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WHERE HAS THE MONEY GONE? DECLINING INDUSTRIAL SUPPORT OF ACADEMIC R&D

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A three-decades-long trend of increasingly strong ties between industry and universities may have ended. Between 1972 and 2001, industrial support to universities and colleges grew more rapidly than any other source of support for academic research and development (NSB 2006, vol. 2: appendix table 5-2). A 1996 National Academy of Sciences report stated that "The prevalence and vitality of research partnerships between industrial organizations and universities have increased dramatically over the last two decades" (NAS 1996:1). A decade later, at an April 2006 meeting held at the National Academies, prominent industry and university speakers indicated that negotiations of sponsored research agreements, particularly disagreements over the treatment of intellectual property (IP), were negatively affecting the entire industry-university research partnership in the United States.[1] It was pointed out that U.S. companies increasingly choose to work with foreign rather than U.S. universities, encouraged by the more favorable IP rights that foreign universities offer and the strong incentives for joint industry-university research that foreign governments provide.

Against this background, it is perhaps not surprising that, beginning in 2002, the absolute value of industrial R&D dollars to academic institutions—funds provided directly to academic institutions for the conduct of research—began to decline. This trend has continued through 2004, the latest year for which data are available (NSF/SRS 2006).[2]

Funding Trends

Industrial R&D support to U.S. universities and colleges in current dollars reached a high of $2.2 billion in 2001 and has declined every year since, to $2.1 billion in 2004, a 5.1% decline over the 3 year period (figure 1). The share of academic R&D support provided by industry peaked at 7.4% in 1999 and declined every year thereafter, reaching 4.9% in 2004. The decline in industry's share was offset by an increase in the federal government's share. Industry's contribution to academic R&D as a proportion of all industry internal R&D funds was 1.1% in 2004, down from 1.5% in 1994, and its lowest level since the mid 1980s.

Among academic institutions performing R&D during the period 1994–2004, the number supported by industry and the number supported by funds from any source were both relatively stable (figure 2). However, a year-to-year comparison shows that institutions reporting an increase in industrial R&D support outnumbered those reporting a decrease through 2001, but the numbers between 2002 and 2004 were almost equal (figure 3).

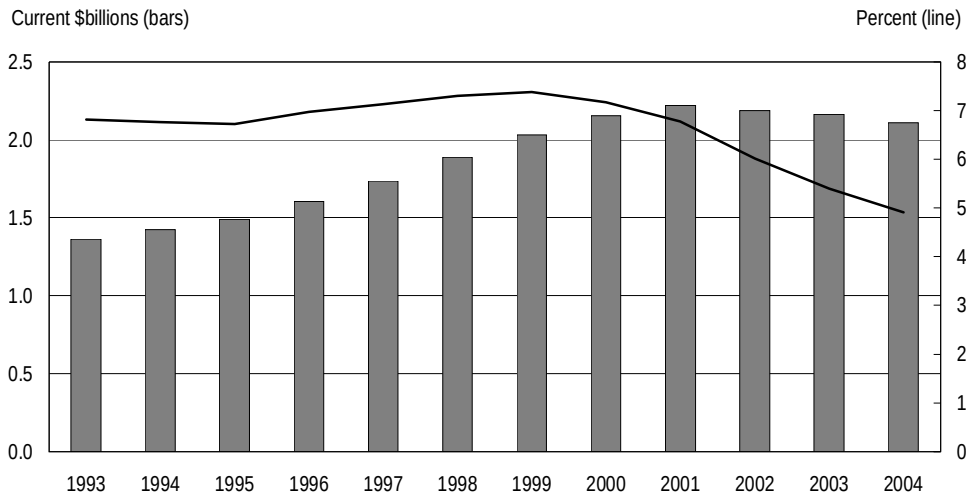
Distribution of Support

Industrial R&D support to academia has historically been concentrated in relatively few institutions. Between 1993 and 2004 the distribution of such support

[1] Re-Engineering the Partnership: Summit of the University-Industry Congress, 25 April 2006, Washington DC. Meeting and related materials available at http://www7.nationalacademies.org/guirr/Meetings.html.

