Changing U.S. Output of Scientific Articles: 1988–2003

Special Report

Division of Science Resources Statistics
Directorate for Social, Behavioral, and Economic Sciences

National Science Foundation

May 2007

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and Robert K. Bell

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Suggested Citation
National Science Foundation, Division of Science Resources Statistics, 2007. *Changing U.S. Output of Scientific Articles: 1988–2003.* NSF 07-320, Derek Hill, Alan I. Rapoport, Rolf F. Lehming, and Robert K. Bell (Arlington, VA).

May 2007

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Executive Summary

In an unexpected development in the early 1990s, the absolute number of science and engineering (S&E) articles published by U.S.-based authors in the world's major peer-reviewed journals plateaued. This was a change from a rise in the number of publications over at least the two preceding decades. With some variation, this trend occurred across different categories of institutions, different institutional sectors, and different fields of research. It occurred despite continued increases in resource inputs, such as funds and personnel, that support research and development (R&D).

In other developed countries—a group of 15 members of the European Union (the EU-15) and Japan—the absolute number of articles continued to grow throughout most of the 1992–2003 period. During the mid- to late 1990s, the number of articles published by EU scientists surpassed those published by their U.S. counterparts, and the difference between Japanese and U.S. article output narrowed. Late in the period, growth in the number of articles produced in some of these developed countries showed signs of slowing.

The trend in number of S&E articles produced in four developing East Asian economies (the East Asia-4) was markedly different. This group exhibited strong growth in the number of articles, number of influential articles, and percentage of overall output classified as influential. Nonetheless, because the East Asia-4 began the period with a much less mature S&E research establishment than the three S&E publishing centers named above, it continued to lag behind them on the measures examined.

The unprecedented plateau in the number of U.S. S&E articles should not be confused with a decades-long and familiar decline in the U.S. share of the world's S&E articles. As other states built up their S&E capabilities, the U.S. share of the world's articles in natural sciences and engineering dropped from 38% in 1973 to 28% in 2003. This decline in share is not surprising, nor has it been viewed as a cause for concern. By many measures, including articles published in peer-reviewed journals, the United States has been the world's leading scientific nation for decades and remains the world's leading scientific nation.

On the whole, the U.S. share of the world's S&E articles remained relatively more robust in biomedical fields than in the physical sciences and engineering, where share declines tended to be greatest and output statistics tended to lag. In fields where U.S. shares of world article output dropped least, the United States was increasing its rate of international collaboration relatively quickly and thus was increasingly sharing credit with other countries.

Although the U.S. share of the world's influential articles dropped substantially, the United States remained dominant in this area. At the end of the period studied, U.S. institutions were at least partially responsible for half of the world's influential articles; no other major publishing center approached this figure. Moreover, compared with other major publishing centers, a considerably higher percentage of total U.S. output was classified as influential.

The U.S. academic sector, which dominates U.S. article production, largely mirrored the overall U.S. trends, although its growth in article output over the entire period compared favorably with that of other sectors. The most prestigious academic institutions, however, experienced relatively slow output growth. The increase in collaboration across national, institutional, and sectoral boundaries, which is most fully documented in academic sector data, was perhaps the most striking trend in S&E research and publication during this period.

INTRODUCTION

PURPOSE AND SCOPE

Scientists and engineers ordinarily publish their research results in peer-reviewed journal articles. The number of these articles is an indicator of research output, although an admittedly imperfect one. Citations to these articles are an indicator, also imperfect, of the extent of the cited article's influence. In recent years, international use of these and related indicators has become widespread as countries have sought to assess their relative performance in S&E research.

This report is part of a larger study by the National Science Foundation (NSF), Division of Science Resources Statistics (SRS), on changing patterns and trends in U.S. production of scientific articles since the late 1980s. The study was initiated in light of evidence that the growth in the number of U.S. articles, which had continued for more than two decades, began to slow in the 1990s even though R&D funds, research personnel, and similar research inputs continued to grow.

SRS plans to publish results from this study in a series of three reports, each focused on a different aspect of the issue. The present report is purely descriptive and does not attempt to speculate about explanations for the findings. It presents quantitative data on patterns and trends in article production and citations during the 15-year period between 1988 and 2003. The second report, *The Changing Research and Publication Environment in American Research Universities* (http://www.nsf.gov/statistics/srs07204), which is based on qualitative data from interviews and focus groups, summarizes the views of experienced observers and practitioners in research universities about how the worlds of academic S&E research and publication changed during the study period. Some of the observations in that report bear on possible explanations of the patterns and trends in the quantitative data reported here. A third report (forthcoming) analyzes quantitative data on research inputs and outputs in the U.S. academic sector to explore possible factors associated with the patterns and trends described in the first two reports. None of the reports speculate about possible policy implications of the findings.

This report is confined to a presentation of data derived from the most comprehensive database available on scientific publications. It makes no attempt to cover the large, dispersed literature bearing on various aspects of the changing environment for research and publication (e.g., Stephan et al. on faculty commercialization and publication activities; Stossel and Stossel on publication patterns in a single discipline; Cummings and Kiesler on multidisciplinary and multiinstitutional research; Tijssen on changes in publication practices in the industrial sector; Tenopir and King on the rise of electronic journals).[1] Nonetheless, these more targeted studies and others like them, which use other, more theoretically driven analytic models and less-comprehensive databases, suggest significant avenues for further research. In many cases, studies such as these prompted examination of the patterns presented in this report.

ORGANIZATION OF THE REPORT

This report is divided into a methodological section and three substantive sections. The methodological section discusses the database, selection of the journal set, and various ways to count articles. The first substantive section examines and compares overall trends in S&E article production in four major publishing centers: the United States, the EU-15, Japan, and the East Asia-4.[2] This section also includes a description and comparison of trends in national article outputs in the different S&E

[1] Stephan, P.E., S. Gurmu, A.J. Sumell, and G. Black. Who's Patenting in the University? Evidence from the Survey of Doctorate Recipients. Forthcoming in *Economics of Innovation and New Technology*. http://www2.gsu.edu/~ecosgg/research/pdf/sgsb_eint.pdf. Accessed December 2006.; Stossel, T.P. and S.C. Stossel. 1990. Declining American Representation in Leading Clinical Research Journals. *New England Journal of Medicine* 322 (11): 739-42.; Cummings, J.N. and S. Kiesler. 2005. Collaborative Research Across Disciplinary and Organizational Boundaries. *Social Studies of Science* 35/5 (October): 703-722.; Tijssen, R.J.W. 2004. Is the commercialisation of scientific research affecting the production of public knowledge? Global trends in the output of corporate research articles. *Research Policy* 33: 709-33.; Tenopir, C. and D.W. King. 2000. *Towards Electronic Journals: Realities for Scientists, Librarians, and Publishers*. Washington, D.C.: SLA Publishing.

[2] The four major publishing centers accounted for 78% of world S&E article production in 2003.

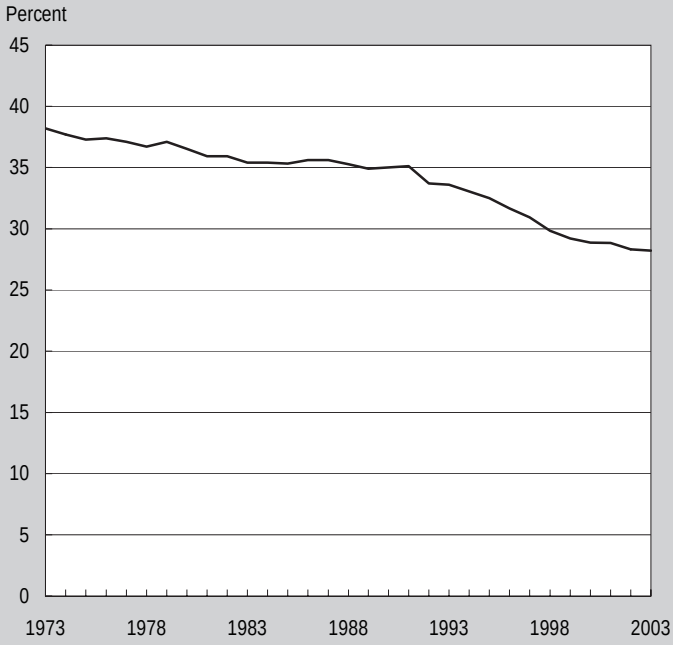
What prompted this study?

The number of science and engineering (S&E) articles published by U.S.-based authors in the world's major peer-reviewed journals leveled off in the 1990s. Publications had risen over at least the two preceding decades, and a plateau was unexpected given that resource inputs that support R&D, such as funds and personnel, continued to increase.

This unprecedented, prolonged plateau in absolute number of U.S. S&E articles, accompanied by steady rises in resource inputs, provided the impetus for this study and gave it its central focus. It should not be confused with a decades-long and familiar decline in the U.S. share of the world's S&E articles, shown below.

The U.S. share of the world's articles in natural sciences and engineering dropped from 38% in 1973 to 28% in 2003. This decline in share, reflecting the build-up of other nations' S&T systems, is not surprising and has not been viewed as a cause for concern. By many measures, including articles published in peer-reviewed journals, the United States has been the world's leading scientific nation for decades and remains the world's leading scientific nation.

U.S. share of world natural science and engineering article output, fractional counts: 1973–2003



SOURCES: National Science Board, Science & Engineering Indicators, 2006, appendix table 5-26 and Science & Engineering Indicators 2006, appendix table 5-41; Thomson ISI, Science Citation Index; and ipIQ, Inc.

fields. Subsequent sections examine patterns and trends in strategically important parts of the research enterprise. The second substantive section focuses on influential (i.e., highly cited) articles and journals. These articles and journals are important because a nation's involvement in influential research indicates worldwide leadership in S&E and can have implications for economic and technological leadership. The third substantive section describes trends in the output of the U.S. academic sector. This sector produces the most articles of any U.S. sector. Developments in this sector therefore are especially important to the overall health of a nation's research system and affect the nation's ability to attract and retain talented researchers from other countries. This section pays particular attention to the top U.S. research universities.[3] Research is central to the overall mission of these institutions, many of which achieve or aspire to worldwide recognition as research leaders. These institutions thus comprise the most strategically important part of this institutional sector.

[3] Based on total R&D expenditures during the 1988–2001 period.

Methodological Issues

Numerous technical issues arise in counting the journal articles that nations and institutions produce. Three such issues are especially consequential: the journal database, expanding and fixed journal sets, and whole counts versus fractional counts.

The Journal Database

The first issue is which articles to count. This report presents counts of S&E articles, notes, and reviews published in scientific and technical journals tracked by Thomson ISI[4] and indexed in the *Science Citation Index* and *Social Sciences Citation Index*. Counts exclude all letters to the editor, news pieces, editorials, and other content whose central purpose is not presentation or discussion of scientific data, theory, methods, apparatus, or experiments.

Thomson ISI tracks a set of more than 5,000 internationally recognized journals that it has determined to be the most influential in the world. S&E articles in these journals build primarily on one another to form the scientific literature. These journals contain approximately 15 million citations, about 85% of which are to articles in journals in the Thomson ISI database. Coverage extends to electronic journals, including print journals with electronic versions and electronic-only journals. Journals of regional or local importance may not be covered, which may be especially salient for research in engineering/technology, psychology, the social sciences, the health sciences, and the professional fields,[5] as well as for nations with a small or applied science base. Thomson ISI covers non-English language journals, but only those that provide their article abstracts in English, which limits coverage of non-English language journals.

Relative to other bibliometric databases, Thomson ISI indexes a wider range of S&E fields and contains more complete data on the institutional affiliations of an article's authors. For particular fields, however, other databases provide more complete coverage. Although the body of this report relies exclusively on Thomson ISI data, appendix table 1 contains comparable data from several other bibliometric databases; brief descriptions of those databases are provided in the table notes. These databases exhibited generally similar trends to the Thomson ISI of flattening U.S. output and continued growth by the EU-15 and Asian countries starting in the mid-1990s.

Expanding and Fixed Journal Sets

A second issue is how to deal with changes in the set of journals tracked by Thomson ISI. Over time, many new journals emerge and attain influence, while a few older journals decline or stop publication. Because the global S&E research enterprise is growing, the net direction of change is toward more articles and more journals in the Thomson ISI database. The database grew from 4,460 journals in 1988 to 5,262 in 2001, and many of the journals indexed published more articles per issue and more issues per year toward the end of the period than they did in previous years.[6]

At any given time, the expanding set of journals tracked by Thomson ISI is the most suitable indicator of the mix of journals and articles. Patterns of authorship and citation in this set reflect the fields, nations, and institutions in which high-quality research is being produced. However, an expanding set of journals poses problems for trend analyses. Changes in the expanding set over time can result not only from changes in how and where scientists and engineers perform research, but from changes in the journals Thomson ISI chooses to include or the depth of its coverage in different fields or languages. In addition, an expanding universe of articles makes changes in the shares attributable to different parts of the research community less readily interpretable.

[4] Thomson ISI changed its name to Thomson Scientific in June 2006. This article uses the company's name at the time of the study. All data from the Thomson ISI database presented in this report derive from the Science Indicators database prepared for the National Science Foundation by ipIQ, Inc. (formerly CHI Research, Inc.).

[5] The professional fields include communication, education, information and library science, law, management and business, miscellaneous professional fields, and social work.

[6] Among the journals included in the Thomson ISI database since 1985, the average annual number of articles per journal rose from 102 in 1986 to 142 in 1999.

One alternative analytic strategy is to follow a fixed set of journals that existed throughout the period under study. Changes over time within this set are likely to reflect real output changes rather than variation in the depth of Thomson ISI's coverage of different sources of output. However, comparisons within a fixed set of journals have a major limitation. Because new research communities often spawn new journals to disseminate their research findings, a fixed journal set underrepresents, perhaps severely, the types of research that were not already well established at the outset of the period. The longer the period being studied, the less adequate a fixed journal set becomes as a representation of the world's articles throughout the period.

