percent after two years of the Seoul National, Yonsei, and Korea University graduates who entered one of 27 American PhD programs in fall 2002 and assuming no further attrition among the group, an average annual graduating PhD class of 40 Seoul National, Yonsei, and Korea University alumni implies that at least 50 of their alumni enter U.S. economics PhD programs each year.

The 25 American undergraduate alma maters that generated the most AUIT economics PhDs between 1997 and 2003 are reported in Table 3. The list is dominated by research universities that offer a PhD in economics. Average annual rates of AUIT PhDs generated by these institutions (one-seventh of the numbers reported in Table 3) are, for example, 12 from each undergraduate class at Harvard, 10 from each undergraduate class at Berkeley, and about 7 annually from Cornell and

TABLE 3. Top American Sources of Eventual Economics PhDs, 1997–2003

University name	Number of eventual PhDs generated during 1997–2003
Harvard University	86
University of California–Berkeley	69
Cornell University	51
Stanford University	51
University of Wisconsin–Madison	46
University of Michigan	40
Swarthmore College	39
Yale University	39
Princeton University	37
MIT	35
University of Pennsylvania	34
University of Maryland	30
Brigham Young University	28
University of Virginia	28
College of William and Mary	27
Columbia University	27
Texas A&M University	27
University of Illinois	26
University of Texas	26
University of California–Davis	25
University of Massachusetts	25
Williams College	25
UCLA	24
Duke University	23
Miami University	23
Michigan State University	23
Northwestern University	23

Source. Authors' calculations based on the Survey of Earned Doctorates.

Stanford. The only real surprises on the list are the private and public liberal arts colleges—e.g., Swarthmore, William and Mary, Williams, and Miami of Ohio—surrounded by the likes of the larger universities of Wisconsin, Michigan, Texas, and UCLA. For these highly productive liberal arts colleges, the annual average number of eventual economics PhDs generated ranges from 5.4 for Swarthmore to 3.3 for Miami of Ohio.

To better illustrate the relative productivity of liberal arts colleges at generating eventual economics PhDs, we rank the top 25 institution-size-normalized undergraduate alma maters of economics PhDs in Table 4. The number of

TABLE 4. Institution Size-Normalized Top American Sources of Eventual Economics PhDs, 1997–2003

Institution name	Number of eventual PhDs generated 1997–2003	Number of undergraduate degrees awarded 1987–1993	Eventual PhDs generated per 1,000 undergraduate degrees awarded
Swarthmore College	39	2,579	15.12
Agnes Scott College	7	771	9.08
Grinnell College	20	2,212	9.04
Carleton College	22	3,127	7.04
Williams College	25	3,593	6.96
Harvard University	86	12,500	6.88
Macalester College	17	2,620	6.49
Princeton University	37	7,742	4.78
Trinity University	16	3,515	4.55
MIT	35	7,849	4.46
Stanford University	51	11,597	4.40
Yale University	39	9,115	4.28
Wabash College	5	1,274	3.92
Bowdoin College	10	2,557	3.91
University of Chicago	21	5,567	3.77
Oberlin College	19	5,038	3.77
Wellesley College	15	4,099	3.66
Earlham College	6	1,700	3.53
Kalamazoo College	6	1,726	3.48
Beloit College	5	1,531	3.27
Pomona College	8	2,491	3.21
Illinois Wesleyan University	8	2,529	3.16
College of William and Mary	27	8,737	3.09
Amherst College	9	2,917	3.09
Columbia University	27	8,932	3.02
Rice University	13	4,434	2.93

Source. Authors' calculations based on IPEDS completions data available on WebCASPARE. Calculations are limited to schools that produced an average of at least 100 BA/BS degrees and an average of at least 5 economics BA/BS degrees per year during 1987–93, and who produced at least 2 PhDs during the period 1997–2003.

economics PhDs generated by each institution during 1997–2003 is divided by the size of each institution's total undergraduate graduating class from 10 years earlier (1987–1993). Although only 4 liberal arts colleges appear among the top 25 American undergraduate producers of eventual economics PhDs listed in Table 3, Table 4 shows that the liberal arts colleges send the greatest proportion of their graduates on to earn PhDs in economics. Swarthmore leads the list, with an average of one-half of 1 percent of its graduates each year eventually earning a PhD in economics, or about 15 economics PhDs generated per 1,000 Swarthmore graduates.

