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Have Forms of Primary Financial Support for S&E Graduate Students Changed During The Past Two Decades?

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The importance of research assistantships as a primary support mechanism for graduate students increased significantly during the 1980s.

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The nation's research universities have traditionally coupled advanced education with research—in the process generating new knowledge as well as training scientific and engineering talent. This close coupling is reflected in the variety of forms in which financial support is provided to science and engineering (S&E) graduate students. Concerns have been raised about the role of different types of financial support modes in preparing science and engineering students for employment and about the appropriate mix of support.[1] It would therefore be useful to examine how forms of support for S&E graduate students have changed during the past two decades.

Mechanisms of support include:

- assistantships—financial assistance provided by the universities in return for work classified as research or teaching, depending on the duties assigned to the student;
- fellowships—competitive awards (often from a national competition) made to students which require no work of the recipient;
- traineeships—awards given to students selected by the universities; and
- self-support—support from loans or from personal or family financial contributions.

Sources of support include Federal agencies, academic institutions, state and local governments, foreign governments, nonprofit institutions, and industrial firms. Most graduate students are supported by multiple sources and mechanisms over their course of study—and often in any given academic year. Generally, however, one form of support may be designated the primary mode of support for a student in a given year; information on this primary support mode is available from academic departments.[2]

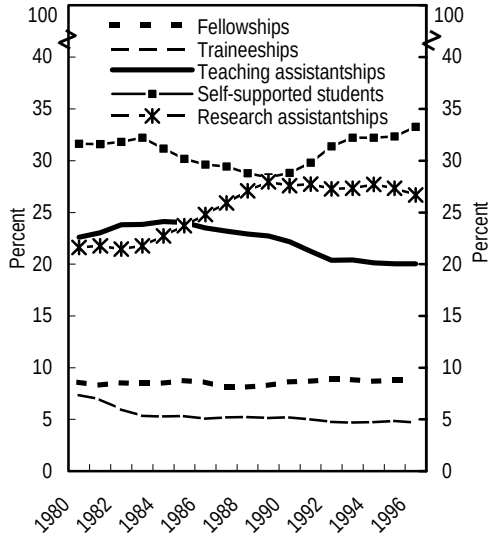
[1]For example, by the Committee on Science, Engineering, and Public Policy (COSEPUP), 1995, *Reshaping the Graduate Education of Scientists and Engineers*. Washington, DC: National Academy Press.

[2]See National Science Board, *Science & Engineering Indicators—1998*, NSB 98-1 (Washington, DC: U.S. Government Printing Office, 1998) chapter 5, "Integration of Research with Graduate Education."

Trends in Primary Support[3]

Since 1980, there have been significant shifts among the different types of primary support mechanisms (figure 1). *These shifts have been due more to rapid growth in some support mechanisms than to a decline in the absolute number of students supported by any of them.* For example, the proportion of graduate students with primary research assistantship (RA) support increased from 22 to 27 percent between 1980 and 1996. This increase

Figure 1. Primary mechanisms of financial support for full-time S&E graduate students: 1980-96



NOTE: Percentages do not total 100 because other/unknown mechanisms are not included.

SOURCES: National Science Foundation, Division of Science Resources Studies, Survey of Graduate Students and Postdoctorates in Science and Engineering; CASPAR Database System (http://caspar.nsf.gov/webcaspar/).

[3]Data presented here on mechanisms and sources of support for S&E graduate students are from the National Science Foundation-National Institutes of Health annual Survey of Graduate Students and Postdoctorates in Science and Engineering. In this survey, departments report the primary (largest) source and mechanism of support for each full-time, degree-seeking S&E graduate student. Financial support data are not collected for part-time students. Full-time students may be seeking master's degrees rather than Ph.D. degrees, particularly in fields such as engineering and computer sciences. Throughout this discussion, S&E includes the health fields (medical sciences and other life sciences).

was offset by drops in the proportions of students supported by traineeships (from 7 to 5 percent) and teaching assistantships (from 23 to 20 percent). Most of these changes occurred during the late 1980s, proportional shares were relatively stable during the first half of the 1990s. The proportion supported by fellowships remained between 8 and 9 percent between 1980 and 1996; the proportion with primary self-support fluctuated between 28 and 33 percent, with an upward trend during the 1990s. These overall shifts in support mechanisms between 1980 and 1996 occurred for both students supported primarily by Federal sources and for those supported by nonfederal sources. [4]

Primary mechanisms of financial support vary by S&E field.