In view of this limitation, and because the expanding set is more representative of the universe of high-quality research articles in any given year, this report presents data on the expanding journal set. SRS has conducted parallel analyses on both journal sets and found very similar patterns and trends. Appendix table 2 presents trend data drawn from a fixed set of journals restricted to those that were in the Thomson ISI data set from 1985 through 2003.

Fractional and Whole Counts

The third issue is how to attribute articles to nations, institutional sectors, institutions, and fields. The Thomson ISI database contains data on the institutional affiliations of the researchers who receive authorship credit for articles in the journals it indexes. However, apart from names and institutional affiliations, it contains almost no information about the authors themselves—their disciplines, citizenship, age, sex, rank, or status within their institutions, and so forth. Although descriptions of the data in this report may refer to "authorship," unless specified otherwise, this means institutional authorship—that is, the institutional affiliation(s) of the individual(s) in the list of authors.

SRS engages a contractor, ipIQ, Inc., to extract Thomson ISI data into a Science Indicators database. From this database, ipIQ generates article and citation counts and authorship information. To assign credit for contributions, ipIQ records each institutional address listed in an article's author list. It also records the number of author names listed on the article but does not link author names with institutions. For U.S. institutions, ipIQ classifies addresses by institutional sector: academia, federal government, state government, industry, nonprofit, and federally funded research and development centers (FFRDCs). Articles with a foreign institutional address are attributed to their country of origin but are not allocated to particular institutions or sectors. Finally, ipIQ assigns an article to a field of research on the basis of the journal in which the article appears; the field classification of the journal, in turn, is based on the patterns of the journal's citations. ipIQ's field classification is used in most of the analyses presented in this report.

When only one institution is credited as author of an article, attribution is simple: regardless of how many people collaborated in writing the article, the institution receives one credit for it. When articles are the product of collaboration between authors at different institutions, institutional credit may be assigned in two different ways: whole counting and fractional counting. Each has different advantages, and both are used in the analyses presented in this report.

In whole counting, each institution that appears in the author list receives one credit for an article. When articles are authored by collaborating institutions from multiple countries, each country receives one count for its participation, regardless of the number of its collaborating institutions. For example, the United States and France would each receive one credit for an article coauthored by one French institution and two U.S. institutions. Thus, the number of credits for an article varies, depending on the number of institutional authors or the number of countries represented among the collaborating institutions. When institutions collaborate, a single article is counted more than once. As a result, the sum of the whole counts attributed to institutions in a given U.S. institutional sector does not equal the whole count for the sector itself. Likewise, the sum of U.S. sector counts exceeds the U.S. country count, and the sum of country counts exceeds the world count.

In fractional counting, each article receives a single credit, regardless of how many institutions earn authorship credit. When more than one institutional author is involved, credit for the article is divided equally among the institutions that appear in the author list.[7] Thus, in

[7] This method is used even for articles with a very large number of institutional addresses. Thomson ISI does not truncate the list of institutional addresses. ipIQ did truncate after 25 addresses between 1988 and 1991, but this practice affected less than 1% of articles during this period.

collaborations among different institutions, each institution receives a "fractional" credit that represents its share of an article. In the prior example, the United States and France would receive 2/3 and 1/3 of a credit, respectively, for their co-authorship of the article. The same logic applies in dividing credit for cross-sectoral and international collaborations. Because each article is counted only once, the fractional counts for institutions within a U.S. institutional sector sum to the fractional count for the entire sector, and the fractional counts for the various sectors sum to the count for the entire country.

Whole counts are useful indicators of how often an institution, sector, or country is involved in producing articles. Fractional counts are useful in highlighting patterns and trends in the shares of credit attributable to different institutions, sectors, or countries. Neither method adequately captures the many factors that affect how the research community allocates credit for articles. Taken together, the two counting methods provide related, although sometimes different, perspectives on recent trends in the production of S&E articles in the United States and abroad.

Output Trends in Major S&E Publishing Centers

Trends in U.S. Article Output

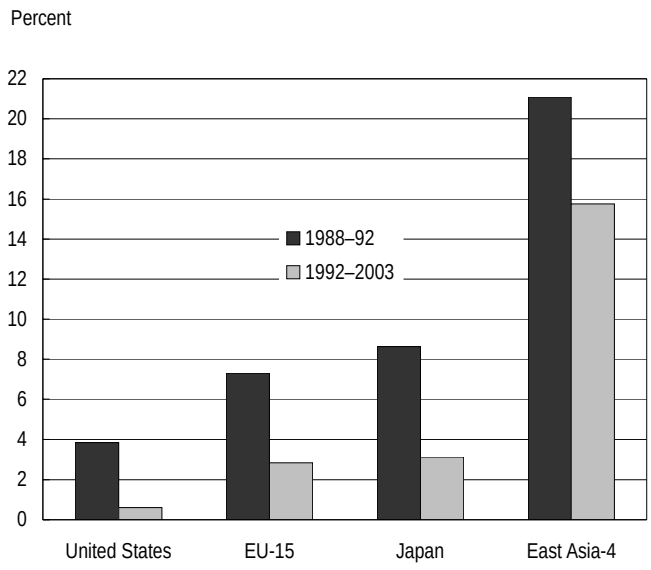
The number of S&E articles credited to U.S. institutions through fractional counting of the expanding Thomson ISI journal set has essentially remained constant since 1992 after growing consistently during the preceding two decades. It is convenient to divide the 1988–2003 period into an early period (1988–92) when U.S. article output was growing and a later period (1992–2003) when it was essentially flat. Output grew at an average annual rate of 0.6% between 1992 and 2003 but all the growth occurred in 2003, so growth was -0.2% through 2002, compared with 2.9% between 1988 and 1992 (figure 1).[8] Appendix table 3 shows U.S. article output and world article share based on fractional counts.[9]

The flattening of U.S. article output occurred despite continued growth of both real R&D expenditures and the academic sector R&D workforce, which produces most U.S. S&E articles (figure 2). Article output of the three other major S&E publishing centers (the EU-15, Japan, and the East Asia-4) grew considerably faster than U.S. output between 1992 and 2003 (figure 1). The growth rates of the EU-15 and Japan during this period, however, were considerably slower than between 1988 and 1992, in a pattern similar to that of the United States.

These changes are not the result of changes in Thomson ISI journal coverage. Although expanding journal coverage over time could affect measures of U.S. output for reasons that have little or nothing to do with publishing intensity, such as coverage of new non-English journals, data from the fixed set of journals that have been part of the Thomson ISI database since 1985 show a similar growth pattern and identical change in the U.S. share (appendix table 2). In several other journal databases, the trend of faster growth in the rest of the world relative to the United States was also similar (appendix table 1). Therefore, except as otherwise noted, this section reports data for the Thomson ISI expanding journal set.

Throughout the 1988–2003 period, international collaboration as indicated by article coauthorship was rising, which affects whole and fractional authorship counts differently (see sidebar "Effect of International Collaboration on Whole- and Fractional-Count Output"). However, overall U.S. output trends based on these two measures are congruent, albeit with somewhat higher U.S.

FIGURE 1. Average annual growth in S&E article output (fractional counts) of major S&E publishing centers: 1988–92 and 1992–2003



S&E = science and engineering; EU = European Union.

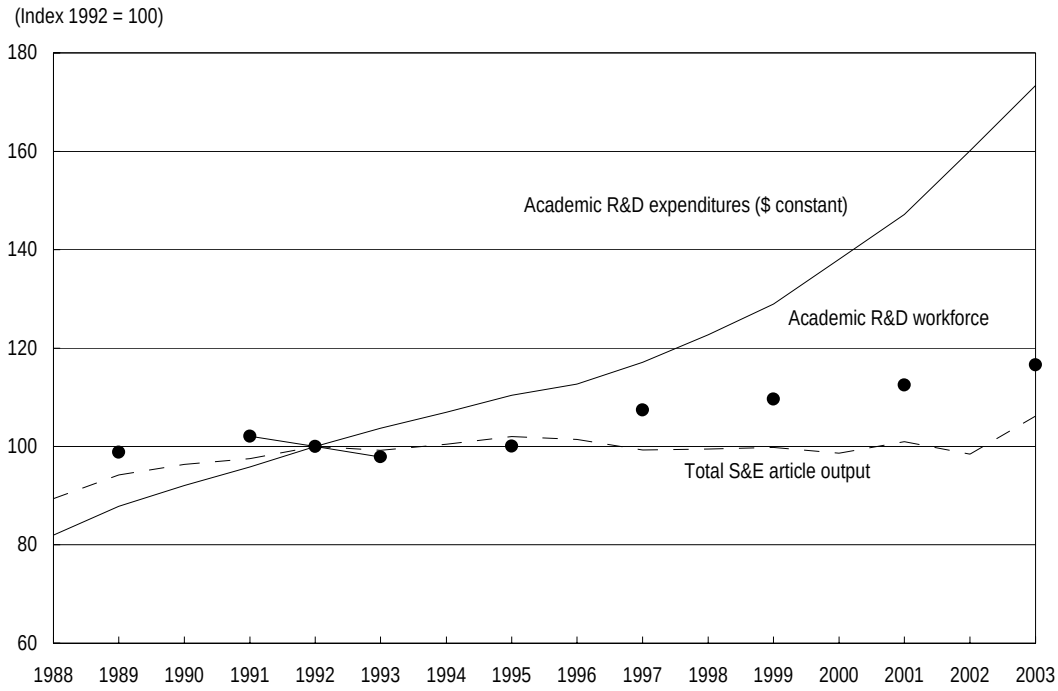
NOTES: Articles on fractional-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives fractional credit on basis of proportion of its participating institutions. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 3.

[8] U.S. article output rose almost 8% in 2003 compared with 2002, following a decline between 2001 and 2002. A similar trend occurred in the EU countries and Japan. Although this trend may reflect a real change in article output, it may also be the result of variation in how quickly publications are added to the Thomson ISI database.

[9] Data on S&E article output from earlier in the 1980s and the 1970s are available in appendix table 5-44 of *Science and Engineering Indicators 1998* and appendix table 5-21 of *Science and Engineering Indicators 1993*, respectively.

FIGURE 2. U.S. S&E article output (fractional counts), academic R&D expenditures, and academic R&D workforce: 1988–2003



S&E = science and engineering; R&D = research and development.

NOTES: Articles on fractional-count basis, i.e., for articles with collaborating institutions, each institution receives fractional credit on basis of proportion of its participating institutions. U.S. academic workforce is number of S&E doctorate-holders employed at all U.S. academic institutions whose primary or secondary activity is R&D. Academic R&D expenditures adjusted by gross domestic product deflator. Data for academic workforce available for odd years; 1992 base year data calculated by averaging 1991 and 1993 data.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; National Science Foundation, Division of Science Resources Statistics, special tabulations; *Academic Research & Development Expenditures: Fiscal Year 2003;* and *Science and Engineering Indicators 2006,* appendix table 5-32.

growth rates when whole counts are used. Thus, U.S. whole-count output slowed in a pattern similar to the flattening of output seen when fractional counts are used (figure 3 and appendix table 4), rising at an average annual rate of 1.2% between 1992 and 2003 compared with 3.4% between 1988 and 1992 (figure 3). Output growth in whole counts in the three other major publishing centers between 1995 and 2003 was higher than in the United States.

Unless otherwise indicated, the remainder of this report presents fractional-count data for the expanding Thomson ISI journal set. However growth trends by field seen in the whole-count data and in the fixed journal set are similar.

U.S. growth trends by field showed some variation (appendix tables 3 and 5). In some fields, the pattern tracks the overall trend fairly closely, but with different dates for the onset of flattening. These include the social sciences (1990), biology (1990), engineering/technology (1993), chemistry (1993), clinical medicine (1995), biomedical research (1995), and psychology (1996). In physics, article output flattened at the same time as overall output but exhibited an outright decline between 1995 and 2003.

In two fields, trends departed substantially from the overall pattern. Article output in the earth/space sciences grew consistently over the entire 15-year period. In mathematics, output declined between 1988 and 1997 but then grew modestly between 1997 and 2003.

Effect of International Collaboration on Whole- and Fractional-Count Output

The ratio of a country's fractional counts to its whole counts is a measure of how much it collaborates internationally. In some contexts, the international collaborating entity is a publishing center, such as the EU-15 or East Asia-4. A lower ratio signifies more collaboration. At the extreme, if a country never collaborated internationally, fractional counting would give it full credit for every article in which it participated—that is, its fractional and whole counts would be identical and the ratio would be 1. As collaboration with other countries increases, a country's fraction of credit for its articles declines, growing smaller relative to its whole counts. Substantively, a country's ratio of fractional counts to whole counts may be interpreted as the proportion of credit attributable to that country for the articles in which the country played an authorship role.

International collaboration can reduce the ratio in two ways: (1) a country may produce more articles in collaboration with other countries or (2) even if the country produces the same number of international articles, it may increase the number of international collaborators per article, so that the country's fraction of credit for its international articles decreases.

Whole and fractional counting are imperfect measures of international collaboration because the allocation of counts to countries is done by the addresses listed on the article. Therefore, if a publication does not list the address of a collaborator, the collaborator's country would not receive credit for the publication.

Between 1992 and 2003, the ratio of fractional counts to whole counts declined in three of the four major S&E publishing centers—the United States, the EU-15, and Japan (table 2). Therefore, growth in article output was less as measured on a fractional-count basis than as measured on a whole-count basis in these S&E publishing centers during this period. Because there was little change in the ratio of fractional counts to whole counts in the East Asia-4, fractional-count and whole-count growth rates were very similar (appendix table 5).

Trends in federal funding by field did not generally coincide with trends in article output in broadly comparable fields (table 1).[10] Beginning in 1990, real growth in federal funds was generally positive and robust, except in chemistry and physics. Yet corresponding growth in article output occurred only in the earth/space sciences, which receive funds classified under geosciences[11] and astronomy. In physics, the funding trend—an increase in real terms between FY 1986 and FY 1990, followed by a decline—was also similar to the trend in article output.

