The Future Market for Ph.D.'s

The rate of increase of Ph.D. production raises policy issues for universities and government.

Dael Wolfle and Charles V. Kidd

From 1861, when Yale became the first American university to grant the Ph.D., through 1970, American universities awarded 340,000 doctor's degrees. Half of these degrees were awarded in the last 9 years of the period. If current projections of degree trends are borne out, another 340,000 (and probably more) will be awarded in the 1971–80 decade.

Projections of future utilization agree that the number of positions will also increase substantially during the 1970's, but not as rapidly as the number of degrees. Many new doctorates will enter nontraditional jobs and will do work that has not attracted many of their predecessors. Moreover, unless strong corrective actions are taken soon, new doctorates of the 1980's will face even bleaker prospects for jobs in the fields where they have traditionally been employed. For colleges and universities will make few new appointments during the 1980's but will be able to educate more doctoral candidates than can be effectively employed in positions which have thus far required this level of education. Few of them will be unemployed, but few will be employed in college and university teaching and research.

These are our qualitative conclusions from the projections described in the appendix (page 790), plus some additional and partly unpublished work. Behind the qualitative agreement there are substantial differences in the rates of increase projected, in the assumptions on which the projections were based, in the methods employed, and in some of the implications for national policy and university plans. To help bring about a better understanding of these differences, on 2 April the Association of American Universities brought together the persons responsible for most of the projections, some critics of their work, and representatives of a number of universities and higher education associations (*1*). What follows is our interpretation of the day's discussion and of the projections upon which the discussion was based.

Dr. Wolfle is professor of public affairs at the University of Washington, Seattle 98105. Dr. Kidd is executive secretary of the Association of American Universities, Washington, D.C. The views expressed in this article are not necessarily those of the Association of American Universities.

Doctoral Supply

All projections of the number of doctor's degrees considered here include the Ph.D., the Ed.D., the new Doctor of Arts degree, and possibly other new doctoral degrees, but they do not include the M.D., J.D., D.D.S., D.D., or other degrees conferred by professional schools.

That there is considerable variability in the projections is shown in Table 1. In 1970, 29,436 doctor's degrees were recorded by the National Research Council's Office of Scientific Personnel (*2*). Projections for 1980 range from 45,000 to 78,000. During the 10 years from 1961 to 1970, 182,000 doctorates were awarded. Projections for 1971 to 1980 range from 369,000 to 520,000 (Table 2).

In making such projections, the usual method is to analyze existing statistical trends and project these trends into the future. Often, but not always, the projected trends are adjusted to take account of some factors that are believed to influence students' decisions concerning pursuit of the doctorate and universities' decisions concerning their doctoral programs. Thus one can estimate the effects of changes in the nature and amount of financial support for graduate students, of changes in draft deferment policies, of changes in students' appraisal of market conditions, or of changes in other presumably influential factors.

The analyst must also decide what trends to use, and over what time period. Projections can be based upon the percentage of the age group that reaches the doctoral level, on the percentage of persons receiving bachelor's degrees who then go on to the doctorate, on the percentage of graduate students who attain the degree, or on other variables or combinations of variables.

The projections summarized in Table 1 differ primarily because they were based upon different trends, or trends over different past time periods, and because they took other factors into account in different ways. Details are or will be available in the original papers and need not be repeated here, but examples will indicate the nature of the differences. Haggstrom's (*3*) three projections are based on different assumptions concerning the effects of market conditions on graduate enrollment and degree completion rates. The Office of Education (*4*) projection is based on data from the past 11 years, while the National Science Foundation (*5*), believing that conditions are rapidly changing, uses only the last 6 years, and even within this shorter time span gives greater weight to experience of the most recent 3 years. In general, use of a short time base, as preferred in this case by the NSF, runs the danger of being unduly influenced by temporary fluctuations in order to take advantage of recent changes that are considered significant. The problem is to decide whether recent changes are really significant. One has to make a choice; different projectors chose differently.

Two other projections can be added to those summarized in Table 1. Mayhew, on the basis of the individual plans of a sample of universities, reported an expected 60,000 to 70,000 doctorates in 1980 (*6*). This level is consistent with the projections by Hall (*7*) and the Office of Education (*4*), and is intermediate between Haggstrom's projections A and B (*3*).

Froomkin (*8*) analyzed what he considered probable trends for several different classes of universities. Private universities, he thought, might freeze doctoral production at about present levels. Large public universities might increase their production during the 1970's at about the same rate private universities increased theirs during the 1960's. Smaller universities and those just starting doctoral programs ac-

counted for 22 percent of the total in the 1960–64 period and for 27 percent in 1965–69. In the 1970's they may, he decided, expand enough to account for 32 percent of the total. These assumptions lead to a 1970–79 total of 369,000, which is in good agreement with Cartter's total of 362,000 for the same period (*9*).

The projections fall into two groups. Haggstrom, Hall, and the Office of Education arrived at "high" projections by, in essence, assuming that trends of the past decade will continue through the next. Mayhew arrived at a comparably high projection by asking universities what they plan to do. Cartter, Froomkin, and the National Science Foundation do not believe the high growth rate of the 1960's can continue; they tempered their projections accordingly and arrived at lower figures. The Commission on Human Resources (*10*) had earlier made projections based on data up through 1965. For the 1966–70 period their projection of 112,000 doctoral degrees was close to the mark (about 4 percent low). For 1971–75, their projection is in the low group.

If universities and graduate students reacted rapidly and in market terms to the current tales of woe, even the low projections would probably be too high for the next several years. However, there is much inertia driving the system on. Many thousands of candidates are on their way to the doctorate; universities rely on graduate teaching and research assistants; universities are judged on the basis of their records as graduate institutions. Efforts are being made to encourage students from groups that have not been well represented in the past. Many veterans are entering or re-entering graduate schools. And underlying all of these factors is an inescapable demographic trend: the college population is getting larger. In 1965, 5 years before the 29,000 doctorates of 1970, 530,000 students received bachelor's degrees and became eligible to enter graduate school. In 1975, 5 years before the 45,000 to 78,000 doctorates projected for 1980, 959,000 bachelor's degrees are projected (*4*).

