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Chapter Title: The Demographic Distribution of American Doctorates

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# 9 The Demographic Distribution of American Doctorates

## 9.1 Faculty Age Structure, Productivity, and Retirement

The supply of academics depends not only on the supply of new doctorates and the sector of employment choices of new and experienced doctorates but also on the age structure of faculty and their retirement behavior. As Table 7.10 indicates, the percentage of doctoral scientists, social scientists, and engineers employed by academic institutions who were age 60 and older rose from 6.9 in 1977 to 11.6 in 1987. A similar increase, in the share of academic doctorates age 45–60 also occurred.[1] As such, the proportion of faculty who are nearing retirement will remain high over the next 20 years. High levels of faculty retirements, which lead to high levels of replacement demand for faculty, contribute to projections of faculty shortages.[2]

Of course, as of 1994, faculty will no longer be subject to mandatory retirement at age 70. If an appreciable number of older faculty can be induced to stay on beyond age 70, would this substantially reduce projected shortages? Is it likely that a substantial number could be induced to stay on? Finally, is it the case that, after some age, on average, teaching and research productivity of faculty begin to decline so that, rather than trying to induce older faculty to remain, universities might more profitably think about ways to "encourage" them to retire?

Bowen and Sosa (1989, chap. 8) have answered the first question, at least for faculty in the arts and sciences. They show that, if the expected retirement rate of faculty in the 65–69 age range could have been cut in half as of 1987, the effect in their projection model would have been to reduce the replacement

1. Changes in the age distribution of doctorate humanists, the vast majority of whom are academics, are quite similar (National Research Council 1989b, 1986, 1982, 1978).

2. As noted in Chapter 6, Bowen and Sosa (1989) have emphasized that the primary cause of projected faculty shortages is the increased demand for new faculty, not the increased replacement demand caused by increased retirements.

demand for faculty by 8 percent during the period 1987–92. This reduction would be equivalent to a 6.5 percent increase in the supply of new doctorates, and, while in itself such an increase would only partially close the shortage they project, it would be a step in the right direction.

Unfortunately, the net effect of delayed retirements on the replacement demand for faculty projected in their model would be much smaller in subsequent five-year periods, as the reduced retirements from the 65–69 age group in each of these periods would be partially offset by an increased number of faculty ages 70 and older who would retire during each period. Indeed, they project that, over the period 1997–2012, the net effect of halving the retirement rates of faculty in the 65–69 age range would be equivalent to only about a 2 percent reduction in the replacement demand for faculty.

With respect to the second question, several recent studies suggest that the uncapping of mandatory retirement in 1994 is unlikely to have effects on retirement rates of even the above magnitudes. Rees and Smith (1990) contrasted arts and sciences faculty retirement behavior at 12 public research universities and private liberal arts colleges that have already eliminated mandatory retirement (owing to state laws or institutional decisions) with faculty retirement behavior at 22 similar public and private research universities and private liberal arts colleges that currently require mandatory retirement at age 70. They found no differences in mean retirement ages between capped and uncapped institutions, even after controlling for institutional type and discipline (humanities, social science, sciences). Mean retirement ages at elite private research universities were seen to be higher than at other institutions, and only at elite public and private research institutions do an appreciable number of faculty currently wait until age 70 to retire. Since very few private research universities have eliminated mandatory retirement yet, this suggests that uncapping might potentially lead to delayed faculty retirement in this set of institutions.

A second study (Lozier and Doris 1990), which focused on a broader set of 101 institutions, also concluded that changes in mandatory retirement laws have little short-run effects on retirement rates. A survey of over 500 retired professors from these institutions found that 80 percent claimed that mandatory retirement rules had not been a significant determinant of when they retired. Since many of the other 20 percent retired at age 70 and many of these people claimed that they would have preferred to retire at age 75 or later, the authors concluded that the uncapping of mandatory retirement will lead to a gradual small shift in retirement patterns.

In contrast, two earlier studies that tried to predict the effect of the increase in the mandatory retirement age from 65 to 70, which was legislated in 1978 and went into effect in 1981 for most colleges and universities, found somewhat larger effects on professors' expected ages of retirement. Holden and Hansen (1989) conducted a survey in 1980 of a sample of faculty age 50 and over from a stratified national sample of institutions and found, after holding

other factors constant, that those employed in institutions that had already raised the mandatory retirement age to 70 planned to retire about one year later than those who faced mandatory retirement at age 65. Montgomery (1989; cited in Holden and Hansen 1989) summarized research contrasting retirement ages in 1980 in Consortium on Financing Higher Education (COFHE) institutions with mandatory retirement ages of 65 and 70 and concluded that faculty facing mandatory retirement at 70 retired, on average, some two years later.

Neither of these earlier studies controlled for the possibility that faculty members may have chosen employment at institutions whose mandatory retirement ages were consistent with their preferences. Such self-selection (faculty who want to retire late choosing institutions with later mandatory retirement ages) would distort their comparisons and cause them to overstate the effects of relaxing mandatory retirement laws. Moreover, there is no reason to suspect that the effect on retirement ages of the movement of mandatory retirement from age 70 to no mandatory retirement would be the same as the effect of the movement of mandatory retirement from age 65 to age 70.

Would increases in retirement ages lead to a decline in faculty productivity? The issue of how faculty productivity varies with age has been addressed for both teaching and research, using proxy measures for productivity in both cases. Feldman's (1983) meta-evaluation of over 100 previous studies concluded that half found no relation and half found a weak negative relation between professors' ages and their students' evaluations of their teaching effectiveness. However, all these studies were cross-sectional in nature and thus do not permit one to identify how a given professor's teaching effectiveness varies over his or her career. In addition, none focused on the teaching effectiveness of professors near the ends of their careers.

More recently, Kinney and Smith (1989) studied the relation between students' evaluations of teaching effectiveness and professors' ages for tenured arts and sciences professors at a single selective research institution. They found that, in cross sections, teaching effectiveness seemed to increase for tenured professors in the humanities and social sciences as they neared age 70 while for professors in the physical and biological sciences there seemed to be a very slight decline.[3] These findings suggest that, at least for this one institution, the uncapping of mandatory retirement should not lead to a dramatic decline in faculty teaching effectiveness.

Similarly, studies of the relation between faculty research productivity and age leave one with the impression that uncapping will not have a major effect on faculty research productivity. Reskin (1985) surveyed the prior literature

3. Kinney and Smith (1989) also emphasize that cross-sectional age–teaching effectiveness relations may be distorted if retirement ages vary systematically with teaching effectiveness. For the institution they studied, they find that there is a slight tendency for the most effective teachers to retire earlier in the humanities and the physical and biological sciences and later in the social sciences.

on how publications and citations vary with faculty members' ages. Although results differ across disciplines, typically she found that, while peak research productivity occurs when faculty members are 10 to 20 years out of graduate school, those faculty who are 40 years out of graduate school publish as much on average as relatively young faculty.