U.S. Share of the World's Articles

The U.S. share of world article output declined between 1992 and 2003. The combination of nearly stagnant U.S. output and continued growth in the three other major S&E publishing centers led the U.S. share to fall from 37% to 30% (figure 4 and appendix table 3). A longer series that is limited to natural sciences and engineering articles shows a long term decline from 38% in 1973 to 28% in 2003 (see inset to figure 4).

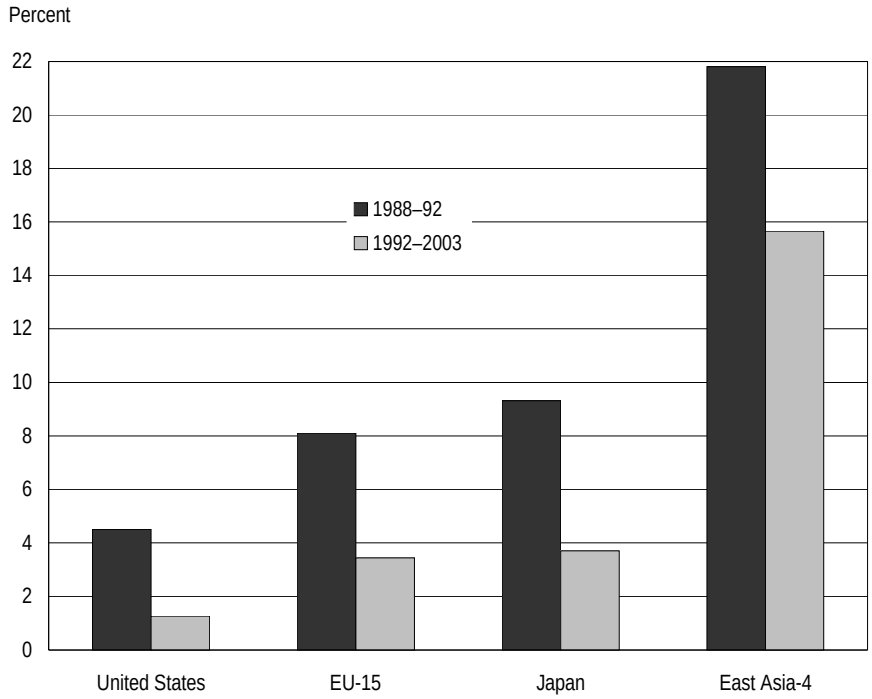
As with output trends, share trends by field varied from the overall average (figure 5). Two fields, engineering/technology and mathematics, experienced percentage point declines that were more than twice the overall U.S. decline during this period. Biomedical research, clinical medicine, the earth/space sciences, and chemistry had a significantly lower than average decline in their shares compared with the overall share trend.

For most fields, the size of the share decline was similar whether measured in whole or fractional counts (figure 5 and appendix tables 3 and 4). Three fields, clinical medicine, biomedical research, and the earth/space sciences, were exceptions. In these fields, the decline in whole-count share was substantially less than the decline in frac-

[10] Because the time needed to carry out research causes a lag between funding and publication of findings, the comparison of funding with article output allows for a 2-year lag between the date of funding and the date of publication (i.e., funding in year 1 is compared with article output in year 3).

[11] Geosciences consists of earth, atmospheric, and ocean sciences.

FIGURE 3. Average annual growth in S&E article output (whole counts) of major S&E publishing centers: 1988–92 and 1992–2003



S&E = science and engineering; EU = European Union.

NOTES: Articles on whole-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives one count for its participation regardless of the number of its participating institutions. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 4.

tional-count share. This finding suggests that, more than in other fields, the loss of fractional-count share in these fields was because U.S. authors were increasing their collaboration with the rest of the world (see sidebar "Effect of International Collaboration on Whole- and Fractional-Count Output").

Article Output in the EU-15, Japan, and the East Asia-4

In contrast to the flattening of article output in the United States between 1992 and 2003, output expanded during this period in the three other major S&E publishing centers (figure 6 and appendix table 3).

Article output in the EU-15 grew at an average annual rate of 2.8% between 1992 and 2003, more than four times faster than in the United States (figure 1), and EU-15 output surpassed U.S. output in 1998 (figure 6 and appendix table 3). As in the United States, EU-15 growth after 1992 was slower than growth between 1988 and 1992. The EU-15 growth trend in the 1985 fixed journal set was very similar and surpassed U.S. output in 1997 (appendix table 2). EU-15 fractional-count output grew faster than U.S. output between 1992 and 2003 in all fields (appendix table 5). In the mid-1990s, EU-15 output surpassed the United States in clinical medicine, the earth/space sciences, engineering/technology, mathematics, and physics (appendix table 3).

Japan's output rose at an average annual rate of 3.1% between 1992 and 2003, five times faster than that of the United States (figure 1). As with the United States and the EU-15, Japan's growth rate began to slow in 1992. Japan's output path was similar in the 1985 fixed jour-

TABLE 1. Average annual growth in federal research funding and S&E article output (fractional counts), by field: 1986–2003

(Percent)

	Federal funding		S&E articles	
Field	1986–90	1990–2001	1988–92	1992–2003
All fields	4.7	5.1	3.8	0.6
Life sciences	6.2	7.6	4.0	0.6
Chemistry	0.3	0.7	3.6	0.7
Physics	3.1	-1.4	3.8	-0.8
Geosciences and astronomy	7.6	1.4	4.9	3.0
Engineering and computer sciences	1.3	5.4	6.8	0.3
Social sciences	10.0	2.4	2.9	0.3
Psychology	5.6	2.8	2.1	0.3
Mathematics	4.7	2.7	-3.0	0.6
Other	6.8	4.7	2.4	1.2

S&E = science and engineering.

NOTES: Federal funding is federal obligations in constant 2000 dollars. Because time needed to carry out research causes a lag between funding and publication of findings, comparison of funding with article output allows for a 2-year lag between date of funding and date of publication (i.e., funding in year 1 is compared with article output in year 3). Articles on fractional-count basis, i.e., for articles with collaborating institutions, each institution receives fractional credit on basis of proportion of its participation. Life sciences include biology, agricultural sciences, and medical sciences. Environmental sciences and astronomy include atmospheric sciences, geological sciences, oceanography, environmental sciences not classified elsewhere, and astronomy. "Other" includes physical sciences not classified elsewhere, social sciences not classified elsewhere, and other sciences.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http:www.isinet.com/products/citation/; ipIQ, Inc.; National Science Foundation, Division of Science Resources Statistics, *Federal Funds for Research and Development: Fiscal Years 1970–2003; Federal Obligations for Research by Agency and Detailed Field of Science and Engineering,* NSF 04-335 (2004). See appendix table 5.

TABLE 2. Indicators of international collaboration for major S&E publishing centers: Selected years, 1992–2003

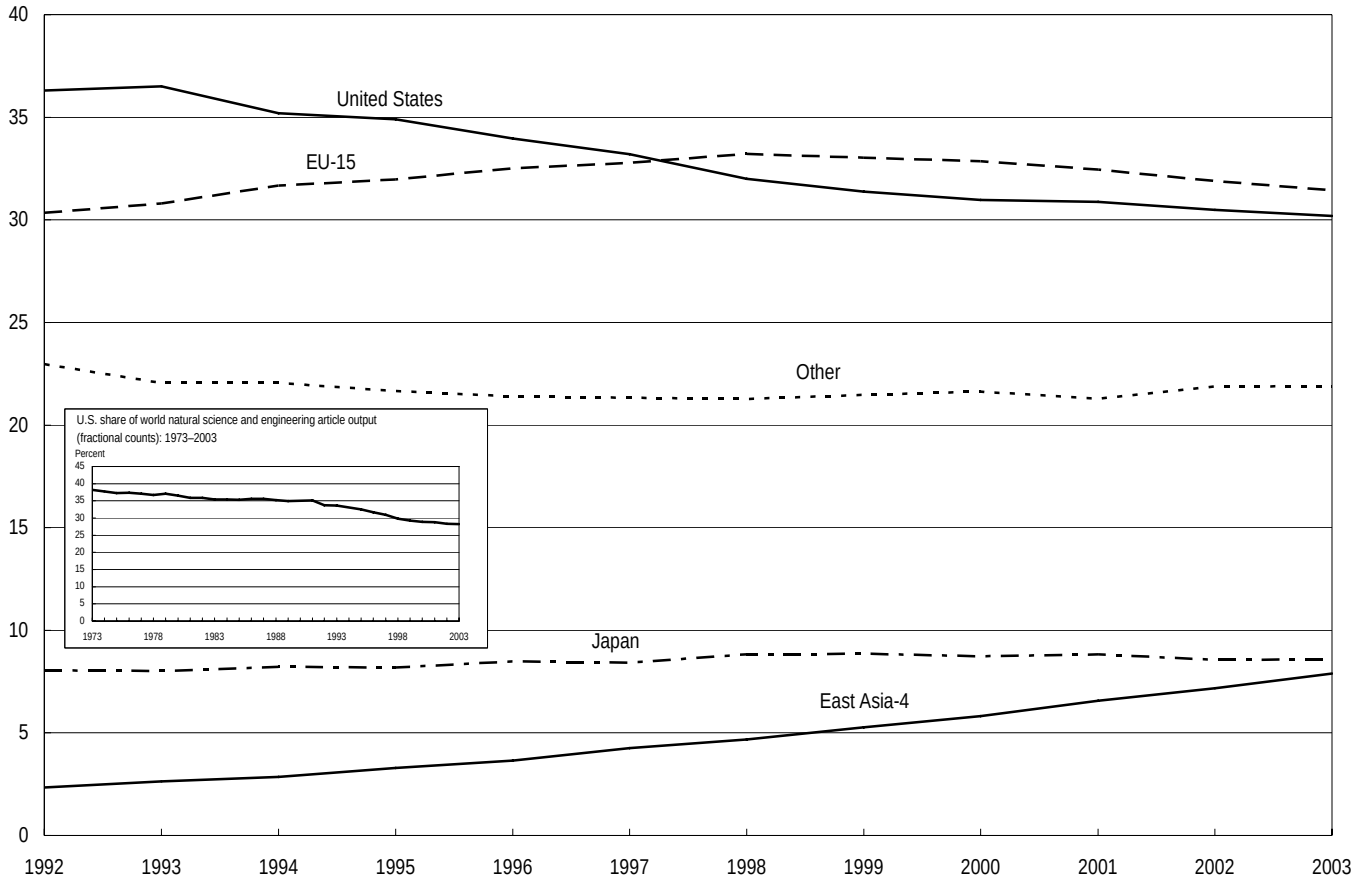
Indicator and publishing center	1992	1995	1997	1999	2001	2003
Ratio of fractional to whole S&E article counts						
United States	0.931	0.917	0.905	0.892	0.881	0.871
EU-15	0.913	0.900	0.890	0.882	0.871	0.862
Japan	0.938	0.922	0.913	0.907	0.896	0.887
East Asia-4	0.865	0.865	0.874	0.876	0.873	0.873
Proportion of international to domestic addresses						
United States	0.135	0.169	0.193	0.218	0.241	0.261
EU-15	0.170	0.200	0.217	0.231	0.254	0.271
Japan	0.143	0.194	0.211	0.207	0.236	0.255
East Asia-4	0.359	0.416	0.354	0.326	0.318	0.316
Percent of S&E articles with an international address						
United States	13.9	16.7	18.8	21.1	23.2	24.8
EU-15	17.3	19.9	21.8	23.4	25.5	27.2
Japan	11.8	14.7	16.5	17.7	19.7	21.5
East Asia-4	25.3	25.6	25.5	25.2	24.8	25.4

S&E = science and engineering; EU = European Union.

NOTES: For articles with collaborating institutions from multiple publishing centers, fractional counts assign each publishing center fractional credit on basis of proportion of its participating institutions, and whole counts assign each publishing center one credit for its participation, regardless of the number of its participating institutions. Proportion of foreign to domestic addresses measured across total articles of each publishing center. An international address is an institutional address outside of the indicated publishing center. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

FIGURE 4. World share of S&E article output (fractional counts), by major S&E publishing center: 1992–2003



S&E = science and engineering; EU = European Union.

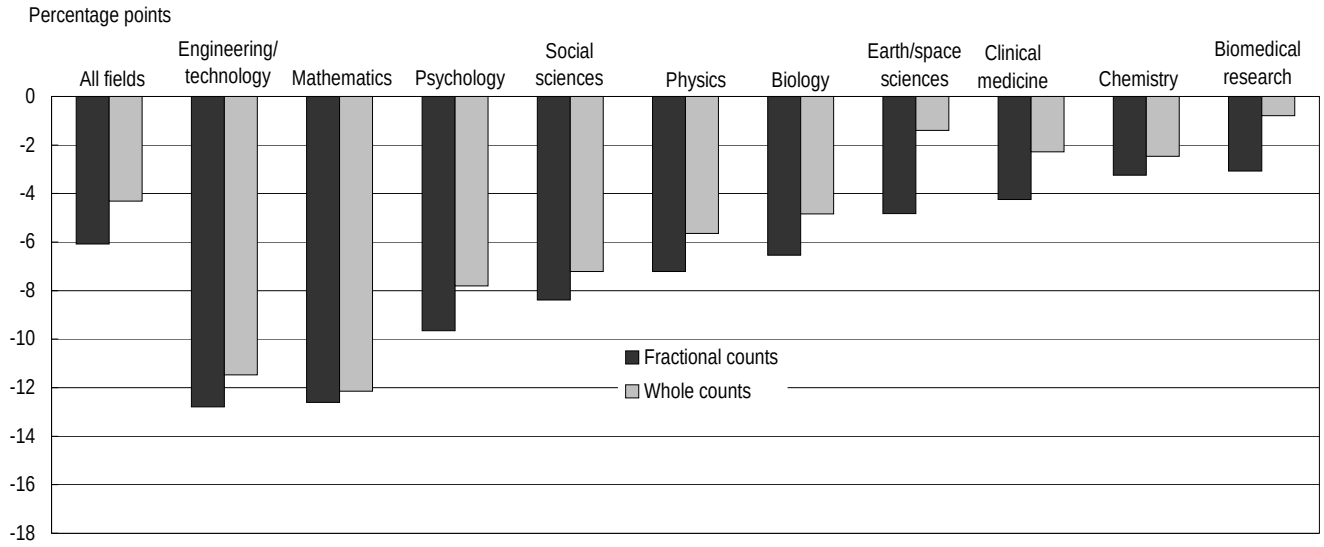
NOTES: Articles on fractional-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives fractional credit on basis of proportion of its participating institutions. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 3.

nal set (appendix table 2). Japanese output growth exceeded that of the United States in all fields between 1992 and 2003 (appendix table 5). In physics, the gap in article output between Japan and the United States narrowed substantially between 1992 and 2003 (appendix table 3), with Japan producing less than one-half the number of physics articles as the United States in 1992, but two-thirds as many in 2003.