How soon and how sharply a shortage of positions will curtail the growth of graduate enrollment is not yet clear. The Council of Graduate Schools found graduate enrollment in 209 institutions to be 6.5 percent higher in the fall of 1970 than in the fall of 1969 (*11*). On the other hand, the NSF has reported that graduate enrollment in science and engineering in 227 doctorate granting institutions dropped 0.8 percent from 1969 to 1970 and that the number of full-time, first-year graduate students in those institutions declined almost 3 percent (*12*). The Engineers Joint Council found full-time enrollment of doctor's degree candidates in engineering to be 1 percent smaller in the fall of 1970 than in the fall of 1969, and part-time enrollment of doctor's degree candidates to be 17 percent smaller (*13*).

If the more cautious projections are right, we can expect some 350,000 to 400,000 doctor's degrees in the 1971–80 period. If the higher projections are more accurate, we will have to plan on approximately half a million. Of the total, between half (Office of Education) and 56 to 58 percent (NSF and Cartter) will be in science and engineering, including mathematics and the social sciences.

Table 1. Projections of numbers of doctor's degrees (in thousands). Some projections are for calendar years and some are for academic years; the distinction is not significant for this paper.

Year	Source of projection and reference							
	Haggstrom (*3*)			U.S. Office of Education (*4*)	Hall, National Research Council (*2*)	National Science Foundation (*5*)	Cartter (*9*)	Commission on Human Resources (*10*)
	A	B	C					
1971	32.7	32.0	31.9	31.3	30.9	31.4	30.7	29.1
1972	35.8	34.5	34.5	33.8	34.0	33.7	31.3	32.1
1973	38.6	36.9	36.9	37.9	37.1	35.9	32.3	35.5
1974	42.2	39.5	39.2	44.0	40.4	38.4	34.4	39.2
1975	46.6	42.5	41.5	46.6	44.1	39.1	36.0	43.0
1976	52.0	46.0	44.1	50.0	48.5	40.4	38.3	
1977	58.3	49.9	46.7	53.0	53.3	41.4	40.5	
1978	64.8	53.8	49.3	56.6	58.7	42.6	43.5	
1979	71.2	57.8	52.1	59.8	63.4	43.9	45.9	
1980	77.7	61.8	55.0	62.5	68.4	45.2	48.0	
1981	84.0	65.6	57.8				49.8	
1982	90.1	69.1	60.5				51.6	
1983	95.8	72.3	62.9				53.4	
1984	101.0	75.1	64.9				55.2	
1985	105.9	77.6	66.7				56.7	
1990	120.8	87.4	74.1					
1995	116.9	84.1	70.7					
2000	119.7	85.8	72.1					
1971–75	195.9	185.4	184.0	193.6	186.5	178.5	164.7	178.9
1976–80	324.0	269.3	247.2	281.9	292.3	213.5	216.2	
1981–85	476.8	359.7	312.8				266.7	

Utilization

There is no comprehensive projection of total utilization over the next decade, but four partial projections are available: The National Science Foundation (*5*) has projected utilization of scientists and engineers at the doctoral level; the Bureau of Labor Statistics (*14*), doctoral scientists and engineers in private industry; Cartter (*9*), faculty requirements; and Balderston and Radner (*15*), faculty requirements.

The NSF projection gives more detail concerning assumptions, methods, and prospective types of utilization than any of the others. For 1980, the NSF projects a total available supply of 315,000 to 336,000 doctorate scientists and engineers (including mathematicians and social scientists) and utilization of from 270,000 to 297,000. The gap of 42,000 between the midpoints of these ranges is greater than the NSF projected in 1969 (*16*). At that time, NSF projected for 1980 a supply of 352,000; basic or "minimal" utilization of 277,000 to 301,000; and possible utilization as high as 389,000. In general terms, the 1969 report projected reasonably good balance in 1980; the new report projects an oversupply of about 40,000.

The projected 1980 supply was obtained by starting with the 1969 supply, adding projections of the number of new doctorates and estimates of the number of immigrants, and then subtracting estimates of the number who will die, retire, emigrate, or leave the field.

In projecting both the academic and the nonacademic markets, it was assumed that the national economy would grow by 4.3 percent a year; that funds for research and development would continue between 2.7 and 3.0 percent of the gross national product; that re-

search and development costs per scientist will increase; that the percentage of newly hired industrial research and development personnel who hold the doctorate will be 10 to 20 percent higher than the doctorate to total ratio in 1969; and that non-research and non-academic employment of scientists and engineers with the doctorate will increase either at past rates or 25 percent more rapidly.

In recent years, approximately half of the new doctorates have gone to faculty teaching positions (*17*). The NSF assumed that during the 1970's the doctor's degree will be held by 95 percent of newly appointed faculty members at graduate institutions and by 62 percent of newly appointed faculty members at 4-year and 2-year colleges.

The Bureau of Labor Statistics (*14*) has projected 1980 requirements in private industry for 55,000 holders of the doctorate in engineering and the natural sciences, an increase of 54 percent over the 1968 employment of 35,800 in these categories. The percentage increase, which was based upon a questionnaire study among employers, agrees almost exactly with the NSF projections for private industry.

Cartter (*9*) has made the most detailed analysis of expected faculty needs for holders of the doctorate. Table 3 gives his projections, by 5-year intervals, of the number of doctor's degrees to be awarded, the number of new faculty members who should hold that degree to match increasing enrollment and to maintain the current percentage of doctorate holders in the nation's faculty, and the percentage of the new doctorates of each 5-year period who would be required for such faculty appointments.