Related evidence is presented by Biedenweg and Shelley (1988), who found that, while the average indirect cost recovery (the amount of external research funding) of Stanford University faculty peaks in the 46–50 age range, average indirect cost recovery of faculty age 66–70 is *higher* than that of faculty who are younger than 40. Similar findings for another major research university are reported in Howe and Smith (1990).

Levin and Stephan's (1989a) study of the publishing performance of biochemists, earth scientists, physicists, and plant and animal physiologists similarly suggests that, while publication counts tend to decline starting somewhere between ages 40 and 55 (depending on the field), older doctorate scientists often publish as much as doctorate scientists below the age of 40. Finally, preliminary results from a Barnard College study of faculty research productivity at 13 elite liberal arts colleges indicate that the fraction of faculty age 60 and above who are in the top quartile of researchers (as measured by recent publications and citations) is about the same as the fraction of all faculty who are in this top quartile (25 percent).[4]

All the studies discussed above are cross-sectional in nature. Levin and Stephan's (1989b) longitudinal study of six subfields of physics and earth science finds that, with the exception of particle physics, scientists in these subfields do appear to publish somewhat less after a point as they age. A second longitudinal study of male sociologists and psychologists found a very high correlation between faculty members' career publications and their publications between the ages of 59 and 70 (Havighurst 1985). Apparently, those faculty who are relatively productive among their cohort when they are young remain relatively productive at the later stages of their careers.

Taken as a group, these results suggest that the uncapping of mandatory retirement is not likely to lead to a substantial decline, on average, in faculty research productivity. Rather, the problem it may create is that some relatively unproductive researchers, who previously could be mandatorily retired at age 70, may now be "attached" to major research universities for longer periods of time. One suspects that the selective use of retirement incentives can help "encourage" relatively unproductive older faculty to retire.[5]

4. I am grateful to Dean Robert McCaughey of Barnard College, director of the Higher Education and College Faculty Study, which is being funded by the Spencer Foundation, for providing me with these results.

5. For example, for a number of years, Stanford University has been alleged to have a retirement incentive plan in which only "below average" productivity faculty have been allowed to participate. Given the result cited above that relatively productive people tend to be so throughout their lifetimes, having a low salary relative to salaries of similarly aged faculty in one's department has been used to measure "below average" productivity.

Of course, some people assert that the relations between publication counts, research grants, and citations, on the one hand, and faculty age, on the other, do not fully convey the importance of having a constant stream of new young faculty entering academe. Young faculty are needed to introduce new research methodologies, new ideas, and new lines of research as well as to serve as role models and mentors for potential new doctorates (National Research Council 1979; Hansen 1985). While this might suggest to some that retirement incentives be given to encourage all faculty to retire at age 70, recent simulations suggest that, even if one doubles the fraction of faculty staying on beyond age 70, the proportion of faculty below age 40 will increase in the United States over the next two decades (Rees and Smith 1990). Projected growth in faculty positions (because of increasing enrollments and an increased share of faculty near retirement age) much more than offsets any projected decline in faculty positions that might occur because of delayed retirements.

## 9.2 Female Doctorates

As Table 9.1 indicates, between 1973 and 1988, the share of new doctorates awarded by U.S. universities to women rose in the aggregate from 0.18 to 0.35. This almost doubling of the aggregate female share was accompanied by substantial increases in the female shares in all fields. These increases, however, did not eliminate female underrepresentation in many fields. So, for example, while over half of new doctorates in education went to women in 1988, reflecting the opening to women of career options in educational administration, substantial underrepresentation of women remains among physical science and engineering new doctorates, where shares of approximately 0.17 and 0.07, respectively, were observed in 1988.

The rapid growth in the female share of new doctorates might lead one to conclude that the proportion of female college graduates who complete doctoral study has increased substantially since the early 1970s. In fact, this has *not* been the case. Table 9.2 contains information on the number of doctoral degrees awarded to women relative to the number of bachelor's degrees awarded to women six years earlier. This ratio hovered around 0.025 during the entire period 1971–72 to 1987–88, and 0.025 is considerably smaller than the comparable ratio of 0.036 reported in Table 6.4 in recent years for all college graduates (regardless of gender). Put another way, as of 1988, the probability that a female college graduate will receive a doctorate was only about two-thirds the comparable probability for males.

The increase in the female share of doctorates that has occurred was caused by two factors. First, the share of bachelor's degrees received by women increased from 0.424 in 1971–72 to 0.502 in 1987–88 (Table 9.2, col. 2); more female college graduates means more potential female applicants for doctoral study. Second, the absolute number of doctorates awarded to males fell from

**Table 9.1** **Share of New Doctorates Awarded by U.S. Universities to Women**

| | Total Doctorates | Physical Sciences | Engineering | Life Sciences | Social Sciences | Humanities | Education | Professional/ Other |
|---|---|---|---|---|---|---|---|---|
| 1973 | .180 | .072 | .014 | .181 | .210 | .286 | .246 | .127 |
| 1978 | .270 | .105 | .022 | .230 | .308 | .377 | .397 | .205 |
| 1979 | .286 | .115 | .025 | .243 | .334 | .384 | .421 | .239 |
| 1980 | .303 | .122 | .036 | .259 | .349 | .396 | .446 | .266 |
| 1981 | .315 | .121 | .039 | .274 | .358 | .413 | .472 | .283 |
| 1982 | .324 | .134 | .047 | .287 | .370 | .424 | .488 | .304 |
| 1983 | .338 | .139 | .045 | .310 | .395 | .437 | .504 | .294 |
| 1984 | .341 | .148 | .052 | .311 | .409 | .450 | .510 | .316 |
| 1985 | .343 | .158 | .063 | .323 | .412 | .434 | .518 | .321 |
| 1986 | .354 | .161 | .067 | .340 | .426 | .452 | .543 | .339 |
| 1987 | .353 | .165 | .065 | .353 | .431 | .449 | .551 | .332 |
| 1988 | .352 | .166 | .068 | .368 | .450 | .443 | .552 | .320 |

*Source: Summary Report 1988: Doctorate Recipients from United States Universities* (Washington, D.C.: National Academy Press, 1989), table E.