Of the top 25 institutions ranked by the proportion of the graduating class that eventually earns a PhD in economics, 24 are private colleges and universities, and the one public institution (College of William and Mary) is the closest thing there is to a liberal arts college in the public sector. Eighteen of the 25 are liberal arts colleges with little or no graduate education on their campus. Although not shown in the table, the trend continues as one moves down these rankings. Not until rank 54 does a large public university (Berkeley) appear on the list. This pattern of dominance of private liberal arts colleges and private universities in producing undergraduates who eventually earn a PhD in economics closely follows the doctoral production pattern in the natural sciences (Tidball 1986, 613).

If there are a large number of economics majors at a relatively small institution, even a small proportion of economics majors proceeding on to a PhD can move an institution up the list reported in Table 4. Some economics departments, however, especially those competing with an undergraduate business school, produce a remarkable number of PhD economists from a relatively small pool of economics majors. We show these institutions in Table 5, where we normalize the eventual economics PhDs generated by each institution by the number of bachelor's degrees each awards in economics. Because of variation in the relative size of economics programs within colleges and universities, only 10 of those listed in Table 4 survive among the leading 25 in Table 5. A few colleges and universities with relatively small economics programs that are near the top of Table 5 are surprising: for example, Illinois Wesleyan, the University of Memphis, and Bemidji State.

Last, to illustrate that the prominence of top liberal arts colleges in generating eventual economics PhDs is not limited to simply the handful of outstanding colleges listed in Tables 4 and 5, Table 6 presents overall institution- and economics-program size-normalized PhDs generated by each of the four categories of undergraduate institution. The economics PhD-granting institutions generated more than 13 times as many BA/BS degrees and more than 7 times as many economics BA/BS degrees as the top-50 liberal arts colleges did from 1987 to 1993. However, liberal arts colleges generated about three times as many PhDs per BA/BS awarded and more than twice as many PhDs per economics BA/BS awarded.

One reason for the disproportionate presence of selective liberal arts college graduates among economics PhDs may be the tendency of individuals to follow in the footsteps of their parents (Laband and Lentz 1985). Although fewer than 3 percent of the nation's college students attend selective liberal arts colleges, almost half of the children of faculty at selective liberal arts colleges and about a quarter of the children of faculty at national research universities attend selective liberal arts colleges (Siegfried and Getz 2006, Table 1). With such a hugely

TABLE 5. Economics Program-Size Normalized Top American Sources of Eventual Economics PhDs, 1997–2003

Institution name	Number of eventual PhDs generated 1997–2003	Number of economics undergraduate degrees awarded 1987–1993	Eventual PhDs generated per economics undergraduate degree awarded
Illinois Wesleyan University	8	42	0.19
Swarthmore College	39	292	0.13
Bemidji State University (MN)	5	44	0.11
Earlham College	6	56	0.11
Reed College	5	47	0.11
Grinnell College	20	191	0.10
Wheaton College (Wheaton, IL)	7	68	0.10
University of Memphis	6	59	0.10
Agnes Scott College	7	75	0.09
University of Alabama	5	55	0.09
Concordia College	5	58	0.09
Oberlin College	19	222	0.09
MIT	35	413	0.08
Carleton College	22	264	0.08
Trinity University	16	195	0.08
Hood College	3	39	0.08
Loyola University of Chicago	3	46	0.07
Miami University	23	355	0.06
Ithaca College	5	78	0.06
Ohio Wesleyan University	5	78	0.06
University of Miami	5	79	0.06
Macalester College	17	272	0.06
Western Kentucky University	6	98	0.06
Rochester Institute of Technology	3	50	0.06
Frostburg State University	4	67	0.06
La Salle University	5	85	0.06
College of Charleston	3	54	0.06

Source. Authors' calculations based on IPEDS completions data available on WebCASPAR. Calculations are limited to schools that produced an average of at least 100 BA/BS degrees and an average of at least 5 economics BA/BS degrees per year during 1987–1993, and who produced at least 2 PhDs during the period 1997–2003.