Balderston and Radner (*15*), making separate projections for public and private universities, public and private 4-year colleges, and public and private junior colleges, found that the sum of these six projections agreed very closely with Cartter's projection of total faculty requirements. NSF projections for doctorate scientists and engineers in faculty appointments are also in good agreement with that segment of Cartter's projections, although it should be remembered that the NSF projections assume that the percentage of doctorate holders will be higher among new faculty members than among present ones, while Cartter's projections assume an unchanged ratio.

The agreement among these three studies indicates that the projected faculty requirements given in Table 3 can be taken as a reasonable base for estimating the future academic market for new doctorates.

Table 2. Projections of total doctor's degrees to be awarded, 1971–1980.

Source of projection	Number
Haggstrom (A)	520,000
Hall—NRC	479,000
Office of Education	476,000
Haggstrom (B)	455,000
Haggstrom (C)	431,000
NSF	392,000
Cartter	381,000
Froomkin	369,000

The Market in the 1970's

Some general conclusions are now clear.

Throughout the 1960's, 60 percent of the total output of new doctorates found their first postdoctoral positions in institutions of higher education and an additional 12 to 14 percent received postdoctoral fellowships, usually at universities (*17*). Both groups included some full-time research appointments; the faculty group included a few administrators; but teaching was the primary occupation. The rule of thumb in recent years has been that half of the new doctorates become college or university teachers.

If the supply projections by Cartter, Froomkin, and the NSF are reasonably accurate, only about a quarter of the new doctorates of the 1970's will be needed as college and university teachers. If the higher supply projections by Haggstrom, Hall, and the Office of Education are more realistic, a smaller fraction will be needed for such positions. Colleges and universities may not be able to hire even this many if financial difficulties require an increase in student-faculty ratios. Or, they could hire more if they decide to enrich their faculties, or if they continue to increase the number of postdoctoral appointments and make compensating reductions in the number of graduate teaching assistants. If, on the basis of such assumptions, one estimates that Cartter's projections of the requirement for new college and university teachers is 25 percent low and that there will be faculty positions for 115,000 new doctorates instead of Cartter's 92,000, still, only 38 percent of the 1970–74 doctorates and only 27 percent of those of 1975–79 would find academic positions. No reasonable change of assumptions predicts that the rule of thumb—50 percent of new doctorates become college and university teachers—will hold during the 1970's.

Of those who enter non-academic work, a smaller percentage than in the past can expect research and development to be their primary activity. In 1969, 76 percent of the doctoral scientists and engineers in non-academic positions were engaged in research and development, and 24 percent in other types of work (*5*). The NSF projections indicate that during the 1970's only half of the new doctorates who accept non-academic positions will be engaged in research and development.

No one is projecting large numbers of unemployed doctorates; they are too able and too well educated for that fate. But many will have to find positions as practitioners of science and engineering in post-R & D industrial activities, administration, secondary schools, commerce, government, and other non-research activities.

This conclusion must be emphasized. The several projections differ in detail, but all agree that many of the new doctorates of the 1970's cannot be employed in the traditional and preferred positions of college and university teaching and research or in research and development positions in industry or government. They will have to find other types of positions.

Growth in Selected Areas

The NSF projections for supply and utilization were developed separately for five broad areas. The match between supply and utilization is projected to be quite close in the physical sciences, the life sciences, and mathematics, although not necessarily within each specific field within those broad categories. In the social sciences there is projected to be a significant oversupply, defined as a situation in which a substantial portion of the doctorates will be employed in jobs not making reasonably full use of their training. In engineering, an even larger oversupply of doctorates is projected, perhaps more than a third of the supply.

In research and development, in engineering, and in parts of the educational system, employers have some choice between applicants with doctor's degrees and applicants with bachelor's

or master's degrees. The doctoral projections can therefore be compared with the Bureau of Labor Statistics (*18*) projection of employment prospects in a number of fields that are normally entered by college graduates.

The Bureau of Labor Statistics expects a reasonably good balance for college graduates as a whole but anticipates imbalances in some fields. They expect an excess supply of school teachers, mathematicians, and life scientists, and shortages of chemists, counselors, dietitians, dentists, and physicians. These projections are based on an elaborate and detailed analysis involving an econometric model of the United States, input-output tables of the American economy, and analyses of trends in the occupational distribution of college graduates.

At the bachelor's level there is enough transferability of skills and flexibility of requirements that normal adjustment mechanisms can be expected to sort new graduates into available jobs. Nevertheless, there will be some significant differences from the market of the 1960's. Technical industry may not expand as it did during the period of rapid growth of aerospace activities, computers, and other new technologies. The service sector will absorb a relatively larger fraction of graduates, but the decline in school enrollment that has already started will mean that school teaching will absorb a far smaller fraction of the college graduates of the 1970's than of the 1960's.

The annual number of doctorates is only about 4 percent as large as the number of bachelor's degrees (although larger in some fields, for example, physics). Any overflow from the market for doctorates that competes with college graduates, or with persons who hold the master's degree, will be too tiny a fraction to have much effect on the market for college graduates. Nevertheless, doctoral competitors in a number of cases would be entering areas in which there is an adequate supply or even an oversupply of college graduates. The doctoral applicants may get the jobs, but at lower salaries than they would like, and at the social cost of bumping suitable candidates with less formal education.

A simple comparison of past and present projected growth rates can be made by comparing the ratio of 1970 to 1960 doctorates with the ratio of projected 1980 to 1970 doctorates. From 1960 to 1970 the annual number of doctorates awarded in the natural sciences tripled; so did the number in the social sciences and humanities. From 1970 to 1980, the Office of Education (*4*) projects the annual number in the natural sciences to go up by 2.3 times, while the number in the social sciences and humanities is projected to double. For representative individual fields, the factors of increase experienced in the 1960's and projected for the 1970's were 4.5 and 2.9 for mathematics and statistics; 2.8 and 2.1 for biological sciences; 3.3 and 2.2 for English and journalism; and 3.7 and 2.6 for foreign languages. In general, the Office of Education projections show almost as rapid increases in fields such as English and foreign languages in which the market is almost wholly academic as in fields such as engineering and biology in which there is a large non-academic market. Cartter (*9*) and the NSF (*5*) project smaller increases from 1970 to 1980 than does the Office of Education, but both expect the increase in the non-science fields to be relatively as great as in the sciences. If these expectations are realized, the percentage of new doctorates in the humanities who will have to find new kinds of positions will be greater than the comparable percentages in the sciences.