**Table 9.2** **Female Earned Degrees Conferred by U.S. Institutions of Higher Education**

| | (1) | (2) | (3) |
|---|---|---|---|
| 1971–72 | .024 | .424 | .51 |
| 1972–73 | .026 | .422 | .57 |
| 1973–74 | .023 | .434 | .82 |
| 1974–75 | .023 | .437 | .96 |
| 1975–76 | .023 | .431 | 1.25 |
| 1976–77 | .022 | .434 | 1.47 |
| 1977–78 | .022 | .436 | 1.69 |
| 1978–79 | .023 | .438 | 1.75 |
| 1979–80 | .023 | .442 | 1.79 |
| 1980–81 | .025 | .453 | 1.89 |
| 1981–82 | .025 | .455 | 1.89 |
| 1982–83 | .026 | .461 | 2.00 |
| 1983–84 | .026 | .471 | 2.08 |
| 1984–85 | .025 | .482 | 2.17 |
| 1985–86 | .026 | .490 | 2.08 |
| 1986–87 | .026 | .498 | 2.17 |
| 1987–88 | .025 | .503 | 2.08 |

*Source:* Author's calculations from data in U.S. Department of Education (1989, table 200).

*Note:* Figures in columns represent (1) ratio of doctoral degrees awarded to women to bachelor's degrees awarded to women six years earlier; (2) share of bachelor's degrees awarded to women six years earlier; and (3) ratio of first professional degrees awarded to women to doctoral degrees awarded to women.

over 28,000 to about 22,000 during the period (U.S. Department of Education 1989, table 200). To a large extent, recent increases in the share of female doctorates reflect a substantial decrease in the likelihood that male college graduates enter and complete doctoral study, not an increased likelihood for female college graduates.

Women are increasingly likely, however, to go on to other forms of post-graduate study, in particular to professional degree programs. In 1971–72 approximately half as many women received first professional degrees as received doctoral degrees (Table 9.2, col. 3). With the opening of the professions to women, female enrollments in medicine, law, and other professional degree programs soared, and, each year since 1982–83, the number of female new first professional degrees has been more than twice the number of female new doctoral degrees. While the ratio of new first professional to doctoral degrees increased somewhat for the population at large during the period 1971–72 to 1986–87 (Table 6.4, col. 6), the increase in the ratio was much more pronounced for females.

One can only speculate about the factors that have induced female college graduates to "flood" into professional rather than doctoral programs. In part, it may reflect the opening up of career opportunities for women in the professions. In part, it may reflect that the lengthening of time to degree, particu-

larly in the nonscience/nonengineering fields (Table 7.4), has a greater effect on women's than men's decisions because longer times to degree require some women to contemplate either postponing childbirth or undertaking doctoral study while they are parents of young children. In part, for similar reasons, the growing need to accept postdoctoral (postdoc) positions in the physical sciences (Table 7.8), which further postpones entry into a permanent academic position, may discourage women from entering doctoral study in the physical sciences. If the latter two hypotheses are correct, and if tightening academic labor markets reduce both time to degree and the need for postdocs (as hypothesized in Chapter 8), one might expect these forces to make doctoral study both in the aggregate and in the physical sciences more attractive to women in the future.

The nature of academic careers may also influence the types of institutions in which new female doctorates locate. "Up or out" tenure decisions are made during the sixth or seventh years of an individual's initial tenure-track appointment, and, especially in doctoral institutions, substantial efforts are required to begin research programs and bring them to fruition. These demands often come at a time when family formation decisions have already been postponed by young female doctorates or young children are already present in their households. As a result, new female academics may often feel pressured to "choose" between their families and their careers.[6]

It is probably not surprising, then, that one observes that women constitute a greater share of the full-time assistant professors at undergraduate institutions than they do at doctoral institutions (Table 9.3). In addition, female new doctorates are much more likely to be employed part-time and on non-tenure-track positions than are male new doctorates (Heath and Tuckman 1989). While some might argue that such patterns reflect discrimination against female new doctorates, especially by research universities, a recent survey of new job market applicants from top economics doctoral programs concluded that females rated employment in a liberal arts college as being preferable to employment in a top-tier graduate department while males ranked the two choices in reverse order (Barbezat 1989b). Similarly, the survey concluded that a higher proportion of females expected to work part-time during part of their careers or to withdraw from the labor force temporarily. Females stressed maternity leaves and family responsibilities as the reasons for these actions.

Even if the tendencies of female faculty to be employed disproportionately at undergraduate institutions or in non-tenure-track positions were the result of voluntary choice, these choices have implications for the attractiveness of academic careers and hence doctoral study for women. It is difficult to move from primarily undergraduate to more research-oriented (Youn and Zelterman

6. New male academics also face such pressures. However, considerable research shows that the vast majority of household and parental responsibilities fall on females in two-earner households, although younger males are increasingly assuming more important roles (Blau and Ferber 1986, chap. 5).

**Table 9.3** **Proportion of Female Faculty and Female/Male Salary Ratios by Rank, Institutional Category, and Affiliation in 1989–90**

| | Proportion Female[a] | | | | Female/Male Salary Ratio[b] | | | |
|---|---|---|---|---|---|---|---|---|
| Affiliation | A | Pu | Pr | C | A | Pu | Pr | C |
| Professors: | | | | | | | | |
| Doctoral level | .09 | .09 | .08 | .17 | .90 | .90 | .88 | .90 |
| Comprehensive | .15 | .15 | .15 | .11 | .96 | .97 | .95 | .91 |
| General baccalaureate | .16 | .15 | .18 | .16 | .94 | .96 | .93 | .93 |
| Associate professor: | | | | | | | | |
| Doctoral level | .23 | .22 | .24 | .29 | .94 | .96 | .93 | .92 |
| Comprehensive | .26 | .26 | .25 | .30 | .95 | .96 | .93 | .93 |
| General baccalaureate | .30 | .31 | .33 | .30 | .95 | .99 | .94 | .97 |
| Assistant professors: | | | | | | | | |
| Doctoral level | .35 | .36 | .30 | .40 | .90 | .91 | .91 | .91 |
| Comprehensive | .40 | .41 | .42 | .40 | .94 | .94 | .93 | .93 |
| General baccalaureate | .43 | .40 | .44 | .46 | .96 | .95 | .97 | .96 |

*Source:* Author's calculations from "The Annual Report on the Economic Status of the Profession, 1989–90," *Academe* 76 (March–April 1990), tables 4, 16,

*Note:* A = all four-year institutions; Pu = public; Pr = private independent; and C = church related.

[a]Share of full-time faculty members in the rank who are female.

[b]Weighted (by institution size) average salary of full-time female faculty in the rank divided by the weighted average salary of full-time male faculty members in the rank.