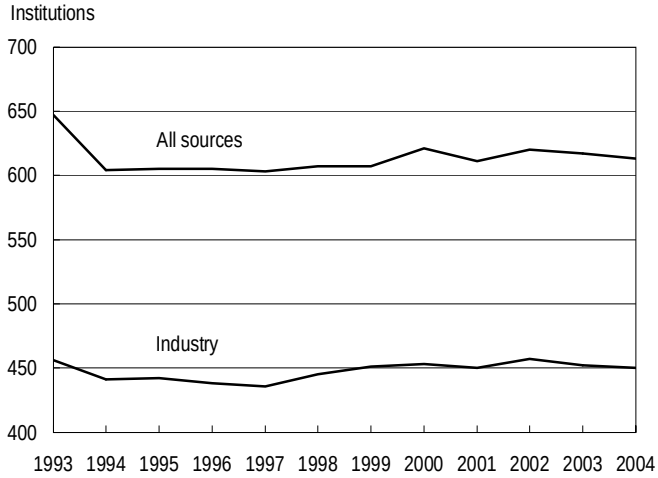
[2] Not included are funds for consultants and undesignated funds.

FIGURE 1. Academic R&D funds provided by industry: 1993–2004



SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, various years.

FIGURE 2. Academic institutions that receive R&D funds, by source of funds: 1993–2004



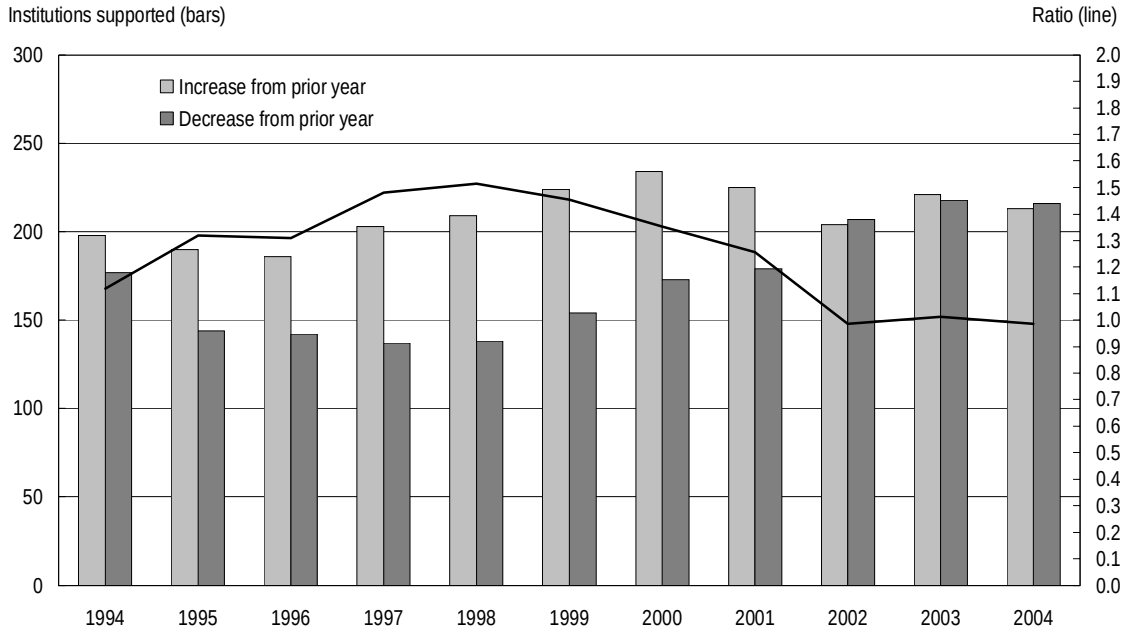
NOTES: These data are not comparable across all years owing to changes in the survey's sampling design. FY 1993 was a census of all institutions doing at least $50,000 in R&D, whereas FY1994–97 was a sample of those institutions. FY 1998–2004 was a census of all institutions doing at least $150K in R&D.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, various years.

became more concentrated at research-intensive institutions (as defined by total R&D expenditures). The top 200 universities and colleges (ranked by total R&D expenditures) accounted for about 95%–96% of total R&D and about 93%–94% of industry R&D support in both 1993 and 2004. However, looking separately at the top 100 institutions and those ranked between 101 and 200, a different picture emerges. In 1993, the top 100 institutions received 74% of industry funds; by 2004 they received 76%. Those institutions ranked between 101 and 200 received 17% of industry support in 2004, compared with 20% in 1993. There was no such change in the distribution of total R&D funds between these two groups during this period (see also NSB 2006, chapter 5).