Table 3. Doctor's degrees, new college and university teachers needed to maintain quality of faculty, and percentages of doctorates needed for such faculty appointments (from Allan M. Cartter).

Period	Projected doctor's degrees	New teachers with doctorate required	Column 3 as percentage of column 2
1960–64	59,300	33,900	57%
1965–69	103,600	41,500	40%
1970–74	157,600	47,700	30%
1975–79	204,100	44,200	22%
1980–84	258,000	27,100	11%
1985–89	?	— 400	0%

Doctorates in education (Ph.D. or Ed.D.) may become special victims of changing demographic trends. The baby boom that began swelling elementary school enrollment early in the 1950's has moved up through elementary and secondary grades and into colleges and universities where enrollment will continue to increase until about 1982. In the mid-1960's the annual number of births began to drop. As a result of these trends, enrollment at all levels from kindergarten through the university increased by 30 percent between 1960 and 1969 (from 46 million to 59 million), but it is projected to rise by only 5 percent (from 60 million to 63 million) between 1970 and 1979 (*4*). At the elementary and secondary levels, enrollment increased by 13 percent between 1960 and 1969, and it will fall by 6 percent in the 1970–79 decade. Against this history and prospect, more doctoral degrees in education were granted during the past 6 years (about 27,000 from 1966 through 1971) than were granted over the preceding 15 years (about 24,000 between 1950 and 1965) (*19*), and the number projected for the 1971–80 period is 80,000 (*4*). Doctorates in education serve as teachers or administrators at all educational levels. During the 1970's they will face a thin market. School enrollment will be dropping. Consequently, colleges of education will not need to expand. What kinds of jobs will new doctorates in education find if output continues to rise under these conditions? Will they bump holders of master's degrees?

The Market in the 1980's

The decline in enrollment that has already started in the elementary grades will move progressively through secondary schools and colleges. Projections of college enrollment usually assume that the percentage of high school graduates who enter college will climb further, but that level is already so high that a limit is being approached. In the future, changes in the size of the age group, rather than changes in the percentage of the age group that enters college, will therefore be the primary factor determining college enrollment.

Cartter and Haggstrom both project college and university enrollment (full-time equivalent) to increase to about 10 million in 1982, to decline until 1988, and then to begin to rise again. The size of the increase in the 1990's will depend on future birth rates, on attendance patterns, and on possible structural changes in higher education. However, the trough that is now mov-

ing through the elementary grades will be followed by a new wave that has already begun to appear in birth statistics—the first echo of the post-war baby boom. Close to the end of the century, college and university enrollment will probably climb back up to approximately the level of the projected 1982 high.

Using these basic demographic trends, Brode (*20*) has projected market prospects to the year 2005 for persons with the bachelor's degree in the natural sciences and engineering. He points out that since 1960 the annual number of college graduates in the natural sciences and engineering has remained very close to 3.8 percent of the number attaining age 22 in each year. This level he considers to be a natural ceiling set by the intellectual requirements of effective work in these fields. Thus, by taking 3.8 percent of each successive group of 22 year olds, Brode projects future supply. He assumes that requirements will increase linearly, in direct proportion to the total population, which is increasing at about 1.3 percent a year. Comparing a linearly increasing requirement with a new supply consisting of 3.8 percent of the persons reaching age 22 each year shows a surplus of bachelor's level scientists and engineers lasting from 1968 to 1986, followed by a shortage lasting from 1987 to 2005.

The basic and inescapable demographic trends, as Cartter has pointed out, indicate that new faculty positions will be few during the 1980's. With falling enrollment, there will be no need for faculty expansion, and it is even likely that some vacancies created by retirement or death will not have to be filled until enrollment begins to go up again in the 1990's.

Going beyond the academic sphere, Froomkin (*8*) has made some first approximation calculations of total requirements for persons with the doctorate in 1990. Projections of GNP, percentage of GNP devoted to research and development, and cost of research provided him a means of estimating the number required for research and development. He added these projections to Cartter's projections of faculty requirements and assumed that the number of doctorates needed in other types of work would represent the same proportion of the total number on faculties and in research and development as predicted for the 1970's. Then, just to be safe, he doubled some of the more uncertain figures. These calculations led to the disturbing conclusion that the number of doctorates needed to be added to the nation's stock during the 1980's would be less than half of the number that are expected to be added during the 1970's.

Of course, there are large margins of error in such a calculation, but there is also a strong warning of danger. In the past 5 years, graduate schools have been turning out 20,000 to 30,000 doctorates a year, mostly for academic or research and development positions. By 1980 they are threatening to produce 50,000 a year or maybe more. In the 1980's, when academic requirements will be largely dried up, what will the new doctorates do? For what will they be educated?

Reliability of the Projections

Before turning to the policy implications of the projections, an assessment of their reliability is called for. Many factors could cause them to be wrong. Will large numbers of graduate students become discouraged and drop their plans for the doctorate, as they see the market for Ph.D.'s growing progressively weaker, or will they press on, perhaps even in larger numbers, hoping that higher qualifications will enhance their chances in an unfavorable market? Will the federal government take some far-reaching measures that will drastically change the number and pattern of job opportunities? What major structural changes in higher education will take place, and what will be their effects? Will more people from government, business, and labor backgrounds be recruited for faculty appointments? Will junior colleges grow at a relatively faster or relatively slower pace than in the past, and will their standards change so that they offer employment to more candidates with the doctorate? Will colleges and universities adopt the Carnegie Commission on Higher Education's proposals (*21*) that the time required to earn the bachelor's degree and some of the professional degrees be reduced, or the proposals that there be more options of intermediate degrees, part-time adult programs, and easier movement out of and later back into the university, perhaps several times during a career? If these proposals are adopted, how will they affect faculty requirements?