1988); as a result, it is not surprising that the female share of associate and full professors at doctoral institutions tends to be less than their share at comprehensive institutions, which in turn tends to be less than their share at general baccalaureate institutions (Table 9.3). Salaries, especially at the senior levels, tend to be higher at doctoral than at comprehensive institutions and higher at comprehensive than at baccalaureate institutions (Table 6.2). Hence, on average, female full-time faculty are disproportionately found teaching in lower-paying institutions and thus can expect to have lower career earnings than male full-time faculty. Studies also suggest that part-time non-tenure-track academic positions rarely lead to tenure-track positions, tend to receive smaller salary increases than full-time positions, and have limited opportunities for promotion (Tuckman and Pickerill 1988).

Within institutional categories and academic ranks, the average full-time female faculty member also receives a lower salary than the average full-time male faculty member (Table 9.3). For example, in doctoral institutions in 1989–90, the typical female professor received 90 percent, the typical associate professor 94 percent, and the typical assistant professor 90 percent of her male counterpart's salary. In part, but only in part, this reflects the fact that females in senior ranks tend to have somewhat less seniority than males (Kasper 1990b). In part, this reflects the fact that females represent a greater share

of doctorates in such fields as the humanities (Table 9.1), which tend to be relatively low paying (Table 6.3), than they do in such fields as engineering and the physical sciences, which, because of market conditions, tend to be higher paying. In part, some might argue that this reflects salary discrimination against female faculty.[7] Save for the gender differences that are due to seniority differences, lower within-institution pay for females will also discourage women from entering doctoral study and academe.

Clearly, policies that increase the attractiveness to women of employment at higher-paying research-oriented universities would increase the attractiveness to them of academic careers and doctoral study. Provision for "tenure clocks" to be slowed or temporarily stopped for a year when children are born or adopted—an alternative that some institutions are beginning to experiment with—may prove useful, as would provisions for reduced teaching loads for new assistant professors, another alternative that many economics departments and business schools are now adopting (Stromsdorfer 1989).[8] Of course, to increase the flow of women into doctoral study in the sciences and engineering requires policies to increase precollege mathematics and science training for women, to increase the flow of women into undergraduate science and engineering majors, to provide women with incentives and encouragement to enter and complete doctoral study, and then to facilitate the start of their research careers (National Science Foundation 1988d, 1989e).

## 9.3 Minorities

Table 9.4 presents data on the race and ethnicity of U.S. citizen and permanent resident new doctorates during the period 1978–88. While there have been increases in both the absolute number and the share of new doctorates awarded to native Americans, Asians, and Hispanics, in contrast the number and share of new doctorates awarded to blacks declined over the period. Indeed, in 1988, only 3.8 percent of new doctorates were awarded to blacks, even though they represent over 13 percent of the 18- to 24-year-old population in the United States. Similarly, although Hispanic doctorate production has been increasing, in 1988 only 2.8 percent of new doctorates were awarded to Hispanics, even though they represent over 10 percent of the 18- to 24-year-old population in the United States (Carter and Wilson 1989, table 1).

In fact, these data do not fully convey the extent of the underrepresentation in many fields of blacks and Hispanics in the new doctorate population. Table 9.5 presents data on the field distribution of U.S. citizen doctorates in 1988 by race and ethnicity. Quite strikingly, 46 percent of new black doctorates

7. For a comprehensive study of gender-based salary differences in academe over the period 1968–84, see Barbezat (1989a).

8. Of course, while reduced teaching loads for new assistant professors would increase the attractiveness of academe to new doctorates, they would lead to increased work loads for other faculty or an increase in the demand for new faculty.

**Table 9.4** **Doctorates Received by U.S. Citizens and Permanent Residents by Race and Ethnicity (share of the total)**

| | Total | Native Americans | Asian | Black | Hispanic | White | Unknown Race/ Ethnicity |
|---|---|---|---|---|---|---|---|
| 1978 | 26,635 | 60 | 1,032 | 1,106 | 538 | 22,342 | 1,557 |
| | | (.002) | (.039) | (.041) | (.020) | (.839) | (.058) |
| 1979 | 26,784 | 81 | 1,102 | 1,114 | 539 | 22,396 | 1,552 |
| | | (.003) | (.042) | (.042) | (.020) | (.836) | (.058) |
| 1980 | 26,512 | 75 | 1,102 | 1,106 | 485 | 22,461 | 1,283 |
| | | (.003) | (.042) | (.042) | (.018) | (.847) | (.048) |
| 1981 | 26,342 | 85 | 1,073 | 1,110 | 526 | 22,470 | 1,078 |
| | | (.003) | (.041) | (.042) | (.020) | (.853) | (.041) |
| 1982 | 25,616 | 77 | 1,044 | 1,143 | 614 | 22,140 | 638 |
| | | (.003) | (.041) | (.045) | (.024) | (.864) | (.025) |
| 1983 | 25,633 | 82 | 1,043 | 1,005 | 608 | 22,244 | 651 |
| | | (.003) | (.041) | (.039) | (.024) | (.868) | (.025) |
| 1984 | 25,250 | 74 | 1,019 | 1,055 | 607 | 21,863 | 632 |
| | | (.003) | (.040) | (.042) | (.024) | (.859) | (.025) |
| 1985 | 24,687 | 95 | 1,069 | 1,043 | 634 | 21,291 | 555 |
| | | (.004) | (.043) | (.042) | (.026) | (.862) | (.022) |
| 1986 | 24,513 | 99 | 1,059 | 949 | 679 | 21,222 | 505 |
| | | (.004) | (.043) | (.039) | (.028) | (.866) | (.021) |
| 1987 | 24,569 | 115 | 1,167 | 906 | 710 | 21,124 | 547 |
| | | (.005) | (.047) | (.037) | (.029) | (.860) | (.022) |
| 1988 | 24,783 | 93 | 1,233 | 951 | 693 | 21,353 | 460 |
| | | (.004) | (.050) | (.038) | (.028) | (.862) | (.019) |

*Source: Summary Report 1988: Doctorate Recipients from United States Universities* (Washington, D.C.: National Academy Press, 1991), table F.