Authors based in the East Asia-4 produced S&E articles at a sharply accelerating pace. Between 1992 and 2003, growth in collective article output averaged almost 16% per annum, more than 25 times faster than in the United States (figure 1). Rapid growth pushed this region's share of the world's S&E articles from 2% in 1992 to 8% in 2003, nearly equivalent to Japan's share (figure 4 and appendix table 3). Growth in East Asia-4 article output in the 1985 fixed journal set was equally rapid, resulting in a share increase of similar magnitude (appendix table 2). Engineering/technology and chemistry were among the fields that grew the most rapidly during this period. In 1992, the East Asia-4's article output in engineering/technology and in chemistry was less than 20% that of the United States. In 2003, they reached more than 70% of the U.S. total (appendix table 3). Output in both fields surpassed that of Japan in about 2000.

FIGURE 5. Decline in U.S. world share of S&E article output, by field: 1992–2003

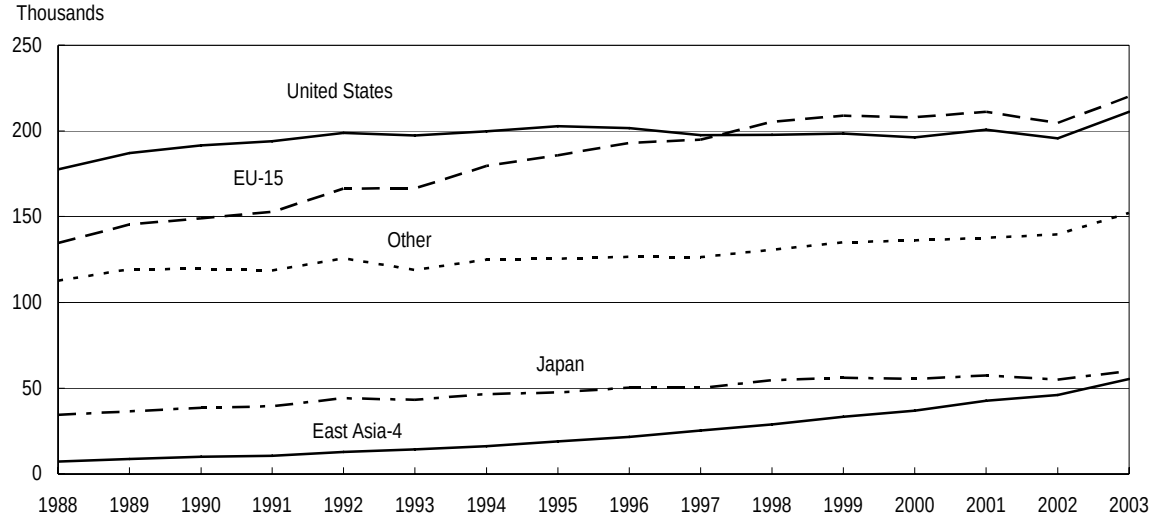


S&E = science and engineering.

NOTES: Fields ranked by decline of their fractional count share between 1992 and 2003. For articles with collaborating institutions, fractional counts assign the United States fractional credit on basis of proportion of its participating institutions, and whole counts assign the United States one credit for its participation, regardless of the number of participating institutions. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc., and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 3.

FIGURE 6. S&E article output (fractional counts) of major S&E publishing centers: 1988–2003



S&E = science and engineering; EU = European Union.

NOTES: Article counts on fractional basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives fractional credit on basis of proportion of its participating institutions. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 3.

Trends in Influential Articles and Journals

A publishing center's authorship of prominent S&E articles can be an indicator of the quality or influence of the research results it produces. Two citation measures are used to gauge quality and influence: (1) the frequency with which an article is cited and (2) the frequency of citation to the journal in which the article appears. Better and more influential articles tend to generate more citations.[12] Because articles in frequently cited journals[13] tend to be more widely noticed, these journals are able to attract better submissions and to publish better articles. These citation measures provide an indication of capability and competitiveness at the frontiers of research.

Shares of highly cited articles are used to analyze trends because worldwide counts of highly cited articles fluctuate for reasons unrelated to influence (see sidebar "Methodology for Determining Influential Article Counts by Percentile"). Unless otherwise noted, the top 5% share of cited articles and journals is used as the measure of highly influential research. Results were similar when analyses were conducted using other percentile shares (see sidebar "Trends in Various Percentiles of Cited Articles and Journals").

United States

The U.S. share of the world's highly influential S&E articles slipped between 1992 and 1996 (appendix table 8). It then dropped more substantially, from 56% in 1996 to 50% in 2003 (figure 7).[14] The drop paralleled the decline

[12] Citations are not a straightforward measure of either quality or influence. Other factors affect what authors choose to cite; e.g., they are likely to cite their own previous articles and the work of colleagues, mentors, friends, or scientists in their own country. Different fields have different citation patterns. In addition, authors who are members of relatively large disciplinary or national communities are cited more frequently than those in smaller communities.

[13] Journals are ranked by the average number of citations to articles published in each journal. Because the journal citation ranking is an average, articles appearing in highly cited journals may not necessarily be highly cited.

[14] Citation counts are based on a 3-year period with a 2-year lag. In 2003, for example, a highly influential article is an article published between 1999 and 2001 that received more citations in 2003 than 95% of the articles published in these years. Because of the lag between publication and citation, the measure of highly influential articles begins with 1992, using data on articles cited in that year that were published between 1988 and 1990.

Methodology for Determining Influential Article Counts by Percentile

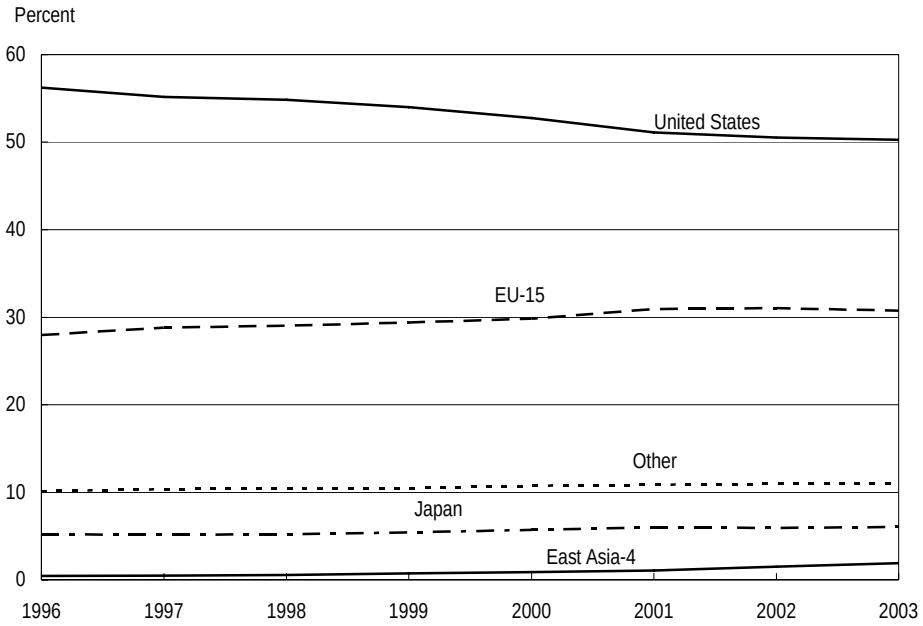
In a given group of articles, the 5% that receive the most citations are classified as highly cited. For example, in a set of 765 articles, the 38 most frequently cited articles (.05 x 765) would be counted as highly cited if there were no ties. In the example below, 20 articles received at least 30 citations each and 40 received at least 25 citations each; therefore the total number of articles in the top 5% is either 20 or 40, depending on whether the 20 articles that are tied with 25 citations are excluded or included. In such cases, SRS excludes the articles in the tie. Because ties are ubiquitous in the citation data, the actual number of articles included in the top 5% is ordinarily less than 5% (how much less varies from year to year).

Citations	Article counts (N = 765)
75	1
50	4
35	5
30	10
25	20
20	50
15	75
10	100
5	200
0	300

Trends in Various Percentiles of Cited Articles and Journals

Trends among the top 1%, 5%, and 10% of cited articles were similar in the four S&E publishing centers and in most fields (table 3 and appendix tables 6 and 7). In a few fields—notably mathematics—trends in the top 1% were somewhat different from trends in the top 5% and top 10%, possibly because of the very low article counts in the top 1% in these fields.

FIGURE 7. World share of highly influential S&E articles (fractional counts) of major S&E publishing centers: 1996–2003



S&E = science and engineering; EU = European Union.

NOTES: Citations are references to scientific articles in journals covered by S*cience Citation Index (SCI)* and *Social Sciences Citation Index (SSCI).* Highly influential articles are top 5% of cited articles based on a 3-year period with a 2-year lag (e.g., for 2003, highly influential articles are articles published in 1999–2001 that were among the top 5% in citations in articles published in 2003). Actual number of articles in top 5% is ordinarily less than 5% because articles with same frequency of citation that exceed top 5% are not included. Articles on fractional-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives fractional credit on basis of proportion of its participating institutions. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *SCI* and *SSCI,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 8.

TABLE 3. World share of highly cited S&E articles (fractional counts), by major S&E publishing center and percentile: 1992, 1997, and 2003
(Percent distribution)

	Top 1%			Top 5%			Top 10%		
Publishing center	1992	1997	2003	1992	1997	2003	1992	1997	2003
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	64.6	61.6	56.6	58.5	55.2	50.3	56.0	51.5	46.5
EU-15	23.3	25.1	27.7	26.2	28.8	30.7	27.3	30.5	32.3
Japan	4.2	4.4	5.3	5.3	5.2	6.0	5.7	5.9	6.6
East Asia-4	0.1	0.2	1.1	0.3	0.5	1.9	0.4	0.7	2.4
All other	7.8	8.8	9.3	9.8	10.4	11.0	10.6	11.4	12.2

S&E = science and engineering; EU = European Union.

NOTES: Citations are references to scientific articles in journals covered by *Science Citation Index (SCI) and Social Sciences Citation Index (SSCI).* Highly cited articles based on a 3-year period with a 2-year lag (e.g., for 2003, highly cited articles are articles published in 1999–2001 that received the most citations in articles published in 2003). Highly influential articles are top 5% cited articles. Actual number of articles in top 5% is ordinarily less than 5% because articles with same frequency of citation that exceed top 5% are not included. Articles on fractional-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives fractional credit on basis of proportion of its participating institutions. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *SCI* and *SSCI,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 6,7, and 8.

in the U.S. share of published articles that occurred when overall U.S. article output flattened beginning in 1992 (figure 6). For the three other major S&E publishing centers, shares of the world's most influential S&E articles increased during this period.

By field, the change in the U.S. share of highly influential articles was largely similar to the change in the U.S. share of total article output (figures 5 and 8).[15] In physics and engineering/technology, the United States experienced the largest declines during this period; by 2003 the U.S. shares of highly influential articles were lower in these fields than in all others. Shares in the earth/space sciences and mathematics declined by nearly as much as those in physics and engineering/technology. The decline in the U.S. share of highly influential articles in clinical medicine and biomedical research was less than the overall decline in the U.S. share of highly influential articles. Similarly, those fields experienced less of a decline in their shares of total world article output than did the United States as a whole.

Whole-count trends in the U.S. share of the world's highly influential articles between 1996 and 2003 were similar to fractional-count trends: the U.S. lost share while the shares of the three other major S&E publishing centers increased. The U.S. whole-count share during this period fell from 62% to 58% (figure 8 and appendix table 9). The whole-count decline was less than the fractional-count decline, however. Consistent with the overall trend for all publications, the United States increasingly received credit for highly influential articles by participating in international collaborations.

The U.S. whole-count share declined in all fields between 1996 and 2003, but the size of the decline varied by field (figure 8 and appendix table 9). In three fields—clinical medicine, biomedical research, and the earth/space sciences—more than half of the U.S. share decline disappeared when publications were measured using whole counts rather than fractional counts. This finding suggests that the United States largely maintained its worldwide position in these fields, although it did so by more frequently engaging in international collaboration. The same trend occurred in all U.S. articles in these fields (figure 5). In all other fields, however, whole counting produced only marginal differences in the size of the U.S. decline, suggesting that other nations with growing article shares were displacing some of the U.S. share in highly influential publications.

Between 1996 and 2003, the overall decline in the U.S. share of articles published in highly influential journals was similar to the decline in highly influential articles (figure 9 and appendix table 10). The magnitude of the decline differed among fields, however, and these differences in magnitude did not correspond to differences for highly cited articles. For chemistry, clinical medicine, and engineering/technology, the decline in the share of articles in highly influential journals was greater than in the decline in the share of highly influential articles. In contrast, for the earth/space sciences and social sciences, the decline in share of articles in highly influential journals was smaller than the decline in share of highly influential articles.