Primary Mechanism and Source of Support by S&E Field

Students majoring in different S&E fields rely on different primary mechanisms of financial support. In some fields, students are supported primarily by RAs; in others by teaching assistantships; and in some fields, the primary means is self-support.

Research Assistantships by S&E Field

Although RAs accounted for 27 percent of all primary support mechanisms in 1996, they comprised more than 50 percent of the primary support mechanisms for graduate students in the atmospheric sciences, oceanography, agricultural sciences, chemical engineering, and materials engineering. In contrast, they accounted for less than 20 percent in all the social sciences, the mathematical sciences, and psychology (table 1).

The significance of the Federal Government as the primary source of support for RAs also varies by field. It was the primary source of support for about half of the graduate research assistants overall, for about 75 percent of those in the physical sciences, 60 percent in the environmental and computer sciences, just above 30 percent in psychology, and only 20 percent in the social sciences (table 2).

Teaching Assistantships by S&E Field

Teaching assistantships accounted for 20 percent of all primary support mechanisms in 1996. By field, they comprised more than 40 percent of the primary support mechanisms for graduate students in chemistry and mathematics and more than one-third for those in physics and the earth sciences. In contrast, they accounted for less than 12 percent of those in the atmospheric sciences, oceanography, agricultural sciences, medical sciences, aeronautical/astronautical engineering, and materials engineering (table 1). The Federal Government has an almost negligible role in supporting teaching assistantships.

Fellowships and Traineeships by S&E Field

Fellowships accounted for only 9 percent of all primary support mechanisms for S&E graduate students in 1996. However, they were an important primary support mechanism for students in the history of science, anthropology, and astronomy, accounting for 37, 20, and 18 percent of the primary support mechanisms, respectively. Students with primary traineeships accounted for fewer than 5 percent of all full-time S&E graduate students in 1996. However, 11-12 percent of the students in the biological sciences, medical sciences, and other life sciences received their primary support through traineeships (table 1).

The Federal Government was the primary source of support for about one-quarter of all graduate students with a fellowship as their primary support. This was also the case for about two-thirds of those with traineeship support. The Federal Government was a more important primary source for fellowships to graduate students in aeronautical/astronautical engineering, astronomy, and the atmospheric sciences, providing 56, 53, and 51 percent of such support, respectively. In contrast, it provided only 13 percent of primary fellowship support in the social sciences. The Federal Government provided almost 80 percent of primary support for traineeships in the life sciences, compared to 23 percent in the computer and 17 percent in the social sciences (table 2).

[4]Total Federal support of graduate students is probably underestimated because reporting on Federal sources includes only direct Federal support to students and support to research assistants financed through the direct costs of Federal research grants. This omits students supported by departments through the indirect cost portion of research grants; such support is classified as institutional (nonfederal) support, since universities have discretion over how to use these funds. For additional information on trends in support mechanisms by primary source, see NSB (1998), chapter 5, "Integration of Research with Graduate Education," pages 5-31 and 5-32.

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Table 1. Full-time S&E graduate students, by field and percent of primary support mechanism: 1996