The importance of industrial R&D support to research institutions with lower levels of total R&D expenditures has also changed over the past decade. One analysis ranked the top 200 academic institutions in terms of total R&D expenditures in both 1980 and 1991 and placed them in eight groups of 25 (NSB 1993, table 5-1). It showed that in both years, each of the four lower-

FIGURE 3. Trends in industrial R&D support to universities and colleges: 1994–2004



NOTES: Ratio is number of institutions reporting increased industrial R&D expenditures from prior year divided by number of institutions reporting decreased industrial R&D expenditures from prior year. Institutions with imputed or estimated values are excluded from the analysis.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, various years.

ranked groups received a larger average share of their R&D support from industry than each of the four higher-ranked groups. Table 1 shows comparable data for 1993, 1998, and 2004. In 1993 the results were identical to those in the earlier years, and in 1998, three groups in the institutions ranked 101 to 200 received a larger share of their funds from industry than any of the four groups in the top 100 institutions. However, by 2004, only two of the four lower-ranked groups (151–175 and 176–200) received a larger share of their funds from industry than any of the four top groups.

Trends in the number of top 200 institutions that receive more than 10% of their total R&D funds from industry have changed as well (table 1). The number of such institutions rose from 24 to 57 between 1980 and 1991, but by 2004 that number had fallen to 21. Between 1993 and 2004, the total number of academic institutions receiving more than 10% of their R&D funds from industry fell from 179 to 101, a drop of more than 40%.

Public and Private Institutions

Industrial R&D support trends differ little between public and private academic institutions. The absolute level of support peaked in 2001 for both kinds of institutions, with the share of support attributable to industry peaking earlier—1998 for public institutions and 1999 for private institutions. Both groups receive about the same share of their R&D funds from industry. Between 1993 and 2004 the number of public institutions receiving industry support increased slightly, and the number of private institutions declined slightly. Less than 70% of private institutions receive R&D support from industry, compared with close to 80% of public institutions.

Other Indicators

Trends in academic scientific articles with industry participation also suggest a recent decline in industry-university collaboration (table 2). The percentage of all academic articles with an industry coauthor increased steadily between 1993 and 2001 but declined in both 2002 and 2003. Industry participation showed the same trend when the set of academic articles was limited to those whose coauthors were from a sector other than academe (industry, government, not-for-profit) or were foreign.

Fewer citations of U.S. science and engineering (S&E) articles in U.S. industrial patents may also be suggestive

TABLE 1. Industrial funding of academic R&D, by institutions' level of R&D expenditures: 1993, 1998, and 2004

	Average R&D funding from industry (%)			Schools with >10% of R&D funding from industry (number)		
Ranking group	1993	1998	2004	1993	1998	2004
All universities and colleges	9.3	8.5	5.9	179	158	101
1–200	7.9	8.0	5.0	50	52	21
1–25	5.6	7.7	5.4	2	4	3
26–50	7.3	6.6	5.0	4	5	3
51–75	6.0	6.7	4.0	3	4	0
76–100	6.5	5.3	3.8	1	2	0
101–125	8.4	7.7	5.0	10	8	3
126–150	8.2	7.8	4.0	9	9	1
151–175	10.8	8.8	5.5	11	9	5
176–200	10.4	13.2	7.1	10	11	6
>200	10.0	8.7	6.3	129	106	80

NOTES: Institutions were ranked from highest total R&D expenditures to lowest, then sorted into groups of 25. Average proportions of total R&D funding from industry are unweighted (each institution in grouping is treated equally). Average proportion for all universities and colleges and share of all academic R&D funds provided by industry may not be identical.

SOURCE: National Science Foundation, Division of Science Resources Statistics, Survey of Research and Development Expenditures at Universities and Colleges, various years.

TABLE 2. Collaboration between academe and industry in the production of scientific articles: 1993–2003

	Academic articles[a]		Academic articles with industry coauthor		
Year	All	Sector[b] or foreign coauthor	Articles	% all academic articles	% articles with sector or foreign coauthor
1993	170,562	36,893	8,711	5.1	23.6
1994	173,992	38,577	9,396	5.4	24.4
1995	178,224	40,217	9,946	5.6	24.7
1996	179,876	40,724	10,055	5.6	24.7
1997	178,254	40,952	10,182	5.7	24.9
1998	180,222	41,660	10,496	5.8	25.2
1999	182,158	42,737	10,825	5.9	25.3
2000	181,518	42,626	10,805	6.0	25.3
2001	187,791	45,010	11,585	6.2	25.7
2002	184,882	44,134	11,294	6.1	25.6
2003	200,727	48,242	12,114	6.0	25.1

[a] Articles with at least one academic author.