disproportionate presence of faculty brats at selective liberal arts colleges, only a modest intergenerational correlation in occupation is necessary for liberal arts colleges to be overrepresented among PhD students (in any discipline). Furthermore, undergraduate economics students at liberal arts colleges may receive more attention from faculty that leads them to think about a career as a professional economist. The typical (median) economics graduate of a liberal arts college writes almost twice as many economics term papers as does a graduate of a national research university (4.0 vs. 2.2 papers, McGoldrick 2006, Table 5b). Moreover, relatively

TABLE 6. AUIT PhDs Generated, Normalized by Institution Size and Economics Program Size

Institution type	Number of PhDs generated 1997–2003	Number of BA/BS graduates generated 1987–93	Number of economics		PhDs per 1,000 BA/BS graduates
			BA/BS graduates generated 1987–93	PhDs per 1,000 BA/BS graduates	
Econ PhD granting	1,752	2,298,218	113,800	0.76	49.52
Top-50 liberal arts	427	173,465	14,889	2.46	85.83
Other public	257	822,377	17,924	0.31	21.80
Other private	265	304,806	10,539	0.87	34.58

Source. Authors' calculations based on SED and IPEDS completions data available on WebCASPAPAR.

Note. AUIT = American undergraduate institution trained.

more economics departments in liberal arts colleges than at national universities report that their students' written work is published (65 percent vs. 43 percent) and, of that published work, relatively more from liberal arts graduates (77 percent) than from national research university graduates (52 percent) is published in professional academic journals (McGoldrick 2006, Table 5b). If conducting research that is publishable is more common at liberal arts colleges, academic careers might emanate from liberal arts college graduates more frequently.

The institutions in Table 5 have proven to be very productive at generating eventual economics PhDs—sending between 6 and 19 percent of their economics graduates on to PhDs. Those institutions among the top-50 liberal arts colleges or with economics PhD programs that send an abnormally low proportion of their economics graduates on to earn PhDs in economics might prove to be fertile ground for recruiting new economics PhD students. These institutions can be identified by reproducing Table 5, absent any limitation on the number of PhDs produced from 1997 to 2003, and looking at the bottom of the list. For example, universities with PhD programs in economics that send less than one-half of 1 percent of their undergraduate economics graduates on to earn economics PhDs include Connecticut, Fordham, Pittsburgh, SUNY-Albany, SUNY-Buffalo, and Vanderbilt. Top-50 liberal arts colleges that send less than one-half of 1 percent of their economics graduates on to economics PhDs include Barnard, DePauw, Denison, Hampden-Sydney, Holy Cross, and Union.

UNDERGRADUATE ORIGINS AND ECONOMICS PhD PROGRAM OUTCOMES

As part of our study of the economics PhD production process, we are following the progress of 586 students who began PhD study in one of 27 economics PhD

programs during fall 2002. Among the 27 are 15 of the 22 largest and 12 others, each averaging at least 5 PhDs per year.⁷ The programs are diverse in terms of 1993 National Research Council (NRC) ratings (Goldberger, Maher, and Flattau 1995). Three are Tier 1, six Tier 2, seven Tier 3, six Tier 4, and four Tier 5. One is unranked.⁸ Thus, the programs are drawn from all quality tiers, but larger, higher-ranked universities are overrepresented. Together the 27 programs produced 42 percent of the PhDs issued by U.S. programs awarding at least one degree from 1998 to 2001.⁹ Fourteen of the largest 20 PhD programs and 9 of the top 15 PhD programs in economics as ranked in 1993 by the NRC (Goldberger, Maher, and Flattau 1995) are included.¹⁰

To compare various student characteristics and outcomes across the type of undergraduate institution that the fall 2002 entering cohort of PhD students had attended, we used the same four categories of U.S. colleges and universities employed earlier. However, because of potential differences in language barriers to learning in the United States, we subdivided the foreign institutions into those in (a) Britain, Canada, Ireland, Australia, and New Zealand, where English is the dominant language, and (b) all other countries. Using this division, Table 7 shows that 38 percent of the fall 2002 entering cohort earned a bachelor's degree from a

