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II Academic Labor Supply

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6 Projections of Shortages

6.1 An Overview of the Study

Projections of forthcoming shortages of Ph.D.s abound. A major book coauthored by a former president of Princeton University, who is now president of a major foundation, is announced to the world in a front-page story in the *New York Times* (Bowen and Sosa 1989; Fiske 1989). The book concludes that by the late 1990s there will be large shortages of faculty in the arts and sciences and that these shortages will be especially large in the humanities and social sciences, where there may be as few as seven candidates for every ten faculty positions. A National Science Foundation internal staff report projects a substantial shortfall in science and engineering doctorates starting in 1994 (National Science Foundation 1989a). A National Research Council committee projects substantial shortages of biomedical doctorates by the year 2000 (National Research Council 1990). These projections all lead the president of the American Association for the Advancement of Science to talk about the need for immediate corrective actions (Atkinson 1990).

Economists typically define shortages as arising when, at the prevailing salaries in an occupation, the quantity of labor demanded exceeds the quantity of labor supplied (Ehrenberg and Smith 1991, chap. 2). As long as salaries are free to rise, shortages will eventually be eliminated. Concern over potential shortages of doctorates in academe occurs both because academic institutions may not possess the resources to increase faculty salaries substantially, and because, even if they do, the time it takes graduate students to complete doctoral degrees is sufficiently long that an increase in graduate enrollments in response to a salary increase would increase the supply of new doctorates only many years later. Thus, if shortages do materialize in the future, they may persist for a number of years.

Among the policies proposed to avert these projected shortages are in-

creased financial support for graduate students and the shortening of the time it takes graduate students to complete their degrees. Yet, as is indicated below, empirical evidence on the magnitudes of likely supply responses to such proposed changes is actually quite scanty.

How these estimates of shortages are arrived at can be illustrated by briefly summarizing Bowen and Sosa's (1989) projection model of the demand and supply in the arts and sciences for faculty with doctorates. At the risk of simplifying, their analysis proceeds as follows. First, they use data on the current age distribution of faculty and estimates of departure rates (to nonacademic jobs, retirement, and death) by age to project the replacement demand for faculty each year. Quite strikingly, they show that plausible changes in retirement behavior that might be induced by the abolition of mandatory retirement have only small effects on replacement demand.

Next, data on population trends and age-specific college enrollment rates are used to project college enrollments, and data on trends in enrollment by major are used to project enrollments in the arts and sciences. Data on trends in student/doctoral faculty ratios (which have been decreasing) and assumptions about whether these ratios are likely to rise or fall in the future are then used to project how changes in enrollment will translate into changes in the demand for new faculty with doctorates.

As shown below, while the number of Ph.D.s granted by U.S. universities has been roughly constant in recent years, nonacademic job opportunities are increasingly available to new Ph.D.s. In addition, new Ph.D. recipients are increasingly citizens of foreign countries who are temporary residents in the United States, and these new doctorates' probabilities of obtaining employment in the United States are low.[1] Projections of future academic labor supply are made on the basis of these trends and projections of the number of college graduates. Supply and demand forces are then integrated and the projections of future shortages obtained. Even Bowen and Sosa's most "optimistic" set of assumptions lead to projections of a 43 percent underproduction of new doctorates in the arts and sciences as a whole and a 66 percent underproduction in the humanities and social sciences during the period 1997–2002 (Bowen and Sosa 1989, table 8.5).

As noted by Bowen and Sosa, their projections of the supply side of the academic labor market, which are typical of those used in other studies, are based on a number of simplifying assumptions and "avowedly rough judgments" (Bowen and Sosa 1989, p. 166). Similarly, some of their proposed policy remedies, such as increasing financial aid for graduate students and shortening the time it takes students to receive degrees, are made without presenting any evidence on the likely magnitude of supply responses to these changes. As such, this part of the book reviews the academic literature and

1. These probabilities depend on foreign students' desired employment, academic employers' desires to hire foreign students, and U.S. immigration policies. I return to this point later.

available data (from a wide range of sources) to summarize what we know about academic labor supply and what we need to know to make informed policy decisions. Among the issues to be addressed are the following.

1. Why is the proportion of U.S. college graduates completing doctoral programs today substantially lower than it was 20 years ago? Does this reflect a changing relative financial attractiveness of employment opportunities for people with doctorates or simply a limitation over the last decade in academic employment opportunities? How and why has the distribution of undergraduate majors across fields changed, and how has this affected enrollments in doctoral programs? Has the quality of Ph.D. students declined in recent years?