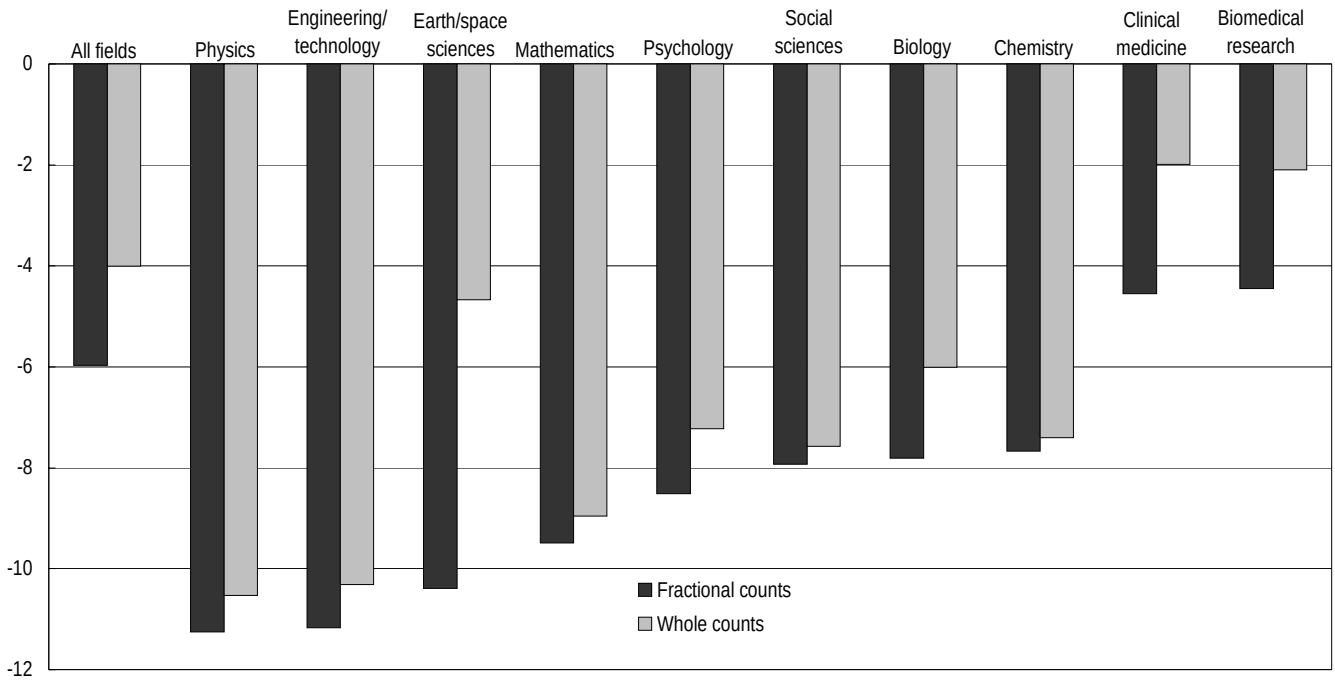
The percentage of total U.S. article output classified as highly cited is a somewhat different indicator of quality and influence. It indicates whether prominent articles are becoming more or less common in the output that the United States generates. This percentage remained steady between 1996 and 2003 and was higher than would be expected by chance (i.e., above 5%) (table 4). Likewise, this indicator remained steady in most fields (appendix table 11). The exceptions were engineering/technology and mathematics, where the percentage of U.S. articles classified as highly cited increased between 1996 and 2003.

The EU-15, Japan, and the East Asia-4

The EU-15's share of the world's highly influential articles rose slightly from 28% in 1996 to 31% in 2003 (figure 7 and appendix table 8). By field, the EU-15 share of highly influential articles surpassed that of the United States in physics in 2003, and its gap with the United States in mathematics and engineering/technology narrowed considerably (appendix table 8). For articles in influential journals, share trends by field were somewhat

[15] In analyses of the entire set of S&E articles, the number of articles in the database as a whole is used to calculate the top 5% considered to be highly influential. Because citation patterns vary from field to field, this method of determining the number of highly influential articles causes articles in some fields to be overrepresented and articles in other fields to be underrepresented. However, when citation counts are analyzed by field, articles are classified as highly influential if they are among the top 5% cited in their field, which partially controls for field differences in citation patterns. Thus, the same article may be classified as highly influential in some analyses and not highly influential in others.

FIGURE 8. Decline in U.S. world share of highly influential S&E articles, by field: 1996–2003



S&E = science and engineering.

NOTES: Citations are references to scientific articles in journals covered by *Science Citation Index (SCI)* and *Social Sciences Citation Index (SSCI).* Highly influential articles are top 5% of cited articles based on a 3-year period with a 2-year lag (e.g., for 2003, highly influential articles are articles published in 1999–2001 that were among the top 5% in citations in articles published in 2003). Actual number of articles in top 5% is ordinarily less than 5% because articles with same frequency of citation that exceed top 5% are not included. Fields ranked by difference between 1996 and 2003 fractional count shares. For articles with collaborating institutions, fractional counts assign the United States fractional credit on basis of proportion of its participating institutions, and whole counts assign the United States one credit for its participation, regardless of the number of participating institutions. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences.

SOURCES: Thomson ISI, *SCI* and *SSCI,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 8 and 9.

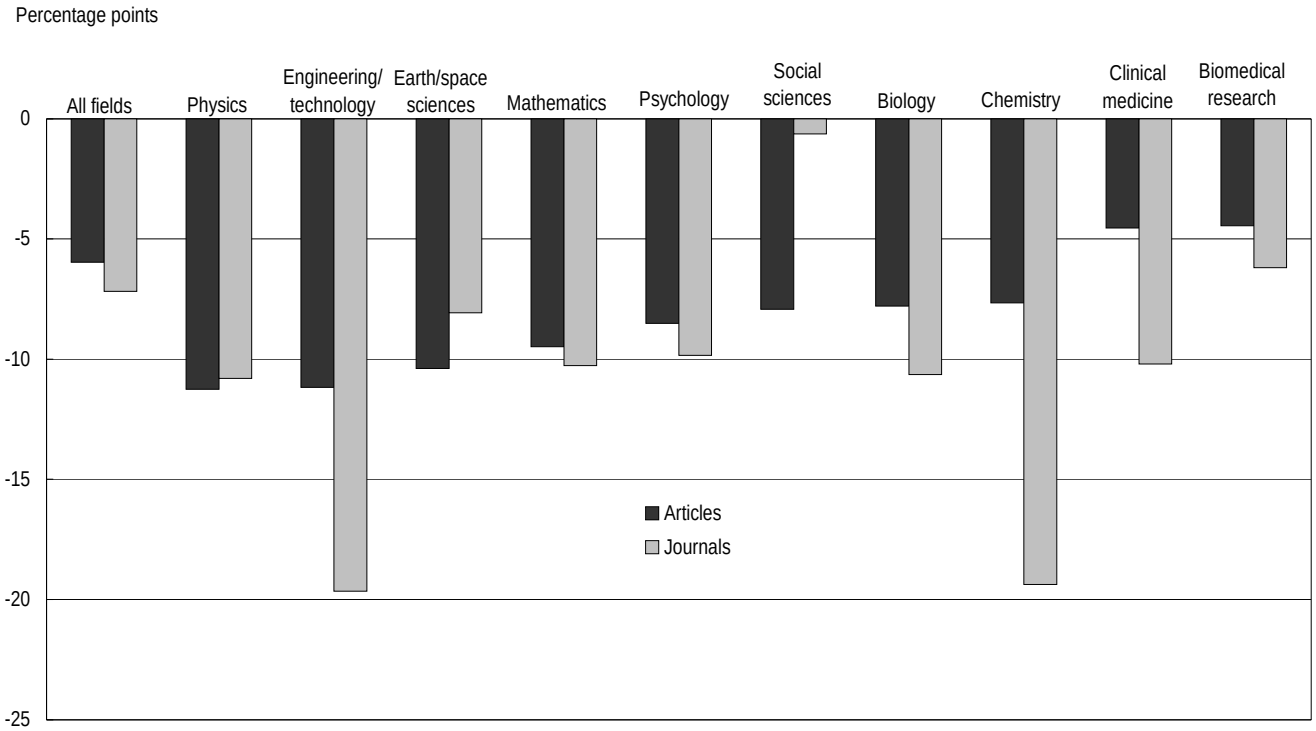
different. However, the EU-15's gap with the United States narrowed considerably in engineering/technology and physics, two fields that exhibited similar trends in highly influential articles (appendix table 10).

Japan's share of the world's highly influential articles remained steady, rising slightly in all fields except the social sciences and psychology during the post-1996 period (figure 7 and appendix table 8). Share trends for articles in influential journals were similar in all fields except physics, where the Japanese share increased at a smaller rate between 1996 and 2003 (appendix table 10).

The East Asia-4's share of the world's highly influential articles more than quadrupled but remained very low overall, rising from less than 1% in 1996 to 2% in 2003 (figure 7 and appendix table 8). However, the East Asia-4 share increased considerably in physics, chemistry, and, especially, engineering/technology. Its share of the world's highly influential engineering/technology articles rose from 3% in 1996 to 10% in 2003, nearly equal to Japan's share. Trends were similar for articles in influential journals (appendix table 10).

Among U.S., EU-15, and Japanese articles, the percentage classified as highly influential remained roughly constant between 1996 and 2003. In contrast, the percentage of East Asia-4 articles in this category doubled during this period (table 5). Despite this trend, the East Asia-4 ended the period with the lowest percentage of its articles (1.6) in the highly cited group, well behind the United States (8.1), the EU-15 (4.7), and Japan (3.4).

FIGURE 9. Decline in U.S. world share of highly influential S&E articles (fractional counts) and of S&E articles published in highly influential journals (fractional counts) between 1996 and 2003, by field



S&E = science and engineering.

NOTES: Citations are references to scientific articles in journals covered by *Science Citation Index (SCI)* and *Social Sciences Citation Index (SSCI).* Highly influential articles are top 5% of cited articles based on a 3-year period with a 2-year lag (e.g., for 2003, highly influential articles are articles published in 1999–2001 that were among the top 5% in citations in articles published in 2003). Actual number of articles in top 5% is ordinarily less than 5% because articles with same frequency of citation that exceed top 5% are not included. Articles on fractional-count basis; i.e., for articles with collaborating institutions, the United States receives fractional credit on basis of proportion of its participating institutions. Highly influential journals are top 5% cited journals based on a 3-year period with a 2-year lag (e.g., for 2003, citations are references made in articles published in 2003 to articles published in 1999–2001). Journals ranked by average ratio of citations to articles published in each journal and by each citing year; number may vary each year because of changes in total number of cited journals. Fields ranked by world share decline in highly influential articles. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences.

SOURCES: Thomson ISI, *SCI* and *SSCI,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 8 and 10.

TABLE 4. Highly influential U.S. S&E articles (fractional counts), by field: selected years, 1996–2003

(Percent of U.S. S&E articles)

Field	1996	1998	2000	2002	2003
All fields	7.8	7.9	8.0	8.0	8.1
Chemistry	10.0	9.7	10.0	9.8	9.9
Physics	8.8	8.7	8.6	8.9	8.6
Biomedical research	8.0	8.1	8.2	8.1	8.0
Mathematics	6.9	7.9	7.6	7.4	7.7
Clinical medicine	7.3	7.4	7.5	7.5	7.5
Earth/space sciences	7.8	7.5	7.5	7.5	7.5
Biology	7.0	6.7	6.9	7.1	7.0
Social sciences	6.8	6.8	6.9	7.0	6.8
Engineering/technology	5.3	5.4	5.9	6.5	6.7
Psychology	6.1	6.2	6.2	6.1	5.9

S&E = science and engineering.

NOTES: Citations are references to scientific articles in journals covered by *Science Citation Index (SCI)* and *Social Sciences Citation Index (SSCI).* Highly influential articles are top 5% of cited articles based on a 3-year period with a 2-year lag (e.g., for 2003, highly influential articles are articles published in 1999–2001 that were among the top 5% in citations in articles published in 2003). Top 5% article counts normalized to equal 5% of total articles. Actual number of articles in top 5% is ordinarily less than 5% because articles with same frequency of citation that exceed top 5% are not included. Articles on fractional-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, the United States receives fractional credit on basis of proportion of its participating institutions. Fields ranked by 2003 share. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences.

SOURCES: Thomson ISI, *SCI* and *SSCI,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 11.

TABLE 5. Highly influential S&E articles (fractional counts) of major S&E publishing centers: selected years, 1996–2003

(Percent of major publishing center S&E articles)

Publishing center	1996	1998	2000	2002	2003
United States	7.8	7.9	8.0	8.0	8.1
EU-15	4.5	4.5	4.5	4.7	4.7
Japan	3.2	3.1	3.3	3.4	3.4
East Asia-4	0.8	0.8	1.0	1.4	1.6
Other	2.3	2.4	2.5	2.6	2.6

S&E = science and engineering; EU = European Union.

NOTES: Citations are references to scientific articles in journals covered by *Science Citation Index (SCI)* and *Social Sciences Citation Index (SSCI).* Highly influential articles are top 5% of cited articles based on a 3-year period with 2-year lag (e.g., for 2003, highly influential articles are articles published in 1999–2001 that were among the top 5% in citations in articles published in 2003). Top 5% article counts normalized to equal 5% of total articles. Actual number of articles in top 5% is ordinarily less than 5% because articles with same frequency of citation that exceed top 5% are not included. Articles on fractional-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives fractional credit on basis of proportion of its participating institutions. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *SCI* and *SSCI,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 11.