TABLE 7. Characteristics of PhD Students, by Institution Type

Institution type	Number of first-year students generated	Share of first-year students	First-year dropout rate	Two-year dropout rate	<i>M</i> Verbal GRE	<i>M</i> Analytical GRE	<i>M</i> Quantitative GRE
Econ PhD granting	142	0.24	0.17	0.29	598 ^{>a}	732	760 ^{<}
Top-50 liberal arts	33	0.06	0.15	0.21	623 ^{>}	729	765
Other public	30	0.05	0.30 ^{>}	0.50 ^{>}	585	721	743 ^{<}
Other private	18	0.03	0.06	0.28	592	722	751 ^{<}
Britain, Canada, Ireland, Australia, New Zealand	27	0.05	0.07	0.15	606	738	780
Other foreign	336	0.57	0.11 ^{<}	0.25	534 ^{<}	716 ^{<}	781 ^{>}
All AUIT	223	0.38	0.17 ^{>}	0.30	599 ^{>}	729	757 ^{<}
All foreign	363	0.62	0.10 ^{<}	0.24	539 ^{<}	718	781 ^{>}
Total	586	1.00	0.13	0.26	562	722	772

Note. GRE = Graduate Record Exam. For the binary *dropout* variables, the statistical significance of the differences was determined by examining the statistical significance of coefficients from probit regressions of dropout on each institution type. The number of observations for the GRE scores is lower than for the whole sample because GRE score information was not available for 12 students.

^a">" ("<") = value is significantly higher (lower) than the mean for the rest of the sample at the 0.10 level (two-tailed *t* tests).

U.S. college or university, 5 percent from an English-language-dominant foreign university, and 57 percent from other foreign universities.

Assuming that no particular type of U.S. undergraduate institution has been more or less successful in inducing prospective PhD students to apply and enroll if they are admitted, U.S. economics PhD programs that want to boost applications and enrollments from domestically trained undergraduates need not look far. The largest pool of prospects comes from U.S. institutions offering a PhD in economics; close to two-thirds of the AUIT first-year students (142 of 223) earned their undergraduate degrees from these schools. An additional 15 percent of AUIT students are located at the 50 or so most prestigious liberal arts colleges.

Column 3 (Table 7) indicates that by the beginning of their second year of study, 13 percent of the entrants (77 individuals) had dropped out. By the beginning of their third year of study (fall 2004), attrition was 26 percent for the enrolling cohort. Substantial differences in attrition emerge on the basis of type and location of undergraduate training. For example, the 17 percent first-year dropout rate for AUIT PhDs was 7 percentage points higher than that of those trained overseas, a difference that is statistically significantly different at the .10 level.¹¹ Moreover, there are substantial differences in attrition based on the type of undergraduate institution attended. Among AUIT PhD students, the lowest attrition (21 percent after two years) occurred among PhD students who earned their undergraduate degrees from the nation's 50 most prestigious private liberal arts colleges (plus the 6 we added), and the highest attrition (50 percent after two years) occurred among the 30 fall 2002 matriculants whose undergraduate degrees were awarded by public universities that do not offer a PhD in economics (although only the latter group's attrition rate is significantly different from that of other PhD students).

In their study of the match between the skills learned in graduate school and those used by economics PhDs on the job, Stock and Hansen (2004, Table 2) reported that among recent graduating cohorts of economics PhDs, analytics (understanding and solving problems, making and analyzing logical arguments) and mathematics (constructing and analyzing proofs, manipulating mathematical abstractions) were consistently rated by graduates as the skills most important for success in their PhD programs. In contrast, the largest fraction of graduates listed communication (speaking and writing effectively, quickly understanding spoken and written ideas of others, explaining ideas clearly) as the skill most important for success in their jobs.