**Table 9.5** **Race and Ethnicity of U.S. Citizen Doctorates Awarded in 1988 (share of field total/share of race/ethnic group total)**

| Field | Native Americans | Asians | Blacks | Hispanics | Whites |
|---|---|---|---|---|---|
| Total | 93 | 612 | 805 | 594 | 20,685 |
| | (.004/1.00) | (.027/1.00) | (.035/1.00) | (.026/1.00) | (.91/1.00) |
| Physical science: | 11 | 111 | 32 | 69 | 2,913 |
| | (.004/.118) | (.035/.181) | (.010/.039) | (.022/.116) | (.93/.014) |
| Physics & astronomy | 1 | 19 | 11 | 13 | 645 |
| Chemistry | 5 | 47 | 17 | 43 | 1,231 |
| Earth, atmos., & mar. sci. | 2 | 8 | 2 | 8 | 476 |
| Mathematics | 2 | 17 | 1 | 3 | 308 |
| Computer science | 1 | 20 | 1 | 2 | 253 |
| Engineering | 4 | 141 | 19 | 43 | 1,527 |
| | (.002/.043) | (.081/.230) | (.011/.024) | (.025/.072) | (.881/.074) |
| Life sciences: | 18 | 127 | 71 | 84 | 4,019 |
| | (.004/.194) | (.029/.208) | (.016/.088) | (.019/.141) | (.931/.197) |
| Biological science | 6 | 100 | 36 | 61 | 2,867 |
| Health science | 5 | 16 | 25 | 10 | 586 |
| Agricultural science | 7 | 11 | 10 | 13 | 586 |
| Social sciences: | 12 | 85 | 158 | 133 | 3,864 |
| | (.003/.129) | (.020/.134) | (.037/.196) | (.031/.224) | (.909/.187) |
| Psychology | 7 | 37 | 96 | 89 | 2,382 |
| Anthropology | 2 | 3 | 5 | 10 | 234 |

| | | | | | |
|---|---|---|---|---|---|
| Economics | 0 | 22 | 11 | 8 | 380 |
| Pol. sci. & int. rel. | 0 | 4 | 7 | 6 | 244 |
| Sociology | 2 | 8 | 14 | 13 | 274 |
| Other social sci. | 1 | 11 | 25 | 7 | 350 |
| Humanities: | 7 | 37 | 77 | 94 | 2,528 |
| | (.003/.075) | (.013/.060) | (.028/.096) | (.034/.158) | (.922/.122) |
| History | 1 | 10 | 8 | 13 | 456 |
| Amer. & Eng. lang. & lit. | 3 | 11 | 26 | 21 | 845 |
| Foreign lang. & lit. | 0 | 5 | 3 | 46 | 219 |
| Other humanities | 3 | 11 | 40 | 14 | 1,008 |
| Education: | 35 | 82 | 370 | 152 | 4,575 |
| | (.007/.376) | (.016/.134) | (.071/.460) | (.029/.256) | (.88/.221) |
| Teacher educ. | 3 | 8 | 31 | 10 | 323 |
| Teaching fields | 2 | 10 | 49 | 25 | 690 |
| Other educ. | 30 | 64 | 290 | 117 | 3,562 |
| Professional/other: | 6 | 29 | 78 | 19 | 1,259 |
| | (.004/.066) | (.006/.047) | (.056/.097) | (.014/.002) | (.905/.061) |
| Bus. & management | 4 | 16 | 16 | 4 | 558 |
| Communications | 0 | 1 | 10 | 2 | 171 |
| Other prof. fields | 2 | 12 | 52 | 13 | 503 |
| Other fields | 0 | 0 | 0 | 0 | 27 |

*Source: Summary Report 1988: Doctorate Recipients from United States Universities* (Washington, D.C.: National Academy Press, 1989), table G.
*Note:* Includes only doctorates whose citizenship and race/ethnic group are known.

were in the field of education. As a result, while blacks represented 3.5 percent of the American citizen doctorates awarded in 1988, they represented only 1.0 percent of those awarded in the physical sciences, 1.1 percent in engineering, 1.6 percent in the life sciences, and 2.8 percent in the humanities. The small absolute number of black and other underrepresented minority doctorates produced in most fields should make clear the difficult task that American institutions of higher education face in trying to achieve increased minority representation on their faculties.

Given current levels of production of minority doctorates, an institution can succeed in improving its minority representation primarily by inducing minority faculty from other institutions to move to it (Mooney 1989). One would suspect that the net result of this competition will be to redistribute minority faculty toward higher-paying doctorate-granting institutions (Table 6.2), which will benefit minority faculty economically in the short run and may also help increase the flow of future minority doctorates in the longer run.[9]

Understanding why minority doctorate production is currently so low and ascertaining what policies might more directly increase the number of minority doctorates are of utmost importance both for equity reasons and because the share of these groups in the youth population is increasing. Put another way, unless we can substantially increase the share of doctorates received by minorities, other things being equal, the total number of new American doctorates will decline.

The factors responsible for the underrepresentation of minority doctorates can be identified early in the educational pipeline. The black and Hispanic shares of the 18- to 24-year-old population rose during the period 1976–88 from 0.123 to 0.139 and from 0.058 to 0.103, respectively, but the white share fell from 0.859 to 0.826 (Carter and Wilson 1989, table 1).[10] While high school completion rates rose substantially for blacks, remained roughly constant for whites, and began and ended at roughly the same level for Hispanics during the period, the 1988 rate of 0.823 for whites exceeded the 0.754 rate for blacks, which in turn exceeded the 0.552 rate for Hispanics (Carter and Wilson 1989, table 3). The latter is equivalent to a 45 percent Hispanic high school dropout rate.

The fraction of students who graduate from high school that ever enroll in

9. An unresolved issue is what effect such competition will have on the historically black colleges and universities in the United States. In 1987, 97 of these institutions granted 20,291 bachelor's degrees, 4,064 master's degrees, 194 doctoral degrees, and 853 first professional degrees. Assuming that these degrees were all awarded to blacks, they represent, respectively, 35.8, 29.7, 25.2, and 24.9 percent of the degrees awarded to black Americans (Carter and Wilson, 1989, tables 4–7, 12). These institutions tend to be relatively low paying ones, and, if they are weakened by losing some of their better faculty to other institutions, this may have an adverse effect on black doctorate production.

10. Unlike other statistics reported in this chapter, those for whites and blacks discussed in this paragraph include Hispanics of those races. While they exclude Asians and native Americans (they are not broken out separately in these data), the double counting of Hispanics leads the sum of the shares of the three groups to exceed one.