We incline to the view that the net effect of all these prospective changes will not alter the basic picture portrayed by the projections—an output of more doctorates than can be absorbed by the traditional sources of demand. Some of the forces will offset each other. Some will not be significant market influences.

Take, for example, the possibility that sharp changes in the attitudes and aspirations of students will result in a leveling off or even a reduction in the total number who seek doctoral degrees, thus providing a painless cut in the supply of doctorates. This outcome seems unlikely, despite the force and persistence of the disenchanted attitude of a substantial portion of undergraduate students toward higher education. The credential provided by a doctor's degree will probably be sought by a growing number of students as a job ticket, particularly when good positions are scarce. And even if the percentage of college graduates seeking the doctorate does decline, it must be remembered that the annual number of new graduates will continue to increase until about 1985. In 1970, about 750,000 bachelor's degrees were awarded. In 1980 the projected number is approximately 1,100,000.

Anyone making manpower projections knows that some of his assumptions will turn out to be in error. It is therefore necessary to determine how sensitive the projections are to reasonable changes in the assumptions. For example, if the gross national product does not grow as rapidly as expected, if the percentage of GNP devoted to research and development falls below 2.7, or if the costs of research go up more rapidly than anticipated, there will be fewer industrial research and development positions than the NSF projected.

The NSF projections provide the best examples of sensitivity testing because the assumptions involved and the rationale for each are stated explicitly, and because the effect of a small change in each assumption was computed. For example, a change of 1 percentage point in the number of doctorates employed in non-academic and non-R & D positions changes the 1980 utilization total by 2700, while a change of 1 percent in the number of post-doctoral positions alters the utilization total by only 60.

Sensitivity testing is, of course, necessary for other projections. For example, Balderston and Radner's work (*15*) was, to a considerable extent, a test of the sensitivity of Cartter's projec-

tions (*9*) of faculty employment to changes in some of the underlying assumptions. History will surely reveal that some of the assumptions in some of the projections were wrong, but most of the projections have been made with a good deal of attention to that danger.

All in all, it seems to us that the most prudent course is to take the forecasts seriously and to use them as guides to action. After all, the forecasts are broadly consistent in indicating that there will be problems in adjusting supply and demand. The differences lie in the severity of the problem. Accordingly, action should be temperate and considered because we do not know which projections will come closest to predicting the true situation. In this connection, both the federal and state governments, hard pressed financially and seeking ways of saving money, may overreact and cut support for graduate education below the level required to sustain the enterprise at a reasonable level for the long run, and the cuts may be indiscriminate and uncoordinated. We believe that this has in fact happened, and that a more deliberate adjustment is called for.

Better Information and Analysis Needed

Those who will make the relevant policy decisions at different levels—federal agencies, congressmen, state officials, university and college presidents, deans and department heads—can make wiser decisions if their information is better. Accordingly, it is imperative that studies of the prospective supply-demand situation be repeated periodically with improved techniques. Every major professional association should review the situation in its field so that those in the field are well informed. Federal agencies and independent students should continue to redo and refine their forecasts. Periodic revision is necessary to correct errors and to take account of new information. Improvement of forecasting techniques should lead to better coordination among the institutions and agencies that are responsible for higher education and for manpower policy and planning.

Graduate students should be given the clearest possible view of what lies ahead, in the long run as well as in the immediate future. They know the difficulties encountered by the doctorates of last year and this year. They know the kinds of positions traditionally prized. Most of them have adopted the professional values of the graduate departments in which they have been working. Some of them are going to be disappointed, but it is also true that for the next few years most of them will find academic or research positions. All of the projections agree that the number of these positions is still increasing. Whatever the future holds for an individual, he should have as full information as can be provided. Faculty members and department heads have a particularly important responsibility to offer considered advice on the job market. Over the longer run, as the proportion of Ph.D.'s who can be absorbed in university research and teaching drops, there must be a change in the values and aspirations which are taught informally; careers other than research and teaching in universities should be recognized as worthy and rewarding.

The implications of forecasts should be reanalyzed from both general and specialized points of view because the most important consequences of forecasts are the judgments and actions which they affect. Unless the implications of forecasts are reanalyzed at frequent intervals, actions will be taken on the basis of out-of-date assessments.

Implications of a Buyer's Market

A continuing buyer's market will bring shifts in the bargaining power of the buyers—all employers of advanced degree holders—and the sellers —degree holders seeking jobs on the best terms they can get. It is clear that there will be a buyer's market for some time into the future; the question is how favorable the position of the buyers will be.

The terms and conditions of employment of new doctorates will tend to be less favorable than they were when there were more research and teaching jobs than candidates to fill them. Some new doctorates may compete with graduate students for teaching and research assistantships. Postdoctoral stipends may be lower, and universities will be less able to finance postdoctoral appointments as a cushion against an unfavorable job market. Many new doctorates will spend more time teaching undergraduates and less on research than they would prefer. Promotions and rates of salary increase will be slower than they were during the 1960's, and these changes will affect all doctorates, not only the new ones. Tenure rules and retirement plans may be modified in order to spread the burdens of imbalance more equitably among younger and older doctorates. Finally, there will be less mobility than during the past two decades. A prolonged buyer's market will thus generate strains among the sellers as well as between buyers and sellers.

In this situation, sellers will undertake to protect their interests by banding together—either in internal groups or in external groups such as the American Association of University Professors or the American Federation of Teachers —to counter the adverse effects on them of the operation of a free market (*22*). Faculty unionization and other forms of collective protective action will be more widespread as a consequence of the labor market situation. The interests of academics with jobs may be protected through organization and collective bargaining by reducing further the opportunities of those without jobs and by exerting group pressures against the adjustments that a free market would produce. As a group, it will be in the interests of professors to restrict the entrance to the trade by reducing the number of doctoral candidates, but conflicting pressures to expand will exist. All in all, those with jobs may be on a collision course both with their employers and with job seekers, but the impact on the latter, particularly in science and engineering, will be softened somewhat by the existence of non-academic job opportunities.