The inclination to enter and ability to succeed in a PhD program may depend on a student's innate quantitative and verbal skills. Those skills, in turn, may be related to the type of undergraduate college a person attended. To explore this possibility, in Table 7, we also report separately by type of undergraduate institution the mean verbal, analytical, and quantitative Graduate Record Exam (GRE) scores for the 2002 entering PhD class. If GRE analytical, quantitative, and verbal scores reflect aptitude in analytic, mathematic, and communication skills, the mix of aptitude among first-year PhD students as reported in Table 7 presents a conundrum. On the one hand, first-year PhD students who completed their undergraduate work at economics PhD-granting institutions earned relatively high analytical scores but low quantitative GRE scores compared with other first-year students (although only the latter is statistically significant), whereas students from foreign institutions

where English is not the dominant language have the highest quantitative but the lowest analytical GRE scores among the first-year class. In both cases, the GRE scores send mixed signals in terms of the students' mastery of the skills rated most important for success in graduate school. On the other hand, bachelors-level graduates of economics PhD-granting institutions and those from top-50 liberal arts colleges earn higher verbal GRE scores than do others, whereas students from foreign institutions where English is not the dominant language earn lower verbal GRE scores—suggesting that the graduates from these different types of institutions may face ease (or difficulty) in mastering the communication skills that their predecessors rate as highly important for success on the job.¹²

In Table 8, we present probit regression estimates of two-year attrition for the 572 members of the entering class for whom we have complete survey information. Unlike the raw means presented in Table 7, the regression controls for differences in demographic characteristics (age, sex, citizenship), school-related characteristics (whether the student held a prior advanced degree, an undergraduate major in economics, math, or a dual major in economics/math, and the years since the undergraduate degree was earned), whether the student indicated an interest in micro theory, macro theory, or econometrics (the core of the first-year curriculum, indicated by the variable *theory interest*) or in another specific field of economics on their economics PhD program application, and GRE scores. The regression also includes first-year financial aid variables, undergraduate institution characteristics, and indicators for particular graduate programs (i.e., binary variables representing each of the 24 institutions with 10 or more students in the regression sample).

The regression estimates indicate that once other factors are controlled, none of the demographic or other school-related characteristics is related to attrition. The only exception is the verbal GRE score, but its impact is small, with a 10-point increase being associated with only a .003 decrease in the probability of dropping out.¹³ Not surprisingly, those who have no financial support are more likely to drop out in the first two years of graduate study, being 21 percentage points more likely to do so than their counterparts with teaching assistantships. Among the undergraduate institution groups, only other foreign is significantly associated with attrition, with those students having about a 0.2 lower probability of dropping out relative to their counterparts from economics PhD-granting institutions.

Last, to examine variations in the time required to earn a PhD in economics, we estimated a hazard model based on a Weibull distribution for 302 economists who earned their PhDs between July 1, 2001, and June 30, 2002, and who answered all pertinent questions on a survey administered in early 2003 as part of a larger study of the labor market for new PhDs (Siegfried and Stock 2004). The survey included at least partial information for 61 percent of those who earned economics PhDs in the United States in 2001–2 and includes PhD graduates from 101 universities. Non-U.S. citizens and graduates holding permanent jobs are under-represented among survey respondents, but the sample is otherwise representative of the graduating class of 2001–2 (see Siegfried and Stock [2004] for a more thorough discussion of the sample and its representativeness).

All individuals in this sample earned a PhD in economics during the same year. They entered graduate school as members of many different cohorts. The

TABLE 8. Attrition From Economics PhD Programs, Probit Model

Variable	<i>M</i>	Coefficient	<i>z</i> ratio
Dropout*	0.26	—	—
Demographics			
Age at matriculation	25.44	-0.004	-0.34
Female*	0.35	0.075	1.72
U.S. citizen*	0.33	-0.115	-1.65
Prior advanced degree*	0.45	-0.002	-0.04
Prior BA/BS economics*	0.70	-0.051	-1.05
Prior BA/BS economics/math*	0.06	-0.130	-1.70
Prior BA/BS math*	0.03	-0.112	-1.16
Years since BA/BS degree	2.69	-0.010	-0.81
Theory interest*	0.34	-0.019	-0.44
No interest specified*	0.25	0.014	0.24
GRE analytical score ($\times 10^{-1}$)	72.28	-0.002	-0.97
GRE verbal score ($\times 10^{-1}$)	56.26	-0.003	-2.07
GRE quantitative score ($\times 10^{-1}$)	77.20	-0.006	-1.16
Primary type of financial assistance			
Teaching assistant*	0.28	—	—
Research assistant*	0.05	-0.107	-0.77
Fellowship*	0.47	0.104	1.84
No support*	0.20	0.214	3.16
Type of undergraduate institution			
Economics PhD granting*	0.24	—	—
Top-50 liberal arts*	0.06	-0.093	-1.17
Other public*	0.05	0.165	1.75
Other private*	0.03	-0.028	-0.28
Britian, Canada, Ireland, Australia, New Zealand*	0.05	-0.163	-1.77
Other foreign*	0.57	-0.187	-2.31