**Table 9.6 Degree Attainment by Race/Ethnicity, Selected Years**

| | 1976 | 1981 | 1985 | 1987 |
|---|---|---|---|---|
| White: | | | | |
| BS | .884 | .864 | .853 | .849 |
| MS | .850 | .820 | .797 | .791 |
| DS | [a] | .877 | .888 | .890 |
| PS | .907 | .905 | .890 | .875 |
| Black: | | | | |
| BS | .064 | .065 | .059 | .057 |
| MS | .066 | .058 | .050 | .048 |
| DS | [a] | .040 | .039 | .033 |
| PS | .043 | .041 | .043 | .048 |
| Hispanic: | | | | |
| BS | .020 | .023 | .027 | .027 |
| MS | .017 | .022 | .024 | .024 |
| DS | [a] | .019 | .024 | .027 |
| PS | .017 | .022 | .027 | .029 |
| Asian American: | | | | |
| BS | .012 | .020 | .026 | .033 |
| MS | .013 | .021 | .028 | .030 |
| DS | [a] | .019 | .022 | .024 |
| PS | .015 | .020 | .026 | .032 |

*Source:* Carter and Wilson (1989, tables 4, 5).

*Note:* BS = share of all bachelor's degrees awarded; MS = share of all master's degrees awarded; DS = share of all U.S. citizen doctoral degrees awarded; and PS = share of all first professional degrees awarded.

[a]Not reported.

a two-year or four-year college also varied over time and across groups. During the period 1976–88, it rose from 0.535 to 0.586 for whites but fell from 0.504 to 0.466 for blacks and from 0.489 to 0.472 for Hispanics (Carter and Wilson 1989, table 1). Not only are blacks and Hispanics less likely to graduate from high school than whites, but, if they graduate, they are also less likely ever to be enrolled in college. Nonetheless, because of the growing shares of blacks and Hispanics in the youth population and the increasing black high school graduation rates. Blacks and Hispanics represent a growing share of the 18- to 24-year-olds who have ever been enrolled in college.

However, enrollment shares do not necessarily translated into degree-attainment shares. While the white share of all bachelor's degrees awarded in the United States since 1976 has roughly tracked the white share of ever-enrolled students, in recent years both the black and the Hispanic shares of bachelor's degrees granted have been less than their enrollment shares (Table 9.6).[11] For example, in 1987, the black and Hispanic shares of bachelor's

11. The sums across the five groups in Table 9.6 of the bachelor's degree, master's degree, and professional degree shares are each less than one because of the omission of nonresident degree shares from the table.

degrees granted were 0.057 and 0.027. Moreover, while the Hispanic bachelor's degree share has risen since 1976, the black degree share has actually fallen.

What factors explain the difference between the bachelor's degree attainment and the ever-enrolled-in-college statistics? Blacks enrolled in two-year colleges are less likely to graduate from them than are white enrollees. If they do graduate, they are less likely to enroll in four-year colleges than are white two-year college graduates. Once enrolled in four-year colleges, they are also less likely to graduate (see Part I). Some similar patterns are observed for Hispanic students, who are also more likely to be enrolled in two-year colleges than white students (Olivas 1986).

Moreover, on receiving bachelor's degrees, blacks are less likely to attain subsequent degrees than are whites, Hispanics, Asian Americans, or native Americans. The white share of doctoral and first professional degrees exceeds their share of bachelor's degrees. The Hispanic and native American shares of all graduate degrees are approximately equal to their bachelor's degree share, and the former have been increasing over time.[12] In contrast, the black shares of all graduate degrees are less than the black bachelor's shares and, save for first professional degrees, have been declining over time (Table 9.6).

Another way to look at the data is to contrast, as has been done earlier for the entire population (Table 6.4) and for females (Table 9.2), the number of doctorates awarded to a group relative to the number of bachelor's degrees awarded to the group six years earlier. Using 1980–81 bachelor's degree data and 1986–87 doctoral degree data, the ratios for white non-Hispanics, black non-Hispanics, Hispanics, Asians or Pacific Islanders, and native Americans/Alaskan natives are 0.030, 0.017, 0.034, 0.056, and 0.029, respectively. The 0.017 figure for blacks stands out quite clearly.

The underrepresentation of most minority groups in the pool of new doctorates reflects primarily their underrepresentation among the pool of college graduates; save for blacks, minority groups' doctorate/bachelor's ratio is about the same as or greater than that of whites.[13] As such, policies to increase the flow of doctorates from most minority groups should probably focus on increasing the flow of college graduates. These include policies to increase high school graduation rates, increase four-year college participation rates for

12. These bachelor's shares, however, are substantially less than their population shares and thus remain a matter of serious social concern. While Asian-Americans share of doctorates in each year is less than their bachelor's share, this is an artifact of the rapid growth in their bachelor's share. In fact, the 1987 doctorate share for the group (0.24) exceeds its 1981 share of bachelor's degrees, 0.21.

13. One qualification is in order here. Some Hispanic citizen new doctorates are individuals who were previously foreign residents, were schooled (through college) abroad, came to the United States for graduate study, and then achieved permanent resident and subsequent citizenship status by marrying American citizens. To the extent that a large number of Hispanic citizen doctorates are obtained this way, I may well be overstating the doctorate/bachelor's ratio for Hispanic American citizens who grew up in the United States. I am grateful to Michael Olivas for stressing this point to me.

high school graduates, and then increase retention rates of college enrollees. In contrast, black college graduates are much less likely to receive doctorates than are graduates from all the other minority groups. Hence, policies designed to increase both the flow of blacks into doctoral programs and their retention are needed, as are policies designed to increase the flow of black college graduates.

Potential policies to increase the flow of low-income black college graduates are discussed in Clotfelter (see Part I). Here, the focus is on factors that may currently limit the flow of black college graduates into doctorate programs. One study of graduating seniors from elite private COFHE institutions found that, after controlling for grades, family income, father's education, and college debt levels, black graduates were in fact as likely to pursue graduate study as white graduates (Schapiro, O'Malley, and Litten, in press). Moreover, neither high debt levels nor low family income levels negatively affected these students' probabilities of attending graduate school, and black/white differences in grades and parental education levels were sufficiently small that graduate school attendance probabilities for blacks and whites were the same in the raw data as well.

Unfortunately, most black undergraduates do not attend, or graduate from, elite COFHE institutions. Indeed, full-time black undergraduates enrolled in four-year institutions are much less likely than comparable whites to attend selective four-year colleges and universities (see Part I). As is demonstrated in the next chapter, graduates of the best research universities (Research I and Research II) and the selective liberal arts colleges (Liberal Arts I) earn a disproportionate share of doctorates. Hence, the distribution of black undergraduates across institutional types has an adverse effect on black students' propensity to attend graduate school.