2. Why has there been a growing lag between college graduation and entry to doctoral programs and a lengthening in the time students require to complete such programs? Do undergraduate loan burdens influence the former and financial support for graduate students and postgraduate job opportunities influence the latter? Do these factors also influence the proportion of graduate students who are studying part-time?

3. Why has the proportion of graduate students accepting postdoctoral appointments prior to permanent employment been rising? Would a shortage of Ph.D.s reduce the proportion of students accepting these appointments, and would a reduction in this proportion increase new applicants to graduate study?

4. Why has the proportion of new Ph.D.s choosing employment in the nonacademic sector increased? Is academe currently losing its best new Ph.D.s to the nonacademic sector? If shortages of new Ph.D.s materialize, will improved job opportunities and increasing wages in academe relative to the nonacademic sector induce more new Ph.D.s to enter the academic sector, more experienced nonacademic Ph.D.s to enter or reenter the academic sector, or fewer experienced academic Ph.D.s to leave the academic sector?

5. How will the changing age structure of faculty influence faculty productivity? How will the uncapping of mandatory retirement affect the academic labor supply?

6. Why are minorities and women underrepresented in academe? What policies may lead to increased representation of these groups?

7. Should (and can) American universities seek to increase employment of foreign students who receive their Ph.D.s here? Should (and can) they increase their employment of American and foreign-born academics currently employed in foreign universities?

8. Would a "Ph.D. shortage" really matter? That is, which institutions are likely to be "hurt" by a shortage of Ph.D.s? Are faculty at these institutions currently major contributors to our stock of research, the production of new Ph.D.s, or the production of undergraduates who go on to Ph.D. study? Could the Ph.D. shortage be averted by the use of more faculty without doctorates? Is there any evidence that a substitution of faculty without for faculty with

doctorates would lead to a reduction in the quality of undergraduate instruction?

The plan of this study is as follows. In the remainder of this chapter, some background data are presented on the academic labor market and new Ph.D. production in the United States. Chapter 7 describes a schematic model of academic labor supply and indicates the underlying trends since 1970 in a number of variables that contribute to projections of shortages of faculty. In Chapter 8, a general model of occupational choice and the decision to undertake and complete graduate study is sketched. This framework, available data, and the prior academic literature are then used to address students' choice of college majors, decisions to undertake and complete graduate study, decisions on the time it takes to complete Ph.D. programs, and decisions on choices of sectors of employment for new and experienced Ph.D.s. Chapter 9, addresses issues relating to the age structure of the faculty and retirement policies as well as minority and female representation in academe. Finally, Chapter 10 considers whether a shortage of American Ph.D.s would really matter and/or could be eased by increased reliance on foreign students trained in the United States, faculty currently employed in foreign institutions, and faculty without doctorates. It also briefly summarizes the implications of the study for both future research needs and public policy.

6.2 Background Data on the Academic Labor Market

In 1987, approximately 722,000 faculty were employed at institutions of higher education in the United States, and about 64 percent of these were full-time employees (Anderson, Carter, and Malizio 1989, table 104). These faculty were employed at over 3,000 different institutions. Table 6.1 presents some background data on their distribution in a recent year across various Carnegie Foundation categories of institutions.[2]

As the table shows, doctorate-granting institutions represent slightly more than 6 percent of all institutions of higher education (col. 2); however, they employ 40 percent of full-time faculty (col. 3). In contrast, undergraduate liberal arts colleges and two-year institutions, which in turn represent about 17 and 40 percent of all institutions, employ only 7 and 20 percent, respectively, of full-time faculty. While the vast majority of faculty at four-year institutions are full-time, more than half of all faculty at two-year institutions are part-time employees (col. 4).

Columns 5 and 6 make clear that not all faculty have doctorates. At major doctorate-granting universities, on average less than two-thirds of full-time faculty have doctorates, while, at selective liberal arts colleges (Liberal Arts I institutions), this number rises to over three-quarters. In contrast, only 12 percent of full-time faculty at two-year colleges have doctorates, and part-

2. These categories were described in this volume's introduction.

Table 6.1 **Faculty Employment in Institutions of Higher Education in the Late 1980s in the United States**