A prolonged buyer's market may also lead to an extension of the kind of credentialism that now requires a bachelor's or master's degree for entrance to some positions for which the accompanying education is not truly requisite. Similarly, a doctoral degree may be required for some jobs that persons with bachelor's or master's degrees could fill adequately.

Just how extensive such changes will be depends on the degree of mismatch between demand and supply, but the trend of developments seems clear. Policy adjustments will be required not only to deal with the output of doctorates and the number of jobs available for them, but also to take account of the many secondary and tertiary effects of a market imbalance. Further thought and writing on the potential implications of a continuing buyer's

market for doctorates is badly needed, because the adjustment to a long-run buyer's market after a 30-year seller's market will not be easy.

Increasing Demand

Any effort at generating a better supply-demand balance which ignored the possibility of increasing the utilization of doctorates would be negative and shortsighted.

The number of new jobs available could be increased by earlier retirement. The potential significance of early retirement is clear: 14 percent of the doctoral scientists in the 1968 National Register of Scientific and Technical Personnel were 55 or older. If retirement age were gradually lowered from 65 or 68 to 60, or 58, or if necessary even to 55, several thousand additional positions would become available each year. Opportunities for younger doctorates would thus be improved. Earlier retirement would lower the average age of faculties; it would be a disaster if there should be as little infusion of young talent into college and university faculties in the 1980's as is indicated in Table 3.

The burden of early retirement would be especally heavy on those who would receive reduced annuities. Avoidance of severe inequities to this group would require extensive changes in retirement funding. Accordingly, a thorough study of the financial and other aspects of early retirement is needed. By how much would contributions have to be increased to provide reasonable annuities with shorter service? What are the potentialities of post-retirement, nonacademic jobs? Could state retirement plans be adjusted?

Changes in tenure rules are another potential means of adjusting to the supply-demand situation. If prevailing tenure rules are not modified, older faculty members will tend to be fully protected and younger teachers will tend to be frozen out. Cartter has suggested an intermediate arrangement of, perhaps, 3-year moving tenure, with a permanent commitment made by the end of 12 years (*9*). Changes in tenure rules and early retirement offer means of distributing the burden of adjustment among younger and older age groups. However, there are few signs that tenure and retirement practices will be changed extensively in the foreseeable future. More searching analyses of both problems under proper auspices are urgently needed.

There is much desirable work to be done on the major social, health, and environmental problems that beset mankind. Some efforts are being directed toward each of these problems, but major successes are likely to come only from sustained, long-range, carefully planned programs. Lecht (*23*) has projected the manpower requirements for large-scale efforts on each of a number of possible national goals. Cost, public values, national priorities, and probabilities of success would all have to be considered, but surely it would be better to try to use abundant intellectual re-

Appendix: Coverage, Major Assumptions,

Wallace R. Brode (*20*)

Coverage: Scientists and engineers with bachelor's or graduate degrees.

Major Assumptions: The requirement for scientists and engineers is approximately a fixed percentage of the total population. The annual new supply will be approximately 3.8 percent of the number of persons reaching age 22, for this percentage represents a ceiling on the number qualified to earn degrees in science and engineering.

Conclusion: There will be an annual surplus of scientists and engineers until 1986, and a deficit from 1986 to 2005. The 1968–1986 surplus will about equal the 1987–2005 deficit.

Bureau of Labor Statistics (*14*)

Coverage: Ph.D. scientists and engineers in private industry.

Major Assumptions: Future needs can be estimated by major employers.

Conclusions: Requirements will increase 53.5 percent from 1968 to 1980, from 35,800 to 55,000.

Bureau of Labor Statistics (*18*)

Coverage: Major professional fields in which a baccalaureate or advanced degree is required or expected.

Major Assumptions: Projected requirements are derived from an input-output model of the national economy, assuming full employment; continuation of existing economic, social, scientific, and technical trends; a reduction in defense spending; and reduction of armed forces to the pre-Vietnam level. Projected supplies are based on U.S. Office of Education projections of new college graduates and on continuation of past experience concerning labor force entrance of new graduates, attrition, re-entry, and so forth.

Conclusions: The supply in 1980 is projected to be significantly below requirements for chemists, counselors, dietitians, dentists, physicians, and physicists; in reasonably good balance for engineers, geologists and geophysicists, optometrists, architects, lawyers, and pharmacists; and significantly above requirements for mathematicians, life scientists, and school teachers.

Allan M. Cartter (*9*)

Coverage: Doctor's degrees through 1985; new faculty members required through 1990; and relation of supply to faculty requirements in the sciences through 1985.

Major Assumptions: Requirements for faculty are based on estimated college enrollment, which is based on known and projected birthrates and an assumed increase of 1 percentage point a year in the 18-year-olds graduating from high school and the percentage of high school graduates entering degree-credit college courses. Supply of new doctorates will be somewhat smaller than projected by the extrapolation of past trends, for changes in draft

sources as effectively as we can in the achievement of high-priority national goals.

However, all sources of increased demand combined will not generate jobs in the traditional areas of employment fast enough to absorb all of the new doctorates. There is little prospect that such jobs will expand at the rate of 7 percent a year, the rate at which NSF projects the total stock of science doctorates to increase during the 1970's. (*5*). Even under the most optimistic assumptions, supply is destined to outrun demand in the fields traditionally occupied by doctorates. Part of the adjustment must come about through employment in new and unaccustomed areas—academic and non-academic.