The distribution of black college graduates by broad category of major is quite similar to the distribution of white college graduates by major, so differences in undergraduate fields of study per se probably do not contribute to black/white differences in the propensity to attend graduate school.[14] In contrast, black students who take the GRE score, on average, more than 100 points lower on both the quantitative and the verbal aptitude tests (Educational Testing Service 1988, tables 59, 60) than white test takers, and such performance differences may adversely affect their interest or opportunity to enter graduate programs.[15]

As noted above, black college students tend to come from lower-income

14. For example, the shares of bachelor's degrees awarded by U.S. institutions in 1986–87 to whites (blacks) were 0.24 (0.26) in business, 0.09 (0.08) in education, 0.09 (0.06) in engineering, 0.18 (0.20) in other professional fields, and 0.39 (0.40) in arts and sciences (U.S. Department of Education 1989, table 215).

15. No normative judgment should be drawn from this statement as to whether these differences reflect "cultural bias" in the GREs or differences in the backgrounds of black and white students that leave the former less prepared to enter and complete doctoral programs.

families than white college students. While there is no evidence nationally that low family income levels affect the probability of entering graduate school and only mixed evidence that debt burdens do (see Chapter 8), evidence on racial and ethnic differences in the probability of having college loans suggests that financial variables may adversely affect black graduate school attendance.

Table 9.7 presents information on college loan burdens for full-time four-year college students in 1986–87 by race/ethnicity and family income class. Black dependent students from each family income class are much *less* likely to have taken out college loans than students from other race/ethnic groups.[16] Whether this reflects a lower willingness of black families to borrow to finance higher education or a greater concentration of black students in lower-priced public institutions (which reduces their need to borrow) cannot be ascertained from these data. Black independent students in each income class are also less likely to have loans than all other independent students in an income class (save for Asians in a few income classes). However, the loan burdens that these black students acquire are a much higher share of their income (0.637) than are the loan burdens of any other group. Taken together, these results suggest that a lower willingness to borrow for black dependent students and higher loan burdens for black independent students may contribute to the lower probability that black college graduates enroll in graduate school.

The ways that black students finance graduate education once they do enter graduate school serve to exacerbate this problem. As Table 9.8 indicates, in 1988, black doctorates were less likely to have received their degrees from Research I universities than white doctorates for all fields except psychology. In most fields, a smaller proportion of doctorates were self-supporting (family support, loans, nonacademic earnings) in Research I than in other institutions. Hence, on balance, a greater share of black than white doctorates were self-supporting.[17]

These data suggest that increased financial support for black students contemplating doctoral study may prove to be an effective way of expanding the number of black doctorates. Both the federal and state governments and a number of universities and private foundations have, in fact, recently expanded, or introduced, doctoral fellowship programs for minority groups.[18]

It is also important to stress that Schapiro, O'Malley, and Litten (in press) found that having a precollege interest in a career in higher education signifi-

16. Dependent students are those who can be claimed as dependents on their parents', or other adult's, income-tax returns. Independent students are heads of households.

17. Within fields and institutional type, black doctorates were less likely to be self-supporting in some cases.

18. For example, the National Science Foundation sponsors a special minority graduate fellowship program, and the Ford Foundation provides doctoral and postdoctoral fellowship for minorities.

**Table 9.7** **Percentage of All Four-Year College Full-Time Students Receiving Loan Aid and Average of Loans (for those with loans), 1986–87 Academic Year**

| | All | | Asian | | Black | | Hispanic | | White | |
|---|---|---|---|---|---|---|---|---|---|---|
| Family Income Class | % | $ | % | $ | % | $ | % | $ | % | $ |
| Dependent students: | | | | | | | | | | |
| All | 33.5 | 2,341 | 42.6 | 2,592 | 22.8 | 2,348 | 49.3 | 2,177 | 32.7 | 2,364 |
| 0–7,500 | 40.3 | 2,150 | 71.7 | 1,157 | 23.0 | 2,307 | 53.7 | 2,054 | 38.5 | 2,225 |
| 7,501–15,000 | 50.9 | 2,215 | 28.5 | 2,011 | 34.1 | 2,720 | 48.8 | 2,079 | 53.4 | 2,217 |
| 15,001–25,000 | 50.9 | 2,295 | 54.1 | 1,776 | 27.8 | 2.053 | 60.1 | 2,220 | 52.6 | 2,316 |
| 25,001–40,000 | 39.3 | 2,343 | 32.1 | 3,162 | 26.6 | 2,330 | 49.5 | 2,209 | 39.6 | 2,351 |
| 40,001 and over | 20.9 | 2,474 | 48.8 | 3,095 | 14.0 | 2,416 | 30.0 | 2,395 | 20.7 | 2,479 |
| Independent students: | | | | | | | | | | |
| All | 51.5 | 2,403 | 35.9 | 2,537 | 44.7 | 2,230 | 51.5 | 2,406 | 52.4 | 2,416 |
| 0–5,000 | 58.1 | 2,340 | 29.2 | 2,908 | 51.9 | 2,229 | 52.6 | 2,275 | 62.0 | 2,372 |
| 5,001–10,000 | 62.3 | 2,423 | 52.6 | 2,545 | 33.7 | 1,847 | 57.0 | 2,626 | 65.5 | 2,421 |
| 10,001–15,000 | 55.5 | 2,433 | 44.1 | 1,500 | 21.6 | 2,500 | 40.9 | 2,237 | 57.7 | 2,473 |
| 15,001 and over | 33.4 | 2,500 | .0 | | 24.2 | 2,934 | 47.7 | 2,590 | 32.7 | 2,454 |
| Dependent students: | | | | | | | | | | |
| 1. Average loan | | 2,341 | | 2,592 | | 2,348 | | 2,177 | | 2,364 |
| 2. Average family income of families with loans | | 31,026 | | 32,026 | | 28,313 | | 21,009 | | 33,464 |
| 3. (1) divided by (2) | | .074 | | .080 | | .083 | | .104 | | .071 |
| Independent students: | | | | | | | | | | |
| 1. Average loan | | 2,405 | | 2,537 | | 2,230 | | 2,406 | | 2,416 |
| 2. Average family income of families with loans | | 9,157 | | 6,651 | | 3,500 | | 8,075 | | |
| 3. (1) divided by (2) | | .263 | | .381 | | .637 | | .297 | | .247 |

*Source:* Tabulations prepared by Dr. Daniel Sherman of Pelavin Associates, Inc., from the U.S. Department of Education, *1987 National Post Secondary Student Aid Study.*