THE U.S. ACADEMIC SECTOR

OVERALL OUTPUT TRENDS

The academic sector dominates U.S. S&E article production, accounting for nearly three-quarters of U.S. output. Because this sector plays such an important role, indicators of patterns and trends in its article output are worthy of special attention.[16]

Similar to overall U.S. output, academic sector output grew considerably between 1988 and 1992 and flattened thereafter. Average annual growth in the U.S. academic sector was 3.0% between 1988 and 1992, but only 0.8% between 1992 and 2003. Field trends in output were generally consistent with the overall sector trend in both periods, and trends were similar whether measured in whole counts or fractional counts (table 6 and appendix table 12).

Academic sector performance compared favorably with performance in the nonacademic sectors, where growth in annual output was slower in the earlier period (2.4% versus 3.0% for the academic sector) and output declined in the later period (-0.1% annual rate versus 0.8% for the academic sector) (table 7). Within the nonacademic sectors, output between 1988 and 2003 declined in the federal government, the state and local governments, and the private for-profit sectors and increased in the FFRDC and private nonprofit sectors (appendix table 13).

During the period of overall flattening in article output (1992–2003), in almost every ipIQ broad field, the academic sector's share of U.S. articles increased, while the private for-profit sector's and the federal government's shares declined (figure 10). The combined pattern of the academic sector's rising share of articles and the for-profit sector's falling share was especially dramatic in engineering/technology, physics, the social sciences, and the earth/space sciences. The fields of clinical medicine and biology (which has a large component of agricultural sciences) are the only two fields in which the academic sector's share did not increase and the only two in which the private for-profit sector's share did not decline.

[16] Other sectors in which researchers produced articles are the federal government, the private for-profit sector, FFRDCs, the private nonprofit sector, and state and local governments. Articles that cannot be assigned to one of these sectors are categorized as "unknown."

TABLE 6. Average annual growth in U.S. academic S&E article output, by field: 1988–92 and 1992–2003
(Percent)

	Fractional counts		Whole counts	
Field	1988–92	1992–2003	1988–92	1992–2003
All fields	3.0	0.8	3.6	1.5
Biology	0.4	0.3	1.1	1.1
Biomedical research	4.7	0.6	5.4	1.2
Chemistry	3.5	0.9	4.1	1.4
Clinical medicine	2.7	0.7	3.0	1.3
Earth/space sciences	3.6	3.3	4.7	4.5
Engineering/technology	6.5	1.2	7.1	2.0
Mathematics	-2.0	0.7	-1.1	1.4
Physics	3.7	0.0	5.0	1.0
Psychology	1.4	0.6	1.4	1.0
Social sciences	2.3	0.7	2.4	0.9

S&E = science and engineering.

NOTES: For articles with collaborating institutions, fractional counts assign each participating institution fractional credit on basis of proportion of its participation, and whole counts assign academic sector one credit for its participation, regardless of the number of participating institutions. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 12.

TRENDS IN THE TOP 200 ACADEMIC RESEARCH UNIVERSITIES

Within the academic sector, the top 200 R&D institutions (based on R&D expenditures during the 1988–2001 period) account for most of the article output. In 2001, the share of academic articles with at least one author from these institutions was 94%.[17] Because the academic sector dominates U.S. S&E article production and the top 200 R&D institutions are at the core of the academic sector, the analyses that follow are structured around these institutions and how they operate.

Accordingly, unlike other analyses in this report, the following analyses use the S&E field classification of the

[17] For technical reasons, the analysis of the top 200 research universities was confined to the 1988–2001 period. However, data for 2003 are generally consistent with the patterns and trends reported in this section.

TABLE 7. Average annual growth in U.S. S&E article output (fractional counts), by sector: 1988–2003, 1988–92, and 1992–2003
(Percent)

Sector	1988–2003	1988–92	1992–2003
All U.S. sectors	1.2	2.9	0.6
Academic	1.4	3.0	0.8
Nonacademic	0.6	2.4	-0.1
Federal government	-0.1	1.5	-0.7
FFRDCs	1.0	0.8	1.1
State and local government	-0.7	0.0	-0.9
Private for-profit	-0.3	2.8	-1.4
Private nonprofit	1.8	3.1	1.4
Joint	8.2	11.9	6.8
Unknown	2.3	9.8	-0.2

S&E = science and engineering; FFRDC = federally funded research and development center.

NOTES: Articles on fractional-count basis, i.e., for articles with collaborating institutions, each sector receives fractional credit on basis of proportion of its participating institutions.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 13.

Integrated Science and Engineering Resources Data System (WebCASPAR) when presenting data by field rather than the ipIQ field classification. (For a crosswalk between WebCASPAR and ipIQ fields, see appendix table 14.) In addition to aligning more closely with the way in which academic institutions are organized, WebCASPAR fields have a second important advantage: they enable analyses of the relationship between publication outputs and field-specific resource inputs (e.g., academic R&D expenditures, postdocs, S&E doctoral degree recipients).[18]

The top 200 R&D institutions dominate S&E article output in all WebCASPAR fields, receiving authorship credit for between 82% and 83% (psychology, social sciences) and 98% (agricultural and medical sciences) of academic sector articles (figure 11). Output trends for these institutions basically mirror trends for the academic sector as a whole for both fractional and whole article counts (figure 12).

[18] Such analyses will be presented in a future report, as discussed in the conclusion below.

Output Trends

Article output trends varied somewhat for different types of academic institutions, even among the top 200 R&D performers. However, the overarching trend of stronger growth between 1988 and 1992 than in the subsequent period is manifested in practically every category of institution that the study examined.

The Carnegie Foundation for the Advancement of Teaching classification of academic institutions is a widely recognized system for distinguishing among institutions by the range and breadth of their research and education programs.[19] The majority of the top 200 R&D institutions are classified as Carnegie research institutions (n = 125), followed by doctorate-granting institutions (n = 39) and freestanding medical institutions (n = 23) (table 8). Public institutions (n = 145) constitute over 70% of the top 200 institutions.

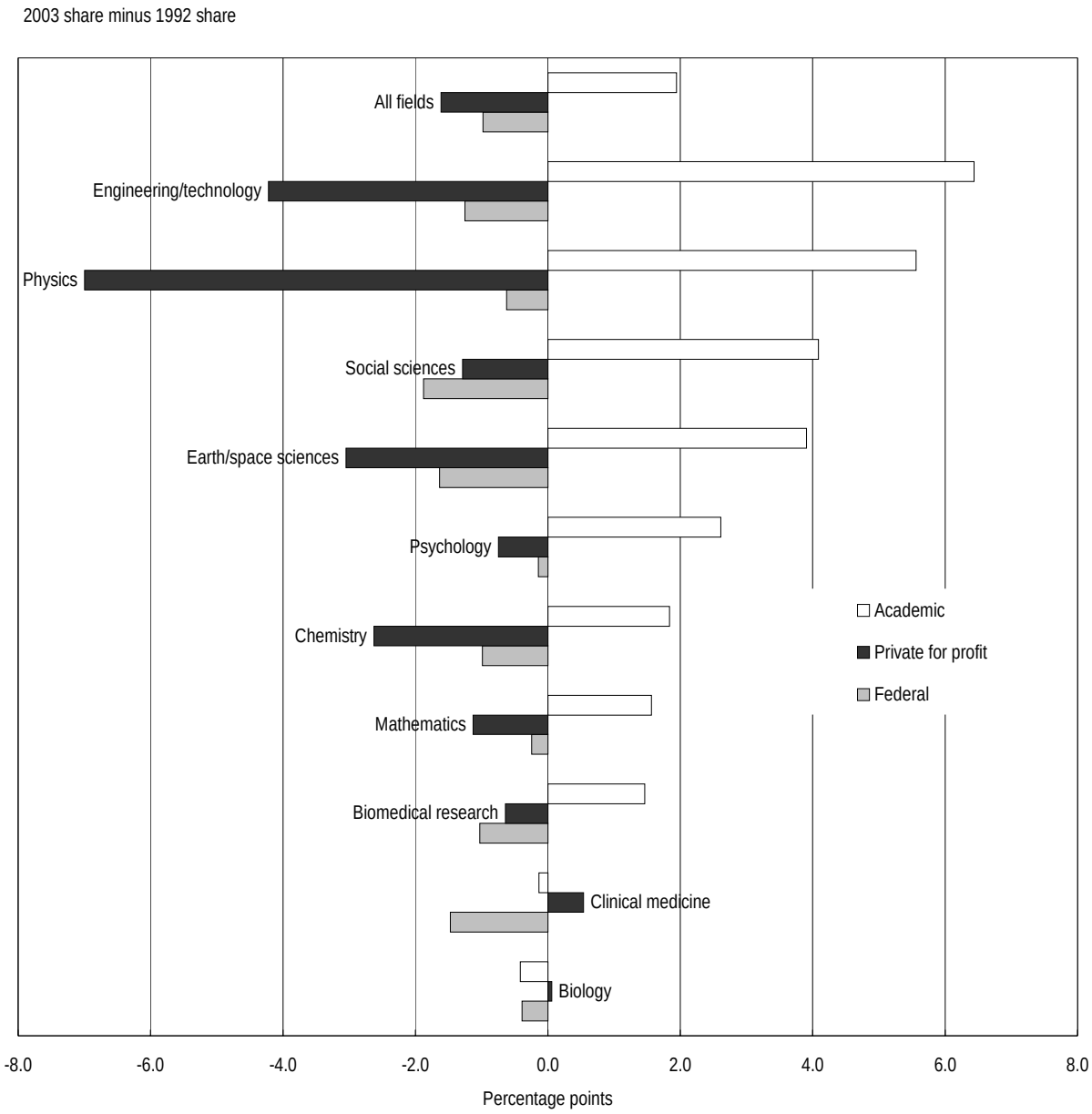
For the entire 1988–2001 period, output growth rates were greater in private research I universities and both public and private freestanding medical institutions than in public research I universities and both public and private research II universities (table 9 and appendix table 15).[20] There were also relatively large increases in top 200 institutions, both public and private, in the other category. For all of these Carnegie classes, growth rates for the 1988–92 period exceeded those for the 1992–2001 period.

Output growth appeared to be weakest in high-quality departments among the top 200 institutions. SRS used the 1994 National Research Council (NRC) ratings of the scholarly quality of graduate departments at U.S. universities as a measure of a university's quality in the

[19] For the purposes of this study, the 1994 Carnegie classification was more useful than the 2000 version because it relies on criteria that are more relevant to the institutional characteristics associated with research and publication. The Carnegie Foundation recently completed a complete revision of its classification system.

[20] Research I and II universities offer a full range of baccalaureate programs, are committed to graduate education through the doctorate, and give high priority to research. Both classes of institutions award 50 or more doctoral degrees each year. Research I institutions receive $40 million or more in federal support annually and research II institutions receive between $15.5 million and $40 million annually.

FIGURE 10. Change in share of U.S. S&E articles (fractional counts) in academic, federal government, and private for-profit sectors: 1992–2003

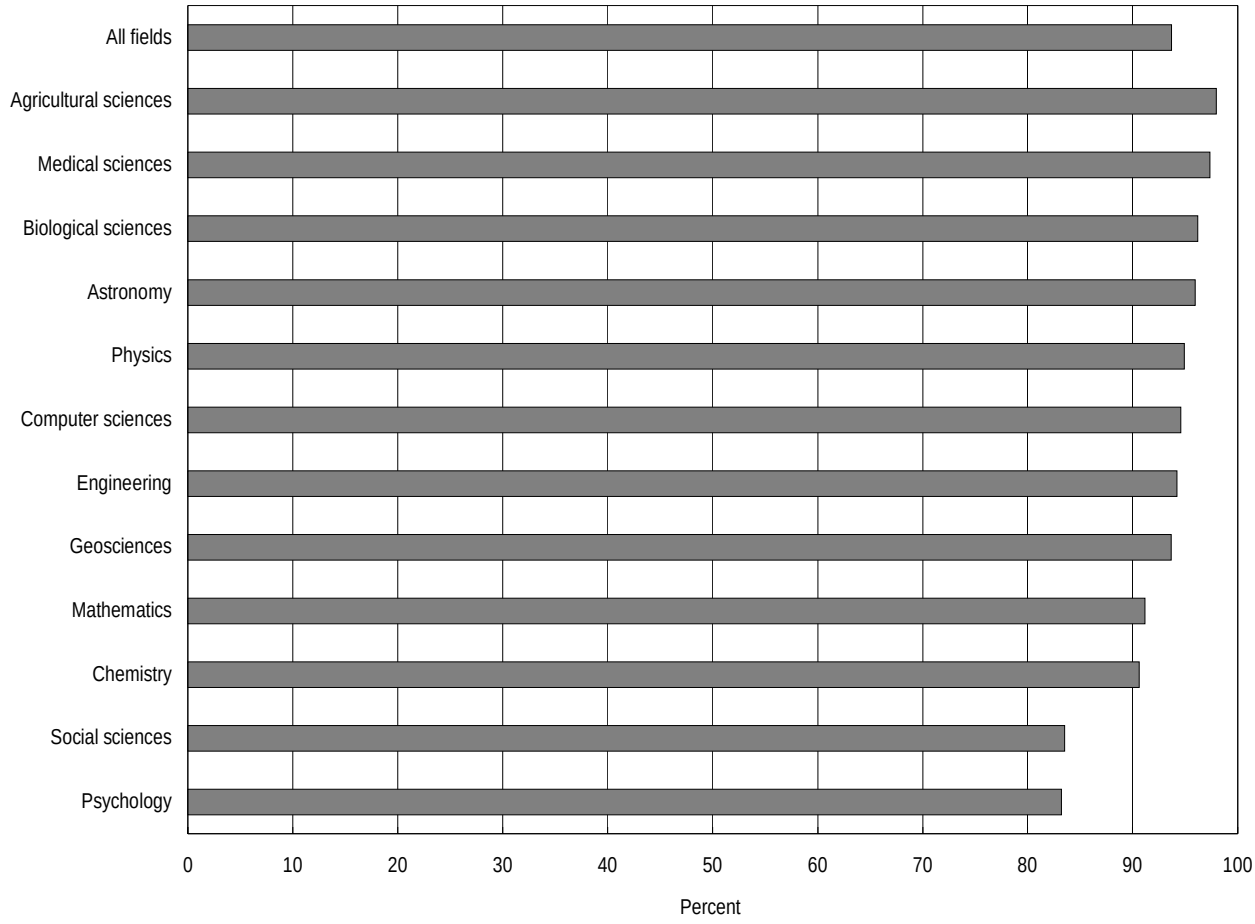


S&E = science and engineering.