Note. *N* = 572. The coefficient column reports the estimated marginal effects (transformed coefficients), evaluated at the mean value of the independent variable. For binary variables, the coefficient column reports the effect of a change in the independent variable from 0 to 1. Coefficients in bold are statistically significant at the .10 level (two-tailed tests). The *z* ratio column reports the *z* ratios for the estimated marginal effects. The regression also includes a constant and binary controls for the 24 PhD programs with 10 or more graduates in the regression sample.

*indicates binary variables.

nature of the sample prevents us from attempting to discern differences between those who earned a degree and those who did not; we are limited to investigating only differences in the speed of completion among those who did earn a degree. Because we plan to continue to follow the cohort of 586 students who entered PhD programs in fall 2002, however, eventually we will be able to estimate a hazard model on a consistent cohort of entering students (in 2002) and control for entering quantitative and verbal aptitude scores.

Included in the current hazard model as explanatory variables for time-to-degree are indicators for particular graduate programs (i.e., binary variables representing the 6 institutions with 10 or more graduates in the regression sample), type of

financial support, type of dissertation (traditional treatise or set of essays), field of specialization, sociodemographic and educational background characteristics, and type of undergraduate institution attended. The variable means and coefficient estimates from the regression are reported in Table 9.¹⁴

We have discussed the relationships of demographic and graduate program characteristics with time-to-degree elsewhere (e.g., Siegfried and Stock 2004, 277;

TABLE 9. Time-to-Degree for the Economics PhD Class of 2001–02, Duration Model

Variable	<i>M</i>	Estimated exponentiated accelerated failure time coefficients	<i>z</i> ratio	Predicted change in time to degree for statistically significant coefficients (in months)
Time to degree (years)	5.60	—	—	—
Demographics				
Age at matriculation	26.32	0.996	-1.94	-0.3
Female*	0.28	0.994	-0.22	
Married at matriculation*	0.23	0.993	-0.16	
U.S. citizen*	0.54	0.996	-0.09	
Had child at matriculation*	0.10	0.967	-0.51	
Female*, had child at matriculation*	0.02	0.991	-0.09	
White*	0.73	1.011	0.32	
Prior master's degree*	0.40	0.930	-2.61	-4.7
Prior economics degree*	0.83	1.031	0.86	
Primary type of financial assistance				
Teaching assistant*	0.31	—	—	—
Research assistant*	0.08	0.923	-1.55	
Fellowship*	0.08	0.868	-3.42	-8.9
Government support*	0.04	0.870	-1.84	
Mixed support*	0.45	0.929	-2.30	-4.8
No support*	0.04	1.110	1.54	
Dissertation set of essays*	0.61	0.908	-3.35	-6.2
Type of undergraduate institution				
Economics PhD granting*	0.31	—	—	—
Top-50 liberal arts*	0.11	0.875	-3.26	-8.4
Other public*	0.08	1.092	1.47	
Other private*	0.08	0.912	-1.54	
Britain, Canada, Ireland, Australia, New Zealand*	0.05	0.844	-2.95	-10.5
Other foreign*	0.37	0.922	-2.01	-5.2

Note. *N* = 302. Regression also includes a constant, binary controls for PhD programs with 10 or more graduates in the regression sample (programs are Chicago, Harvard, MIT, NYU, Maryland, and Berkeley), and binary controls for field of specialization.

*indicates binary variables.

Stock and Siegfried 2006). Here, we elaborate on relationships between type of undergraduate institution and time-to-degree. The group of binary variables indicating various types of undergraduate institutions attended by the 302 PhD economists in our sample explains a statistically significant additional amount of the variation in the time it took them to earn their degrees (the p value in a test of their joint significance is 0.000). There are also economically meaningful differences in time-to-degree among those who attended different types of undergraduate institutions. Those who graduated from a selective private liberal arts college finished about 8 months faster than the benchmark group whose undergraduate study was at a university that also offers a PhD in economics. Those who earned undergraduate degrees from foreign, predominantly English-speaking universities finished 11 months faster, and those who earned undergraduate degrees from other foreign universities finished about 5 months faster than the benchmark. Although not significantly different from the benchmark, the slowest group is those from public universities in the United States that do not offer a PhD in economics, the same group with the worst attrition record.