Institution Type	(1)	(2)	(3)	(4)	(5)	(6)
Total	**3,389**					
Doctorate Granting	**213**	**.062**	**.40**			
Research University I	70	.021	.22	.77	.65	.29
Research University II	34	.010	.07	.82	.58	.20
Doctorate Granting I	51	.015	.06	.69	.64	.20
Doctorate Granting II	58	.017	.05	.73	.65	.18
Comprehensive	**595**	**.176**	**.26**			
Comprehensive I	424	.125	.23	.66	.54	.14
Comprehensive II	171	.050	.03	.66	.51	.15
Liberal Arts	**572**	**.169**	**.07**			
Liberal Arts I	142	.042	.03	.77	.72	.28
Liberal Arts II	430	.127	.04	.63	.50	.17
Two-Year Institutions	**1,367**	**.403**	**.20**	.43	.12	.03
Specialized Institutions	**642**	**.189**	**.05**	.58	.38	.21

Sources: Columns 1 and 2: Carnegie Foundation for the Advancement of Teaching (1987, table 2). Columns 3–6: Authors' calculations from the College Entrance Examination Board, *1988–89 College Characteristics Tapes*. All proportions are weighted (by faculty size) means of individual institution proportions.

Note: Columns are identified as follows: (1) number of institutions of higher education in 1987; (2) share of institutions of higher education in 1987; (3) share of full-time total faculty employment in 1988–89; (4) proportion of faculty who are full-time in 1988–89; (5) proportion of full-time faculty with Ph.D.s in 1988–89; and (6) proportion of part-time faculty with Ph.D.s in 1988–89.

time faculty at all institutions rarely have such degrees. While some faculty are employed in fields where the terminal degree typically is not a doctorate (e.g., fine arts, physical education), these data suggest that academics without doctorates may be viewed as possible substitutes for academics with doctorates, especially at non-research-oriented institutions, if a "shortage" of doctorates materializes.

How much are academics paid? Table 6.2 contains information obtained by the American Association of University Professors (AAUP) from their annual survey of institutions of higher education on average faculty salaries by institutional category, affiliation (public, private, or church related), and rank for the 1989–90 academic year. The AAUP institutional categories are similar, but not identical, to the Carnegie Foundation classifications used in Table 6.1. Data are presented here for doctoral-level, comprehensive (some masters' programs), general baccalaureate (four-year institutions), and two-year institutions; the latter include only those institutions whose faculty have the standard professional ranks (professor, associate professor, and assistant professor) for which the data are reported in the table.[3]

3. For brevity, data for instructors (employed primarily at two-year institutions), lecturers, and individuals without ranks are omitted from these tables.

Table 6.2 **1989–90 Average Faculty Salaries by Institutional Categories, Affiliation, and Academic Rank**

	Affiliation			
			Private	
Rank and Category	All	Public	Independent	Church Related
Professors:				
Doctoral level	59,920	57,520	68,360	61,210
Comprehensive	49,710	49,610	51,000	48,020
General baccalaureate	42,180	43,270	46,830	37,620
Two-year colleges[a]	42,430	43,000	31,560	26,040
All categories	53,540			
Associate professors:				
Doctoral level	42,830	42,010	46,440	43,810
Comprehensive	39,520	39,690	39,740	38,090
General baccalaureate	34,030	35,850	35,940	31,410
Two-year colleges[a]	35,540	35,990	27,830	25,130
All categories	39,590			
Assistant professors:				
Doctoral level	36,110	35,380	39,110	36,330
Comprehensive	32,640	32,730	32,780	31,900
General baccalaureate	28,210	29,650	29,520	26,390
Two-year colleges[a]	30,080	30,560	24,620	22,490
All categories	32,970			

Source: "The Annual Report on the Economic Status of the Profession, 1989–90," *Academe* 76 (March–April 1990), table 3.

[a]Only two-year colleges where faculty have standard academic ranks are included in these tabulations.

On average, full professors', associate professors', and assistant professors' nine-month academic salaries were $53,540, $39,500, and $32,970, respectively, in 1989–90.[4] As Table 6.2 indicates, however, salaries vary widely across categories of institutions.[5] Among the four-year institutions, doctoral-level institutions pay higher salaries than comprehensive institutions, which in turn pay higher salaries than general baccalaureate institutions. Within each four-year institutional category, private independents tend to pay more than public institutions, which in turn pay more than church-related institutions. While the salary differences across institutional categories and affiliations are most pronounced at the full professor level, they exist at other ranks as well.

Why do such differences exist? In part, research-oriented institutions may compete more aggressively for scholars, and the private independent sector

4. These figures exclude employee benefits (which typically exceed 20 percent of salary), summer earnings paid by the institution for teaching or research (from externally funded grants), and all forms of income earned from other sources (such as consulting and royalties).