NOTES: Articles on fractional-count basis, i.e., for articles with collaborating institutions, each sector receives fractional credit on basis of proportion of its participating institutions. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences. Changes in shares for Federally Funded Research and Development Centers, the private nonprofit sector, and state and local governments are not shown.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 13.

FIGURE 11. Share of U.S. academic S&E articles (whole counts) with at least one author from the top 200 research universities, by field: 1988–2001



S&E = science and engineering.

NOTES: Articles on whole-count basis, i.e., for articles with collaborating institutions, both the combined group of top 200 universities and the academic sector receive one credit for participation, regardless of the number of participating institutions. "All fields" includes health sciences and professional fields. Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

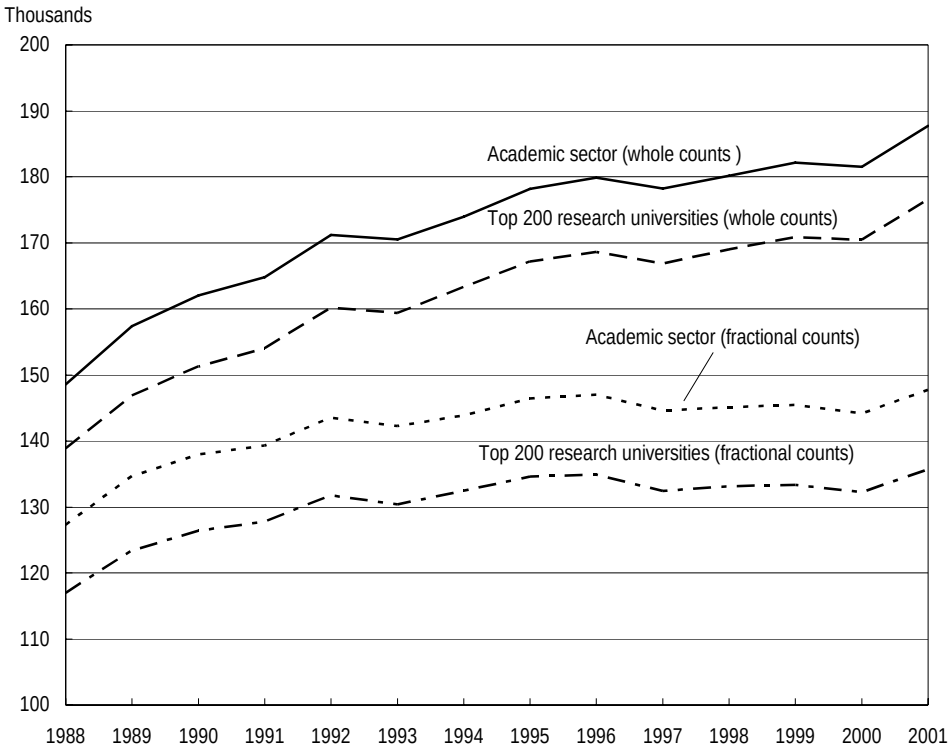
SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

corresponding WebCASPAR field.[21] Figure 13 shows that a lower departmental rating for scholarly quality is generally associated with a higher rate of article growth, except for articles from departments that had a scholarly quality rating of 0 to 1. This pattern is not consistent across fields (table 10 and appendix table 16). Biology, chemistry, engineering, physics, and geosciences generally showed an increasing trend of publication with decreasing NRC ratings, and mathematics showed a reverse trend. Computer sciences, social sciences, and psychology did not demonstrate a clear trend.

Output growth trends are related to trends in institutions' R&D growth; on average, the group of institutions with the fastest R&D growth also had the fastest article growth (figure 14 and appendix table 17). This finding holds both for the entire 1988–2001 period and for the part of the period during which article growth flattened

[21] There were no ratings for the medical sciences.

FIGURE 12. Trends in S&E article output (whole and fractional counts) of entire U.S. academic sector and top 200 research universities: 1988–2001



S&E = science and engineering.

NOTES: For articles with collaborating institutions, fractional counts assign each participating institution fractional credit on basis of proportion of its participation, and whole counts assign both the combined group of top 200 research universities and the academic sector one credit for participation, regardless of the number of participating institutions. Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

(1992–2001). (See figure 2 for an index of both R&D and article growth.)

Collaboration Trends

SRS's international data indicate that during the period under study, collaboration across geographic boundaries became much more widespread. SRS's U.S. data contain information about patterns and trends in collaboration across sectoral and institutional boundaries that is not available internationally. If comparable data on other nations and regions become available, future research can examine how different national trends in collaboration across various kinds of boundaries (if such trends exist) relate to the different trends in overall national S&E publication output.

The U.S. academic sector participated in the worldwide trend toward increased collaboration across geographic boundaries. Between 1988 and 2001, the article output of the academic sector became more collaborative not only internationally, but also across U.S. sectoral and institutional boundaries. As a result, output trends for different types of articles varied substantially, depending on whether collaboration was involved and the type of collaboration that was involved. In general, article output for various types of collaborative articles increased, while single-author and single-institution output declined.

TABLE 8. Carnegie institution type and administrative control of top 200 U.S. research universities

Institution type	Administrative control		
	All top 200	Public	Private
Top 200	200	145	55
Research I	89	60	29
Research II	36	26	10
Doctorate-granting I	16	12	4
Doctorate-granting II	23	20	3
Masters and liberal arts	8	7	1
Engineering	1	1	0
Medical	23	15	8
Other Carnegie	1	1	0
Not classified	3	3	0

NOTES: Institutions designated by 1994 Carnegie classification code. Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCE: Carnegie Foundation for the Advancement of Teaching, *A Classification of Institutions of Higher Education,* Princeton University Press (1994).

The ratio of fractional to whole counts is a measure of collaboration intensity (see sidebar "Effect of International Collaboration on Whole- and Fractional-Count Output"). For the top 200 institutions, the average ratio of fractional counts to whole counts declined between 1988 and 2001, indicating more collaboration over time. Increased collaboration occurred in each WebCASPAR field (figure 15 and appendix table 18); the fields that were more collaborative (astronomy, geosciences, physics) and less collaborative (chemistry, social sciences, psychology) in 1988 were generally the same in 2001.

For most of the top 200 institutions, the trend toward collaborative publications occurred not only on average, but also in each field. For all 200 institutions, the fractional-count to whole-count ratio for all fields combined was lower in 2001 than in 1988 (appendix table 19). At the individual field level, because some institutions produced a small number of articles in some fields in a given year, it is more appropriate to compare collaboration across two periods (1988–94 and 1995–2001) rather than for individual years throughout the 1988–2001 period. The percentage of the top 200 institutions in which collaboration was greater in the 1995–2001 period than in the 1988–94 period ranged from 72% in the agricultural and other life sciences to 98% in the biological sciences (figure 16).

The distribution of types of collaborative articles at the top 200 academic institutions changed dramatically between 1988 and 2001. Articles in which an author at a top 200 institution participates can be broken down into single-author articles and six types of multiple-author articles (figure 17 and appendix table 20):

Single institutions

- Single department-multiple authors.
- Single institution-multiple departments.

Multiple institutions

- More than one top 200 institution.
- Top 200 institution(s) and other U.S. institution(s).
- Top 200 institution(s) and foreign institution(s).
- Top 200 institution(s), other U.S. institution(s), and foreign institution(s).

TABLE 9. Average annual growth in S&E article output (fractional counts) of top 200 U.S. research universities, by administrative control of institution and Carnegie institution type: 1988–2001, 1988–92, and 1992–2001
(Percent)

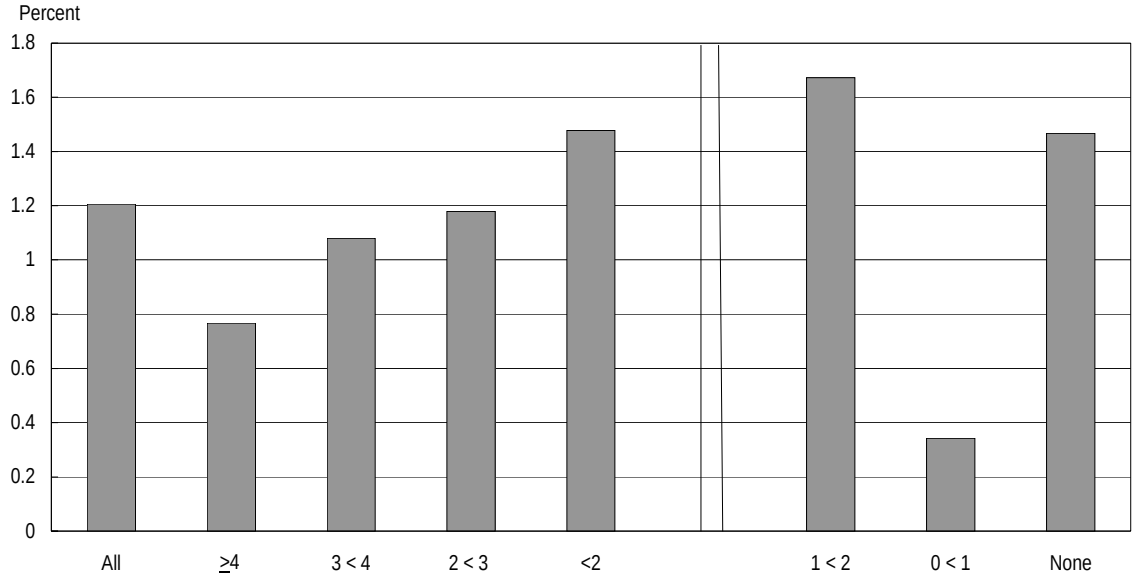
Type of control and Carnegie classification	1988–2001	1988–92	1992–2001
Public	1.0	3.1	0.1
Research I	0.9	2.9	0.0
Research II	1.1	3.4	0.1
Medical	2.0	4.1	1.0
All other	2.0	4.6	0.8
Private	1.6	2.9	1.0
Research I	1.6	2.7	1.1
Research II	0.6	1.5	0.2
Medical	2.1	4.9	0.9
All other	2.4	6.7	0.5

S&E = science and engineering.

NOTES: Articles on fractional-count basis, i.e., for articles with collaborating institutions, each institution type receives fractional credit on basis of proportion of its participating institutions. Institutions designated by 1994 Carnegie classification code. For information on these institutional categories, see Carnegie Foundation for the Advancement of Teaching, A Classification of Institutions of Higher Education, Princeton University Press (1994).Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 15.

FIGURE 13. Average annual growth in S&E article output (fractional counts) of departments at top 200 U.S. research universities, by National Research Council scholarly quality departmental rating: 1988–2001



S&E = science and engineering.

NOTES: 1994 National Research Council ratings of scholarly quality of graduate departments at U.S. universities used as measure of university quality in corresponding field in Integrated Science and Engineering Resources Data System (WebCASPAR), http://caspar.nsf.gov. Higher ratings signify higher scholarly quality. Articles on fractional-count basis, i.e., for articles with collaborating institutions, each institution receives fractional credit on basis of proportion of its participation. Number of articles in each scholarly quality range for each WebCASPAR field in which ratings were provided were aggregated across the 200 universities. For more information about data and methods, see M.L. Goldberger, B.A. Maher, and P.E. Flattau, editors, *Research-Doctorate Programs in the United States: Continuity and Change,* National Research Council (1995). Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 16.

Collaborative articles across institutional boundaries (the last four categories listed above) increased substantially during this period, whereas other types of articles did not (figure 17). In absolute numbers, the largest increase (about 19,000) occurred for articles in which authors from the top 200 institutions collaborated with authors at foreign institutions. In relative terms, the most dramatic increase (almost 300%) was for articles in which authors from the top 200 institutions collaborated with authors from both other U.S. institutions and foreign institutions, but this growth was from a small base. In contrast, articles with either a single author or multiple authors from a single department declined, and the number of articles with authors from multiple departments at a single institution remained fairly flat. The net result of these trends was a drop from 60% to 46% in the proportion of articles credited to a single top 200 academic institution and an increase from 10% to 23% in the proportion of publications with at least one author from a U.S. institution and one author from a foreign institution (figure 18). The trends in individual fields were similar to the overall change (figures 19 and 20). The extent of collaboration varied considerably across fields.

Collaborative articles also showed a trend toward involving more institutions and more individual authors. For articles with participation by a top 200 institution, the numbers of authors, top 200 institutional addresses, and non-top 200 institutional addresses increased between 1988 and 2001 (figure 21). The number of authors per article increased by nearly 50%, and the number of non-top 200 institutional addresses per article almost doubled during this period. The number of top 200 institutional addresses per article increased less rapidly, rising by less than 14%.