The number of new kinds of jobs will depend largely on the rate of growth of the economy and on the areas in which growth is most rapid. As the economy grows and changes, and as national priorities shift, a decade or more hence there will be much use for persons who have academic training well beyond the master's level. Persons with such training, reasonably well adapted to actual job requirements, will have much to offer in a complex society and economy.

The implications for the content of graduate education over the next decade have not been fully considered. Certainly, the traditional discipline-and-research-oriented Ph.D. is not the sole means of preparing people for new roles. Graduate education, which has thus far not been much shaken by the current agitation over the goals and methods of higher education, may face a period of stressful readjustment as the labor market forces a re-examination of what graduate education is for.

Restraining Expansion

A policy of deliberate restraint on the production of doctorates runs counter to many widely accepted values. The doctrine that over the long run society and the economy can productively absorb all of the highly trained people who can be produced is rather deeply ingrained. This view should temper drastic efforts to cut production to fit anticipated demand, if only because demand can be underestimated. However, the doctrine of infinite absorptive capacity certainly does not justify a careless and highly expensive laissez-faire approach to the number of doctorates produced. Absorptive capacity is flexible, but it does not provide a rationale for unlimited expansion, particularly when society rather than the individuals bears most of the cost.

There is also the notion that any qualified person who wants to pursue a course of study leading to a doctoral degree should be able to do so. The expansion of doctoral-level training in recent decades has without doubt been in substantial part the result of a willingness and desire to give the customers what they want. Looking to the future, however, we see little merit in the argument that society should finance doc-

and Conclusions of Selected Projections

deferment policies and the probable reaction of students to a declining job market must be taken into account.

Conclusion: "Even if all junior colleges were converted to 4-year colleges, every high school graduate went to college, and every new college teacher hired in the future possessed the Ph.D., by 1980 a smaller percentage of doctoral degree recipients would be likely to find academic positions than has been true for the preceding 25 years."

Gus W. Haggstrom (*3*)

Coverage: Graduate enrollment and degrees from 1955 to 2000.

Major Assumptions: Three alternative sets of assumptions concerning percentage of bachelor's degree recipients who enter graduate school, retention rates within graduate school, and percentage of graduate students who earn the doctorate. Considers effects of the draft, GI bills, federal support, and immigration. Differences among the three projections result primarily from differing assumptions about the effects of the deteriorating job market for doctorates upon graduate school entrance and completion rates. Projection C, the lowest, assumes these rates will remain at current levels.

Conclusions: Three series of projections of graduate enrollment and numbers of degrees by level and sex for each year through 1980 and at 5-year intervals from 1985 through 2000.

U.S. Office of Education (*4*)

Coverage: Projected number of doctor's degrees, by sex and major field, through 1979–80.

Major Assumptions: Continuation for the next 10 years of the ratio of doctor's degrees to earlier college graduates that has obtained since 1960.

Conclusions: Projections of earned degrees by sex and level, and, for doctor's degrees, by major field, to 1979–80.

National Science Foundation (*5*)

Coverage: Supply and utilization of science and engineering doctorates from 1969 to 1980.

Major Assumptions: Projected requirements based upon explicit assumptions concerning rates of increase of gross national product, funds for research and development, employment requirements in academic and non-academic positions, and assumed increases in percentage of new entrants to each category who will hold the doctor's degree. Projected supply based on trends for the past 6 years, with heavier weighting on the past 3 years.

Conclusions: In the physical sciences, life sciences, and mathematics, supply and requirements will be in approximate balance in 1980. In engineering and in social sciences the projected supply in 1980 will significantly exceed the projected utilization. The percentage employed in positions other than research and development or on university faculties will be substantially larger than at present.

toral-level training for everyone with the necessary ability. (At any given level of support, we take for granted the policy that ability alone should govern access to graduate education.) The demand for the product should be a major determinant of decisions, and we see the prospective market as justifying some restraint on the output of doctorates. The debatable issues relate to such matters as which institutions should be restrained, how much restraint should be imposed, and the mechanisms of restraint.

Any effort to adjust the size of graduate programs to national needs will depend heavily upon the 60 to 70 universities that now produce 70 to 80 percent of all doctoral degrees (*24*). What those universities do to increase, hold constant, or decrease the number of graduate students and the number of degrees will be of particular significance.

Some of the best departments have already reduced the number of graduate students, to sustain the quality of teaching as well as to respond to the labor market situation. In contrast, many faculty members in other institutions aspire to expand doctoral programs or to start new ones.

The decisions of departments as to how many doctorates they will produce or how many they will hire are strongly influenced, and to a substantial degree determined, by external forces (such as state and federal budgets) and by the independent decisions of individual faculty members and department heads. Accordingly, an effective policy of restraint would require a greater degree of consensus and of central authority than now exists on many campuses.

There must be some incentives for faculty, departments, and schools to limit rather than to increase their doctoral production. Financial or other incentives might be provided for those who take such measures as limiting the number of graduate students admitted or eliminating weak and inefficient graduate programs. A detailed examination of possible incentives to limit doctoral output is needed, with an analysis of the financial structure of graduate education, and the financial implications of various methods of reducing size. For example, if fewer students are admitted to departments that have a low ratio between graduate enrollment and faculty, the program will cost more per student. Even elimination of a whole graduate program will not reduce costs much if the undergraduate load requires continuation of the existing faculty. In short, the educational goals, financing methods, and prestige factors in semiautonomous university departments that give a powerful impetus to the development and expansion of graduate programs must be changed. An intensive study of means of bringing about such changes would be worthwhile.

Professional societies have been very influential in promoting the growth of graduate education and in controlling the prestige system which has such an important effect on the growth rate of graduate enrollment. Medicine is an excellent example of a situation where the professional organizations (the American Medical Association and the Association of American Medical Colleges) have promoted quality without expansion, and where great efforts have been necessary to get any expansion. This example suggests that the values of the professional societies might be changed so as to limit graduate growth, rather than promote its expansion.