Graduates who completed undergraduate study at selective American liberal arts colleges or whose undergraduate training was in Britain, Canada, Ireland, Australia, or New Zealand earned a PhD in economics sufficiently faster than the large group of undergraduates from American PhD-granting universities so as to save almost a full academic year. The savings from an academic year could be viewed as a full year's opportunity cost to graduates or a year of financial aid from the PhD department. Applicants from Swarthmore, Williams, or Carleton, therefore, might be viewed appropriately as likely less expensive PhD students than those with a bachelor's degree from Harvard, Berkeley, or Stanford. Accordingly, PhD program admissions committees might reasonably dip further into the credentials pool for those with an undergraduate degree from a selective liberal arts college. On the other hand, expanding the pool of selective liberal arts college graduates attracted into PhD study, which such a policy could induce, may add prospects whose expected time-to-degree differs from the expected length of PhD study of existing matriculants.

CONCLUSION

We documented the types of colleges and universities attended by those who earned doctorates in economics from American universities from 1966 to 2003. The total number of new economics PhDs awarded to U.S. citizens has declined precipitously since 1972. Among those who earned an undergraduate degree in the United States, however, the composition of undergraduate alma maters of the doctorates has been relatively stable, with about 55 percent of those earning a PhD in economics each year holding a bachelor's degree from a university that offers a PhD in economics and a little more than 10 percent holding a bachelor's degree from a selective liberal arts college.

Currently, 18 of the 25 American undergraduate institutions that send the largest percentage of their graduating class on to earn a PhD in economics are private, liberal arts colleges. In addition, graduates of the top liberal arts colleges have the

highest mean verbal GRE scores among the 2002 first-year class of economics PhD students, and among recent cohorts of economics PhDs, liberal arts college graduates completed their degrees in substantially less time than all other PhD students except those from Britain, Canada, Ireland, Australia, and New Zealand.

Worldwide, Seoul National University in Korea is the leading incubator of future U.S. economics PhDs, generating an average of 27 eventual economics PhDs per year during the period of 1997–2002. Among American institutions, Harvard tops the list of undergraduate institutions attended by eventual PhDs in economics, but Swarthmore College and Illinois Wesleyan, respectively, are the top generators of eventual economics PhDs. after controlling for institution and economics program size.