5. Average salaries also vary widely within each institutional category. Data on average salary by rank for individual universities and colleges are found in the American Association of University Professors (1990).

may have the most flexibility to adjust salary levels to compete in this academic market. While other factors may also be involved—for example, faculty whose primary interests lie in undergraduate teaching may be willing to accept lower salaries at baccalaureate institutions because of the nonpecuniary advantages such institutions offer them—it is reasonable to assume that, if a shortage of doctorates were to materialize, the institutions that would have the most difficulty attracting faculty would be those with the lowest salaries. In fact, the smaller variability across institutions of average salaries at the assistant professor than at the full professor level suggests that, at the faculty entry level, average salaries are currently set to allow institutions to compete for faculty.

In addition to variation across institutional type and affiliation, salaries also vary across disciplines. Table 6.3 presents data on the average salaries of full professors and new assistant professors in 1989–90 for 21 disciplines obtained from a survey of state universities and land-grant colleges. These institutions are primarily public; hence, they are not representative of the entire

Table 6.3 **Average Salaries for Full Professors and New Assistant Professors by Discipline, 1989–90**

Discipline	(1) Average Full Professor Salary	(2) Average New Assistant Professor Salary	(3) Ratio of Average Full to Average New Assistant Professor Salary
Business	66,492	48,023	1.38
Law	78,875	43,434	1.82
Engineering	65,342	41,845	1.56
Computer information	67,026	40,672	1.65
Physical sciences	59,122	34,003	1.74
Mathematics	57,237	32,858	1.74
Agricultural sciences	51,034	32,246	1.58
Library	56,541	32,056	1.76
Architecture	53,337	32,013	1.67
Biology	53,997	31,994	1.69
Psychology	56,599	31,492	1.80
Public affairs	55,582	31,204	1.79
Home economics	50,420	31,139	1.62
Communications	52,117	30,887	1.69
Social sciences	56,637	30,546	1.85
Education	50,677	29,339	1.73
Area studies	55,799	29,304	1.92
Letters	53,083	27,596	1.92
Interdisciplinary studies	57,562	27,579	2.09
Foreign languages	52,613	26,832	1.96
Fine arts	46,819	26,667	1.76

Source: "The Annual Report on the Economic Status of the Profession, 1989–90," *Academe* 76 (March–April 1990), table III. These data are taken from the 1989–90 Faculty Survey by Discipline of Institutions Belonging to the National Association of State Universities and Land-Grant Colleges, conducted by the Office of Institutional Research, Oklahoma State University.

academic labor market. Nonetheless, these data make clear how large disciplinary differences in salary are, even when one eliminates medical schools (which the data do), where salaries tend to be the highest.

As table 6.3 shows, at the full professor level (col. 1), salaries in the highest-paying discipline in the sample, law, are almost 1.7 times the salaries in the lowest-paying discipline, fine arts ($78,875 vs. 46,819). At the new assistant professor level (col. 2), the differences are even more pronounced. Here, average salaries in the highest-paid discipline, business, are over 1.8 times the average salaries paid in the lowest, fine arts ($48,023 vs. 26,667). Not surprisingly, those disciplines with the highest starting salaries tend to be those in which there are both high student demand for instruction and highly paid nonacademic employment opportunities for faculty. They also tend to be disciplines in which the ratio of the average full to average new assistant professor salaries (col. 3) are relatively low.[6]

Full professors have much more institutional and academic "specific human capital" and also tend to have stronger ties to their communities than do their younger colleagues. As such, their probability of leaving their institutions is relatively low (Ehrenberg, Kasper, and Rees, in press); thus, institutions are under somewhat less pressure to raise their salaries in response to tightening labor market conditions. However, the broad disciplinary differences that exist, even at the full professor level, suggest that labor market conditions do influence faculty salaries and that projections of future shortages must take this into account.

Tables 6.1–6.3 paint a portrait of the academic labor market at one point in time. However, the academic labor market is fluid and has undergone several swings over the last two decades. For example, between academic years 1970–71 and 1980–81, the salary of the average faculty member in the United States fell by about 21.1 percent in real terms. In contrast, between 1980–81 and 1989–90, the salary of the average faculty member rose by about 16.6 percent in real terms (American Association of University Professors 1990, table I). To take another example, between 1970 and 1980, full-time-equivalent employment of faculty in the United States rose from 402,000 to 522,000, an increase of more than 2.6 percent a year. In contrast, by 1987, full-time-equivalent faculty employment had risen only to 547,000, an increase of less than 0.7 percent a year, and was projected to remain constant through 1990 (Anderson, Carter, and Malizio 1989, table 105).