Field	Research assistantships	Fellowships	Traineeships	Teaching assistantships	Self-support
	[percent of full-time graduate students]				
TOTAL S&E	26.7	8.8	4.7	20.0	33.3
Total sciences	23.3	8.9	5.5	21.2	34.9
Physical sciences	41.2	7.9	2.3	40.2	5.9
Astronomy	45.8	17.8	4.9	28.0	3.4
Chemistry	39.7	7.2	2.6	43.0	5.2
Physics	43.2	8.3	1.7	37.2	6.5
Other	35.7	3.1	0.0	15.8	43.4
Mathematical sciences	10.0	9.9	1.4	55.0	18.0
Computer sciences	23.2	5.4	1.2	19.7	42.3
Environmental sciences	39.7	8.0	1.2	23.4	21.8
Atmospheric sciences	65.3	5.2	0.3	10.2	10.4
Earth sciences	34.9	9.1	1.1	33.8	16.4
Oceanography	56.1	10.3	1.5	10.6	16.0
Other	25.2	4.5	1.6	14.7	46.2
Life sciences	27.8	8.1	10.4	13.1	34.3
Agricultural sciences	55.6	4.9	1.5	10.1	23.7
Biological sciences	39.1	11.1	11.2	19.6	14.7
Medical sciences	20.0	9.9	11.2	9.4	41.8
Other	5.3	3.6	11.7	5.6	64.9
Psychology	13.4	5.6	3.3	17.4	52.4
Social sciences	12.5	13.6	2.9	21.1	43.3
Anthropology	7.5	20.2	2.2	22.3	42.0
Economics	17.8	14.7	2.3	26.0	33.2
History of science	6.3	37.1	2.6	30.7	18.7
Linguistics	7.9	13.9	2.6	27.0	35.3
Political science	8.9	14.1	3.8	16.1	51.0
Sociology	14.3	13.4	3.3	30.4	33.0
Other	15.3	8.0	2.1	16.3	50.8
Total engineering	40.3	8.6	1.3	15.2	27.0
Aeronautical/astronautical	45.9	8.9	1.3	11.8	17.9
Chemical	51.7	12.9	1.3	15.6	14.5
Civil	35.0	7.5	1.3	15.2	33.9
Electrical	38.5	7.7	1.3	17.6	27.6
Industrial	24.9	4.6	1.3	15.3	43.7
Mechanical	40.0	8.5	1.3	17.4	25.0
Materials	65.2	9.3	1.3	10.1	11.6
Other	40.5	11.4	1.3	10.1	26.4

NOTE: Percentages do not total to 100 because other/unknown mechanisms are not included.

SOURCES: National Science Foundation, Division of Science Resources Studies, Survey of Graduate Students and Postdoctorates in Science and Engineering; CASPAR Database System (http://caspar.nsf.gov/webcaspar/).

Self-support by S&E Field

About one-third of full-time S&E graduate students drew their financial support primarily from loans or from personal or family contributions in 1996. The importance of self-support also varied across S&E fields. About 40 percent of students in the computer sciences, medical sciences, anthropology, and industrial engineering, and more than 50 percent of those in psychology and political science relied on self-support for their primary support. Conversely, less than 10 percent of the students in astronomy, chemistry, and physics relied on self-support as their primary financial means (table 1).

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Table 2. Importance of Federal support for selected primary support mechanisms, by S&E field: 1996

Field	Research assistantships	Fellowships	Traineeships
	[percent with primary Federal support]		
Total S&E	49.5	24.4	63.8
Total sciences	50.5	23.0	65.1
Physical sciences	73.6	37.3	56.2
Astronomy	80.1	52.6	59.5
Chemistry	70.3	33.8	50.9
Physics	78.0	39.7	67.8
Other	60.0	0.0	NA
Mathematics	47.5	22.3	33.5
Computer sciences	59.8	27.5	23.3
Environmental sciences	63.4	31.2	52.7
Atmospheric sciences	84.1	51.0	0.0
Earth sciences	62.4	28.8	53.2
Oceanography	67.0	33.6	37.5
Other	35.6	28.3	70.6
Life sciences	48.8	28.4	77.4
Agricultural sciences	35.0	16.9	21.2
Biological sciences	55.8	31.1	72.1
Medical sciences	40.6	25.8	80.9
Other	26.6	23.4	86.2
Psychology	31.2	19.5	39.7
Social sciences	20.5	12.7	16.5
Anthropology	22.0	18.0	16.5
Economics	24.0	12.2	15.1
History of science	13.6	16.3	55.6
Linguistics	27.4	14.8	24.6
Political science	9.6	10.2	6.2
Sociology	23.5	7.9	34.5
Other	23.3	17.3	25.6
Total engineering	47.0	30.0	42.0
Aeronautical/astronautical	62.6	55.7	14.3
Chemical	47.8	28.7	67.7
Civil	36.4	26.7	18.5
Electrical	47.4	27.7	23.7
Industrial	29.2	23.5	92.9
Mechanical	49.7	32.7	33.9
Materials	59.7	36.0	66.7
Other	47.0	28.0	67.5

NA - Not applicable

SOURCES: National Science Foundation, Division of Science Resource Studies, Survey of Graduate Students and Postdoctorates in Science and Engineering; CASPAR Database System (http://caspar.nsf.gov/webcaspar/).

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