The federal government is already trying to exert a downward pressure on the output of doctorates by reducing support for graduate students. Since the peak year of 1968 there has been about a 40 percent drop, from 57,600 to 36,000 in the number of federally supported predoctoral fellows and trainees, as well as a drop in funds for these programs from $287 to $182 million. A sound course of action for the next few years would be to hold constant at the 1970 level of about 40,000 awards and $200 million to finance them (*25*). This policy of stability would forestall the disruptive effects of the abolition of federal support for predoctoral students. However, overall stability would leave unresolved many important questions relating to support by field, the distribution of fellowship support by type of institution, and the form of support. In addition, the current negative federal policy toward graduate education—reduction of federal support of fellowships and training activities—has the undesirable effect of cutting back more at the best universities, where there has been more federal support in the past. While fewer than 10 percent of all graduate students receive federal fellowship support, this assistance is relatively much more important in science and in the better institutions. There is urgent need for a federal policy directed toward maintenance of the strength of the best departments in each field of study, because during the 1970's and 1980's quality should not be sacrificed as a cost of restraining the expansion of doctorate programs.

States can and should restrain the establishment of new doctoral programs and the expansion of existing ones (*26*). Such restraint will not have much impact on total degree output before 1980, but in the 1980–1990 period it could be significant. The 25 "New" institutions in the 1969 ratings of the American Council on Education that were not rated in 1964 awarded only 3.6 percent of the doctorates during the past decade, and some projections indicate that less than 5 percent of the doctorates to be awarded in the 1970's will come from institutions not included in the 1969 ACE ratings of graduate programs (*27*). Even in 1980 more than a third of all doctoral degrees are likely to come from about 25 of the largest universities. If state policy is to affect the major sources of increased graduates, it must influence doctoral programs in existing institutions as well as restrain the development of new doctoral programs.

Only a little more than half of the 60 top universities in the country are public, and state action will have little effect on the others. Moreover, not all states have coordinating or governing boards with enough authority to limit the development of new institutions. Even in states which do have this authority, most public universities have resisted state efforts to plan their graduate programs. This is a thorny political problem. Ideally, state constraints on the creation of new doctorate programs and on the output of existing programs are clearly indicated, but in the real world such constraints are sometimes not applied wisely or objectively. A more detailed analysis is needed of (i) possible effects of increased state control of development of new doctoral programs; (ii) greater state control of funds for graduate education; and (iii) interaction of state planning with institutional planning in the graduate field.

In summary, federal policies and university decisions are restraining the growth of some of the best existing graduate departments at the same time that many states are unable to restrain the establishment of new graduate programs. Moreover, it seems unlikely that many department heads who aspire to establish new doctoral programs will decide on their own not to do so

simply because the total future academic market will be soft. Accordingly, it seems probable that a substantial number of new doctoral programs will be set up in the next few years. It is unlikely that the net result will be in the best national interest; the universities that are most eager to expand are not the ones that are best prepared to offer doctoral programs of high quality.

Universities can change the nature of the training to provide a better qualitative match between supply and demand. In this connection, much attention is being given to the Doctor of Arts degree, which may prove to be better than the Ph.D. as a way to train people for college teaching. However, the D.A. is not promising as a means of increasing the number of available teaching jobs. A marked expansion of production of D.A.'s might simply result in the underemployment of D.A.'s rather than underemployment of Ph.D.'s. The question of how best to prepare doctorate-level students for non-research and non-academic positions—through the D.A. or through practitioner's degrees—should receive greater attention.

Collective Action

While universities ought to maintain much individuality, and while freedom of scholarly effort is a value to be preserved, some problems are too big to be handled by universities acting independently. Controlling the flow—which need not mean dropping below present levels but which would probably mean both slowing the rate of growth and reorienting some of the educational programs—would require collective action. Complete freedom of choice by each university and each college that wishes to become a university would mean that the sum of individually defined interests would add up to a national disservice. A proportionate reduction over all universities would not be the wisest procedure. Yet collective controls which grant continued opportunities for graduate education to the already well-established universities and deny that opportunity to institutions that have high aspirations but not yet reputations or facilities will inevitably create interinstitutional tensions. Somehow, within this difficult situation, efforts should be made to agree upon the desirable flow of new doctorates and upon the universities that can best prepare them. Because large amounts of federal funds will be involved, the federal government should be a partner in the planning. But the universities had better also try to be partners. There will be more shocks in the market place and much lively debate before controlling mechanisms are adopted, but we think it essential that universities move toward a state in which their graduate offerings are conducted within the guidelines of a national pattern.

Conclusion

Even if agreement on "Solutions" is reached, the processes of adjustment will be difficult. More stringent admission standards, quotas, reduced financial support, incentives, or other means of controlling the number of doctorates will challenge established values, frustrate many students and many professors, exacerbate tensions among established and emerging institutions, aggravate the uneasy relationships between universities and government, complicate faculty-administration problems, and accentuate differences between older and younger faculty members. Some academicians will no doubt be inclined to the view that difficulties in the job market for young doctorates created by a laissez-faire approach are moderate compared with the difficulties that will be generated by efforts to adjust supply and demand. We are of the opinion that these problems must be faced, and that the long-range imbalance, inequities, and strains arising from ignoring the problem will far outweigh the stresses generated by efforts to cope with it.

References and Notes

1. The conference was supported by a grant from the Carnegie Corporation of New York. Participants included representatives of a number of universities and higher education associations and the following persons who have recently been engaged in the analysis and projection of trends at the doctoral level: Frederick Balderston (University of California at Berkeley), Robert Cain (National Science Foundation), Allan M. Cartter (New York University), Charles Falk (National Science Foundation), Martin Frankel (U.S. Office of Education), John K. Folger (Tennessee Higher Education Commission), Joseph Froomkin (Semat, Helliesen and Eichner, Inc.), Lee Grodzins (Massachusetts Institute of Technology), Gus W. Haggstrom (University of California at Berkeley), Robert McGinnis (Cornell University), and Neal Rosenthal (U.S. Department of Labor).
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