In further contrast to these swings, Table 6.4 indicates that, after a tripling of the production of doctorates between 1960–61 and 1970–71, annual production of new doctorates in the United States has remained roughly constant—in the 32,000–34,000 range throughout the 1970s and 1980s (col. 5). However, this relative stability masks a number of substantial changes that did

6. Formally, the correlation across fields between starting assistant professor salaries and the ratio of full to starting assistant professor salaries is −0.66.

Table 6.4 **Earned Degrees Conferred by Institutions of Higher Education in the United States, 1960–61 to 1986–87**

Year	Associate's Degrees (1)	Bachelor's Degrees (2)	Master's Degrees (3)	First Professional Degrees (4)	Doctoral Degrees (5)	Ratio of First Professional to Doctoral Degrees (6)	Ratio of Doctoral to Bachelor's Degrees 6 Years Earlier (7)
1960–61	[a]	369,995	81,690	25,253	10,575	2.39	[a]
1961–62	[a]	388,680	88,414	25,607	11,622	2.20	[a]
1962–63	[a]	416,928	95,470	26,590	12,822	2.07	[a]
1963–64	[a]	466,944	105,551	27,209	14,490	1.88	[a]
1964–65	[a]	501,713	117,152	28,290	16,467	1.72	[a]
1965–66	111,607	520,923	140,548	30,124	18,237	1.65	[a]
1966–67	139,183	558,852	157,707	31,695	20,617	1.54	[a]
1967–68	159,441	632,758	176,749	33,939	23,089	1.47	.056
1968–69	183,279	729,656	193,756	35,114	26,088	1.34	.063
1969–70	206,023	792,656	208,291	34,578	29,866	1.16	.064
1970–71	252,610	839,730	230,509	37,946	32,107	1.18	.064
1971–72	292,119	887,273	251,633	43,411	33,363	1.30	.064
1972–73	316,174	922,362	263,371	50,018	34,777	1.44	.062
1973–74	343,924	945,776	277,033	53,816	33,816	1.59	.053
1974–75	360,171	922,933	292,450	55,916	34,083	1.64	.047
1975–76	391,454	925,746	311,771	62,649	34,064	1.84	.043
1976–77	406,377	919,549	317,164	64,359	33,232	1.94	.040
1977–78	412,246	921,204	311,620	66,581	32,131	2.07	.036
1978–79	402,702	921,390	301,079	68,848	32,730	2.10	.035
1979–80	400,910	929,417	298,081	70,131	32,615	2.15	.034
1980–81	416,377	935,140	295,739	71,956	32,958	2.18	.036
1981–82	434,515	952,998	295,546	72,032	32,707	2.20	.035
1982–83	456,441	969,510	289,921	73,136	32,775	2.23	.036
1983–84	452,416	974,309	284,268	74,407	33,209	2.24	.036
1984–85	454,712	979,477	286,251	75,063	32,943	2.28	.036
1985–86	446,047	987,823	288,567	73,910	33,653	2.20	.036
1986–87	437,137	991,339	289,557	72,750	34,120	2.13	.036

Source: U.S. Department of Education (1989, table 200).

[a]Not reported or not calculated.

occur during the latter period. While the production of doctorates remained roughly constant, the number of bachelor's degrees granted in the United States roughly doubled between the mid-1960s and the mid-1970s. As a result, the ratio of doctorates granted to bachelor's degrees granted six years earlier fell from .0064 in 1970–71 to .035 in 1978–79 and has remained roughly constant at the lower level since (col. 7). A much smaller proportion of college graduates are obtaining doctoral degrees now than 20 years ago.[7] Moreover, as will be shown in the next chapter, the proportion of doctorates awarded to foreign residents has increased substantially during the past two decades; thus, the proportion of American citizen college graduates receiving doctorates has actually continued to decline.

Part of the reason that this has occurred is that American college graduates have increasingly turned to other forms of postcollege study. In 1970–71, the ratio of first professional degrees (law, dentistry, medicine, and other professions) to doctoral degrees granted stood at 1.18 (col. 7); approximately the same number of first professional and doctoral degrees were awarded. However, by 1977–78, over twice as many first professional degrees as doctoral degrees were awarded, and this has continued in every year since. The ratio of master's degrees granted (col. 3), which includes MBAs, to doctoral degrees granted (col. 6) has also risen; this stood at 7.18 in 1970–71 but rose to 8.58 in 1974–75 and since then has remained close to or above that level. More college graduates are thus entering terminal master's programs (such as the MBAs) and/or starting study toward a doctoral degree but terminating at the master's level.

7. What is true in the aggregate is not necessarily true in every field. However, the scope of this study precludes detailed analyses by field. For a recent analysis of production of doctorates in the biomedical fields, see National Research Council (1990).