NOTES

1. In a sample of 586 students who entered PhD programs in fall 2002, 36 of 393 foreign students earned their bachelor's degree at a U.S. college, and 6 of 193 Americans earned their bachelor's degree outside the United States (Stock, Finegan, and Siegfried 2006).
2. The data in Figure 1 were assembled from the Survey of Earned Doctorates (SED) and Doctorate Records File (DRF), collected on behalf of the National Science Foundation (NSF) (see <http://webCASPAR.nsf.gov>). These surveys have very high response rates and can be considered comprehensive.
3. Source: <http://www.usnews.com/usnews/edu/college/rankings/ranklibartco-brief.php>. The colleges are Amherst, Barnard, Bates, Bard, Bowdoin, Bryn Mawr, Bucknell, Carleton, Centre, Claremont McKenna, Colby, Colgate, Colorado College, Connecticut College, Denison, DePauw, Dickinson, Davidson, Franklin and Marshall, Furman, Gettysburg, Grinnell, Hamilton, Harvey Mudd, Haverford, Holy Cross, Kenyon, Lafayette, Macalester, Middlebury, Mount Holyoke, Oberlin, Occidental, Pomona, Rhodes, Sarah Lawrence, Scripps, Sewanee—University of the South, Skidmore, Smith, Swarthmore, Trinity College, Union, Vassar, Wabash, Washington and Lee, Wellesley, Wesleyan, Whitman, and Williams.
4. The set of Elite 20 institutions contains 10 universities and 10 liberal arts colleges. Among the 10 universities are the 8 northeastern Ivy League universities, Chicago, and Stanford. Seven of the 10 were founded before the Revolutionary War. Among the others, Cornell (1865) is part of the Ivy League, and Chicago (1891) and Stanford (1891) are venerable institutions from beyond the northeast. All 10 are among *U.S. News & World Report's* top-15 ranked national universities. In light of age, location, and academic credentials, only Duke, MIT, and Northwestern might have substituted for 1 of the 10 chosen universities. All 10 of the liberal arts colleges were founded before 1870. Eight of the 10 are in the northeast. Oberlin (Ohio) and Grinnell (Iowa) were added for geographical diversity. Nine of the 10 colleges are among *U.S. News & World Report's* top-15 ranked liberal arts colleges (Oberlin ranked below 15). In terms of age, location, and academic credentials, only Bowdoin, Carleton, Middlebury, and Davidson might have substituted for 1 of the 10 chosen liberal arts colleges.
5. The engineering colleges are Cal Poly-San Luis Obispo; Cal Tech; Carnegie Mellon; Case Western Reserve; Cooper Union; Georgia Tech; Harvey Mudd College; Illinois Tech; Michigan Tech; MIT; Purdue; Rensselaer; Rice; Rose Institute of Technology; Stevens Institute of Technology; Texas A&M; U.S. Air Force, Military, and Naval Academies; and Virginia Tech.
6. These data are not directly available via webCASPAR but were obtained in late 2003 via a special tabulation from the National Opinion Research Center (NORC), the contractor to NSF for the SED. Because NORC continuously updates the webCASPAR data with late-arriving surveys and the special tabulation that produced Table 3 occurred about two years before our extraction from webCASPAR of the data used in the rest of this article, there is a slight difference in the number of PhDs reported in Tables 2 through 5.
7. Each of the 22 programs with the most economics PhD degrees awarded from 1998 through 2001 was invited to participate; 15 accepted. The remaining 12 programs were selected randomly from the 45 smaller programs that averaged at least 5 PhDs annually from 1998 through 2001.
8. The first tier of NRC rankings consists of Chicago, Harvard, MIT, Princeton, Stanford, and Yale (three of which are included in our study). The second tier is California-Berkeley, Columbia, Michigan, Minnesota, Northwestern, Pennsylvania, Rochester, UCLA, and Wisconsin. The third

- tier is programs ranked 16–30; fourth tier programs are ranked 31–48. We included in the fifth tier the remainder of programs, including one not ranked by the NRC.
9. This statistic is based on tabulations from listings in December issues of the *Journal of Economic Literature*.
 10. There are 223 AUIT students among the 586 in the entering class. Among these, 63 percent attended economics PhD-granting, 16 percent top-50 liberal arts, 13 percent other public, and 8 percent other private undergraduate institutions. These percentages imply that our sample of current PhD students includes more students from economics PhD-granting and fewer from other private undergraduate institutions than are represented by the SED data in Table 1 for PhDs graduating in 1997–2003.
 11. The statistical difference in the means reported in Table 7 was determined using a two-tailed *t* test of differences in means across the undergraduate institutions for the Graduate Record Exam (GRE) variables in columns 5–7 and by examining the statistical significance of estimated coefficients from probit models regressing the dropout variables in columns 3–4 on each of the undergraduate institution variables.
 12. Although not shown in the table, as another test of the belief that mathematical and quantitative abilities have become important predictors of success in graduate school, we also compared the GRE scores of the 12 PhD students among the entering class of 2002 who attended one of the engineering schools listed in Figure 5 against those of the 220 first-year students who attended other U.S. undergraduate institutions. The mean quantitative and analytical GRE scores were higher (by 24 and 22 points, respectively) for those who attended engineering schools, but only the difference in the quantitative score comes close to statistical significance ($p = .13$).
 13. When we estimate the attrition model without GRE scores included, the estimated coefficients on the undergraduate institution variables do not change appreciably. Assuming that GRE scores are a good measure of student ability, this implies that the institution-type variables measure something beyond that.
 14. The 18 graduates whose time-to-degree was more than two standard deviations above the mean of 5.6 years were excluded from the analysis.

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