**Table 9.8** **Primary Sources of Financial Support for Black (B) and White (W) Graduate Students Receiving Doctorates in 1988, by Field and Institution Type**

| | % Share | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Science | | Physical Sciences | | Agricultural and Biological Sciences | | Social Sciences | | Psychology | | Engineering | | Nonscience/ Engineering | |
| Primary Source | B | W | B | W | B | W | B | W | B | W | B | W | B | W |
| All institutions (*N*) | (241) | (10,339) | (28) | (1,880) | (44) | (3,367) | (68) | (1,648) | (99) | (2,403) | (19) | (1,529) | (553) | (8,902) |
| University teaching assistant | 11.4 | 17.8 | 26.9 | 21.6 | 7.5 | 14.6 | 10.7 | 22.1 | 6.0 | 12.5 | .0 | 7.7 | 7.7 | 14.3 |
| University research assistant | 12.3 | 18.8 | 26.9 | 33.6 | 20.0 | 22.7 | 7.1 | 9.5 | 8.3 | 7.8 | 17.6 | 32.7 | 1.7 | 2.9 |
| University other[a] | 11.4 | 6.4 | 3.8 | 4.4 | 17.5 | 7.8 | 12.5 | 7.6 | 10.7 | 6.0 | 17.6 | 7.2 | 10.0 | 6.1 |
| Total university[b] | 35.1 | 43.0 | 57.7 | 59.6 | 45.0 | 45.0 | 30.4 | 39.3 | 25.0 | 26.3 | 35.3 | 47.7 | 19.4 | 23.3 |
| Total federal[c] | 17.1 | 17.8 | 19.2 | 23.7[a] | 32.5 | 29.0 | 10.7 | 7.9 | 13.1 | 5.0 | 17.6 | 21.3 | 6.9 | 3.5 |
| Total personal[d] | 42.7 | 36.6 | 3.8 | 13.8 | 17.5 | 23.9 | 53.6 | 50.0 | 60.7 | 67.3 | 17.6 | 19.8 | 68.5 | 68.9 |
| Total other[e] | 5.2 | 2.5 | 19.2 | 2.9 | 5.0 | 2.1 | 5.4 | 2.9 | 1.2 | 1.4 | 29.4 | 11.3 | 5.2 | 4.2 |
| Research I institutions (*N*): | (138) | (6,411) | (17) | (1,363) | (26) | (2,212) | (36) | (1,121) | (57) | (993) | (14) | (1,165) | (251) | (4,588) |
| University teaching assistant | 15.0 | 18.0 | 18.8 | 18.5 | 12.5 | 12.6 | 17.2 | 23.6 | 10.2 | 17.0 | .0 | 6.8 | 8.3 | 19.2 |
| University research assistant | 12.5 | 21.8 | 31.3 | 37.5 | 16.7 | 23.2 | 10.3 | 10.1 | 6.1 | 9.7 | 25.0 | 34.8 | 1.4 | 4.0 |
| University other | 12.5 | 6.1 | .0 | 4.0 | 12.5 | 6.7 | 17.2 | 9.0 | 14.3 | 6.0 | 16.7 | 6.7 | 13.9 | 7.4 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total university[b] | 40.0 | 46.0 | 50.0 | 60.0 | 41.7 | 42.4 | 44.8 | 42.7 | 30.6 | 32.7 | 41.7 | 48.3 | 23.6 | 30.5 |
| Total federal | 18.3 | 22.3 | 18.3 | 22.1 | 37.5 | 34.7 | 6.9 | 8.6 | 16.3 | 7.4 | 25.0 | 21.9 | 9.7 | 4.3 |
| Total personal | 35.0 | 29.4 | 6.3 | 11.7 | 16.7 | 20.8 | 41.4 | 46.1 | 51.0 | 58.5 | .0 | 19.4 | 61.6 | 61.5 |
| Total other | 6.7 | 2.4 | 25.0 | 2.5 | 4.2 | 2.1 | 6.9 | 2.6 | 2.0 | 1.4 | 33.3 | 10.4 | 5.1 | 3.7 |
| Other institutions (*N*): | (103) | (3,928) | (11) | (517) | (18) | (1,155) | (29) | (527) | (42) | (1,410) | (5) | (384) | (302) | (4,314) |
| University teaching assistant | 6.6 | 17.4 | 40.0 | 30.0 | .0 | 18.4 | 3.7 | 19.2 | .0 | 9.3 | .0 | 10.5 | 7.2 | 9.2 |
| University reaearch assistant | 12.1 | 14.0 | 20.0 | 23.3 | 25.0 | 21.8 | 3.7 | 8.4 | 11.4 | 6.6 | .0 | 26.8 | 1.9 | 1.8 |
| Other university | 9.9 | 6.8 | 10.0 | 5.4 | 25.0 | 9.9 | 7.4 | 4.7 | 5.7 | 5.9 | 20.0 | 8.6 | 6.8 | 4.8 |
| Total university[b] | 28.6 | 38.1 | 70.0 | 58.6 | 50.0 | 50.0 | 14.8 | 32.2 | 17.1 | 21.8 | 20.0 | 45.9 | 16.0 | 15.9 |
| Total federal | 15.4 | 10.9 | 20.0 | 17.9 | 25.0 | 18.1 | 14.8 | 6.3 | 8.6 | 3.3 | .0 | 19.3 | 4.6 | 2.8 |
| Total personal | 52.7 | 48.3 | .0 | 19.6 | 18.8 | 29.8 | 66.7 | 58.0 | 74.3 | 73.6 | 60.0 | 21.0 | 74.1 | 76.6 |
| Total other | 3.3 | 2.7 | 10.0 | 3.9 | 6.3 | 2.1 | 3.7 | 3.5 | .0 | 1.3 | 20.0 | 13.8 | 5.3 | 4.8 |
| Proportion of group receiving degrees from Research I institutions | .57 | .62 | .39 | .73 | .59 | .66 | .55 | .68 | .58 | .41 | .74 | .76 | .45 | .51 |

*Source:* Special tabulations prepared by the Office of Scientific and Engineering Personnel, National Research Council, from the 1988 Survey of Earned Doctorates.

[a]Primarily fellowships and college work study.

[b]Sum of three previous categories.

[c]Primarily fellowships.

[d]Primarily family support, loans, and nonuniversity earnings.

[e]Primarily grants from other organizations and foreign support.

cantly increased the probability that graduates from COFHE institutions enrolled in graduate school. While no analyses were conducted of how such interest varies by race and ethnicity, it is likely that, because the socioeconomic distribution of black families differs from that of white families and because of the paucity of black (and other minority) "role models" among the professoriate, black students will have less interest in and familiarity with academic careers. This suggests that programs that widen their exposure to academic life, such as targeted minority undergraduate research experiences, may also prove useful.[19]

19. An example is a program sponsored by the Dana Foundation that is providing 150 undergraduates at black colleges with both funds to eliminate their college debts and research apprenticeships with senior researchers at Duke University (Teltsch 1989).