[b] Other than academe (industry, government, or not-for-profit).

NOTE: Data for 2003 are latest available.

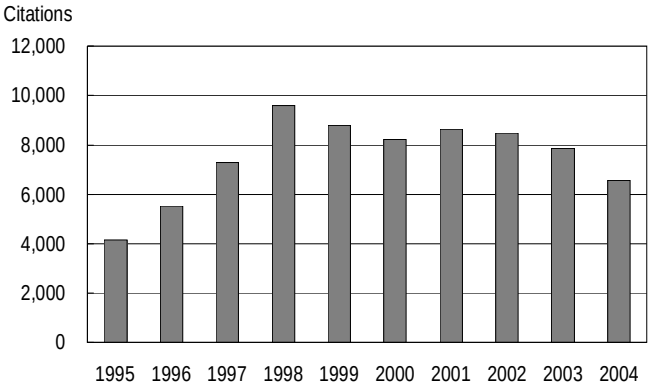
SOURCES: Thomson ISI, Science Citation Index and Social Science Citation Index; ipIQ Inc; and National Science Foundation, Division of Science Resources Statistics, special tabuluations.

of a decline in industry-university collaboration.[3] The number of citations increased rapidly between 1995 and 1998, declined and leveled off for several years, and declined again in 2003 and 2004 (figure 4).

Industry-university collaboration is a clear indicator of the relevance of academic research to commercial activity. Another promising area for study is the likely relationship between commercial activities of U.S. universities and industry-university collaboration. A number of indicators of universities' commercial activities show changes over time (table 3). However,

[3] The academic sector dominates U.S. S&E article production, accounting for nearly three-quarters of U.S. output.

FIGURE 4. Citations of U.S. science and engineering articles in industry patents: 1995–2004



SOURCE: National Science Board, *Science and Engineering Indicators 2006* , volume 2 (NSB 06-01A): appendix table 5-66. Available at http://www.nsf.gov/statistics/seind06/append/c5/at05-66.xls.

the relationships between changes in these indicators and changes in industry-university collaboration are not yet clear.

Patents awarded to U.S. academic institutions increased between 1993 and 1999, dipped, and then leveled off in 2002 and 2003. The number of new start-up companies peaked in 2001, as did new research funding from licenses. The number of equity licenses/options peaked in 2002. A number of other indicators continued to rise through 2003: invention disclosures received, new U.S. patent applications filed by universities, and the number of revenue-generating licenses/options (table 3).

Conclusion

Although both R&D support and publication data suggest a shift in the relationship between industry and academia, the data are not conclusive. Industry can cooperate or collaborate in research with academic institutions in ways other than providing direct financial support or coauthoring scientific articles, including using academic consultants, providing research space or equipment to academic researchers, making use of specialized facilities at academic institutions, and employing student interns. Further research is needed to determine how these relationships have evolved over the past few years and to clarify the relationship between the commercial activities of universities and industry-university collaboration.

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TABLE 3. Indicators of commercial activities of U.S. universities: 1993–2003

(Indexed to 1995)

Indicator	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Patents awarded to all academic institutions	86	95	100	115	130	168	178	165	171	174	174
Academic start-up companies formed	NA	104	100	109	153	165	163	218	238	215	206
New academic research funding from licenses	NA	94	100	138	121	113	132	164	201	189	189
Academic equity licenses/options	NA	NA	100	114	205	212	183	299	331	377	319
Academic invention disclosures received	89	90	100	109	122	129	135	145	152	170	185
Academic new U.S. patent applications filed	84	85	100	115	154	174	205	237	244	274	304
Academic revenue-generating licenses/options	80	83	100	116	132	141	156	177	181	199	260
Academic new licenses/options executed	81	96	100	103	126	144	154	167	154	171	180

NA = not available.

NOTE: Data for 2003 are latest available.

SOURCE: National Science Board, *Science and Engineering Indicators 2006,* volume 2 (NSB 06-01A): appendix tables 5-68 and 5-69. Available at http://www.nsf.gov/statistics/seind06/append/c5/at05-68.xls and http://www.nsf.gov/statistics/seind06/append/c5/at05-69.xls.

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