TABLE 10. Average annual growth in S&E article output (fractional counts) at departments of top 200 U.S. research universities, by field and National Research Council scholarly quality departmental rating: 1988–2001
(Percent)

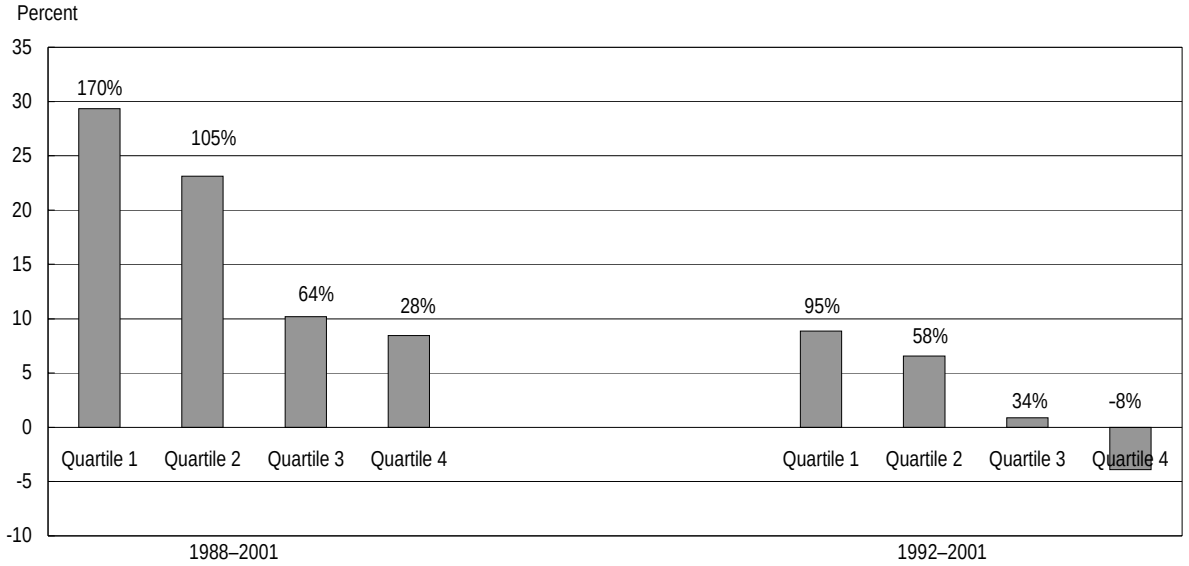
Field	NRC scholarly quality rating					
	All top 200	≥4	3 < 4	2 < 3	<2	No rating
Astronomy	3.3	3.5	2.0	2.7	6.7	4.3
Biological sciences	1.2	1.2	1.2	1.2	2.1	0.8
Chemistry	1.2	0.6	1.2	1.2	2.5	1.7
Computer sciences	2.9	1.7	3.3	3.5	1.6	4.3
Engineering	2.3	1.9	1.9	2.1	4.0	3.2
Geosciences	2.3	-0.6	1.0	0.7	7.1	4.0
Mathematics	-0.3	1.2	-0.6	-1.1	-3.6	1.1
Physics	0.5	-0.3	0.5	1.2	2.5	3.5
Psychology	0.9	0.5	0.9	1.1	-1.1	1.7
Social sciences	0.8	0.1	1.0	0.9	0.0	1.2

S&E = science and engineering; NRC = National Research Council.

NOTES: 1994 NRC ratings of scholarly quality of graduate departments at U.S. universities used as measure of university quality in corresponding field in Integrated Science and Engineering Resources Data System (WebCASPAR), http://caspar.nsf.gov. Higher ratings signify higher scholarly quality. Articles on fractional-count basis, i.e., for articles with collaborating institutions, each institution receives fractional credit on basis of proportion of its participation. For more information about data and methods, see M.L. Goldberger, B.A. Maher, and P.E. Flattau, editors, Research-Doctorate Programs in the United States: Continuity and Change, National Academies Press (1995). Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 16.

FIGURE 14. Growth in S&E article output (fractional counts) at top 200 research universities, by quartile of total R&D growth: 1988–2001 and 1992–2001

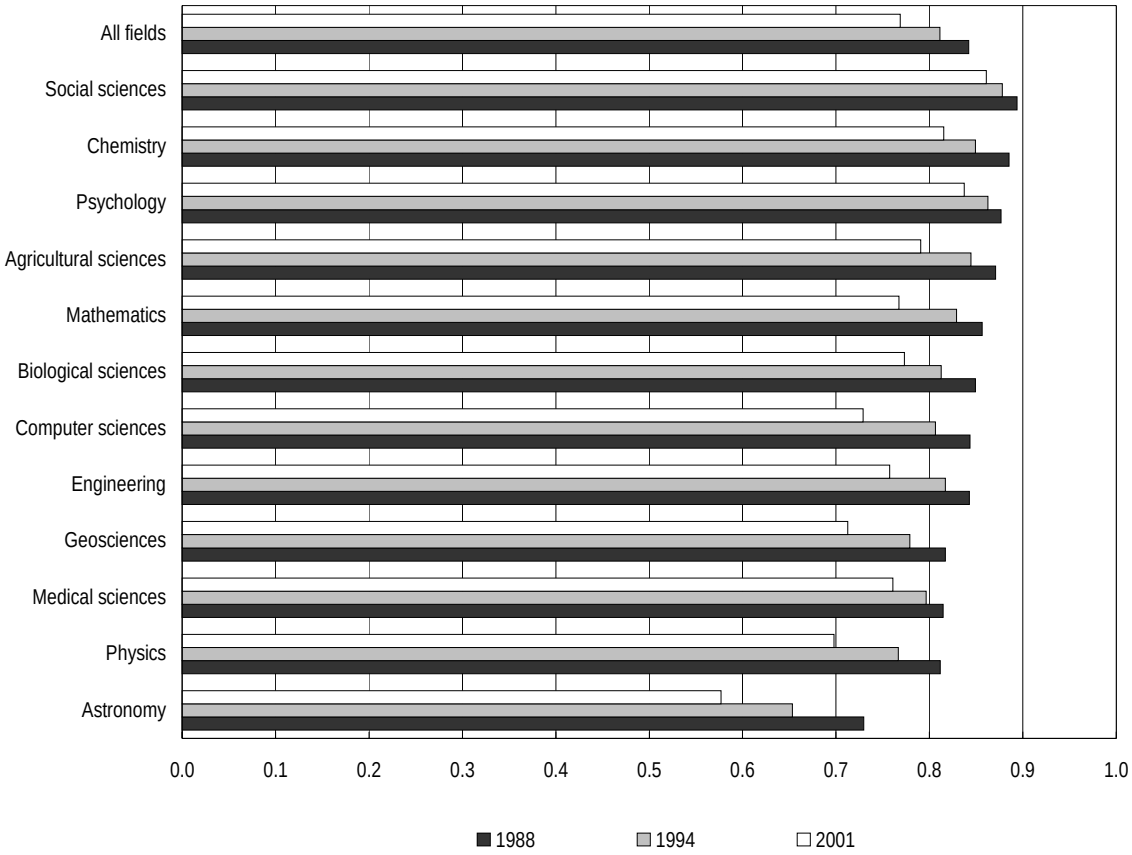


S&E = science and engineering; R&D = research and development.

NOTES: Articles on fractional-count basis, i.e., for articles with collaborating institutions, each institution receives fractional credit on basis of proportion of its participation. Quartiles based on constant dollar R&D growth during 1988–2001 and 1992–2001. Numbers above bars are real (constant dollars) growth in R&D expenditures for that quartile during the period. Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; National Science Foundation, Division of Science Resources Statistics (NSF/SRS), special tabulations; and NSF/SRS, Survey of Academic Research and Expenditures and Integrated Science and Engineering Resources Data System (WebCASPAR), http://caspar.nsf.gov.

FIGURE 15. Ratio of fractional to whole counts of S&E articles for top 200 research universities, by field: 1988, 1994, and 2001

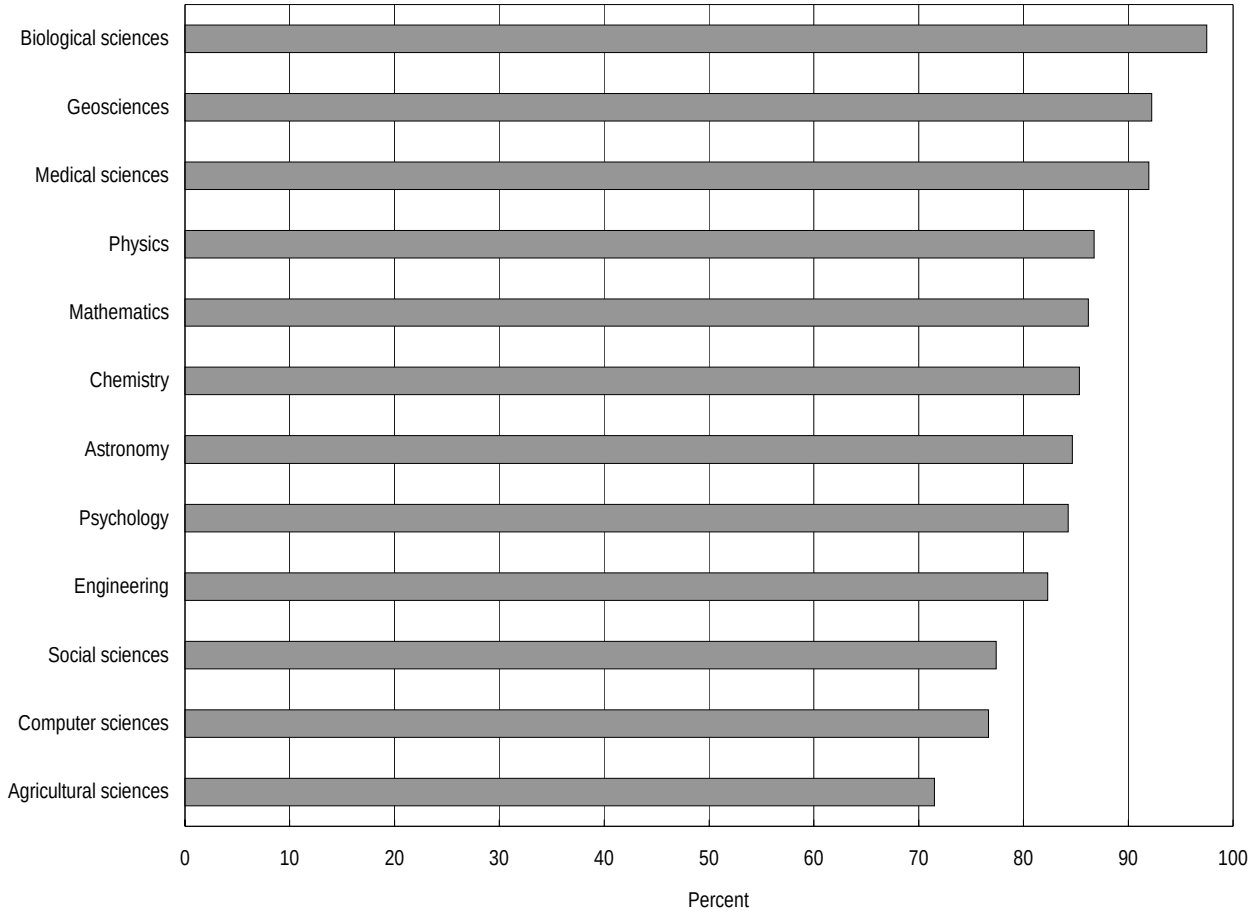


S&E = science and engineering.

NOTES: Ratio measures collaboration trends, with lower ratio signifying more collaboration. For articles with collaborating institutions, fractional counts assign each participating institution fractional credit on basis of proportion of its participation, and whole counts assign the combined group of top 200 research universities one credit for its participation, regardless of the number of participating institutions. "All fields" includes health sciences and professional fields. Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 18.

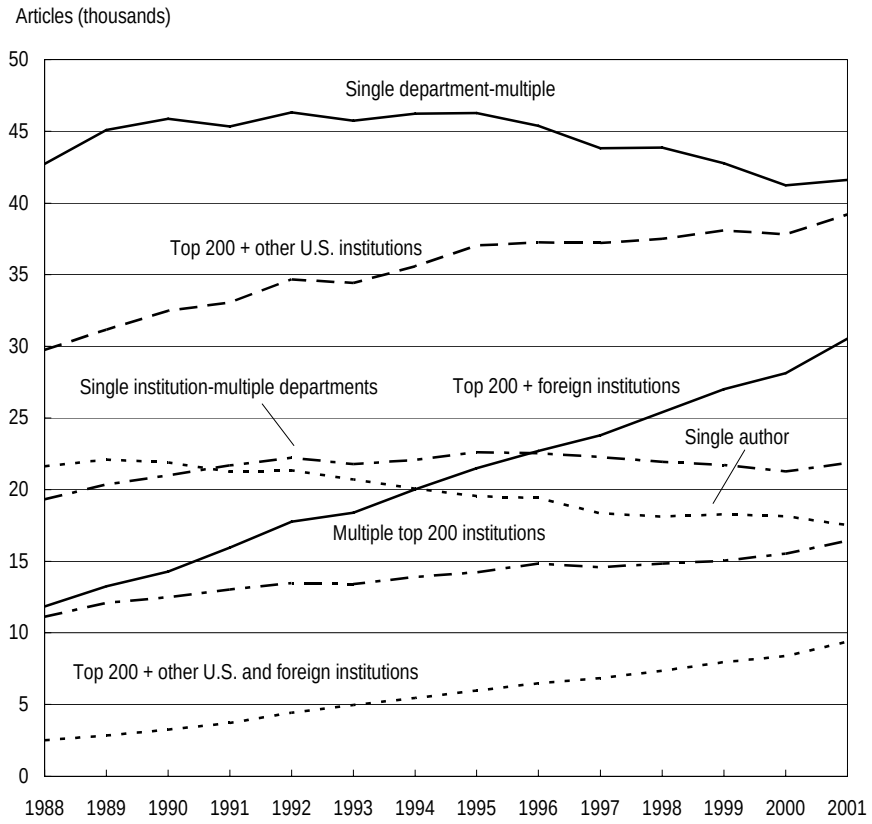
FIGURE 16. Share of top 200 research universities with greater collaboration in 1995–2001 than in 1988–1994, by field



NOTES: Collaboration measured by ratio of fractional to whole counts, with lower ratio signifying more collaboration. For articles with collaborating institutions, fractional counts assign each participating institution fractional credit on basis of proportion of its participation, and whole counts assign each participating institution one credit for its participation. Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, Science Citation Index and Social Sciences Citation Index, http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

FIGURE 17. S&E article output (whole counts) of top 200 academic research universities, by institutional author type: 1988–2001

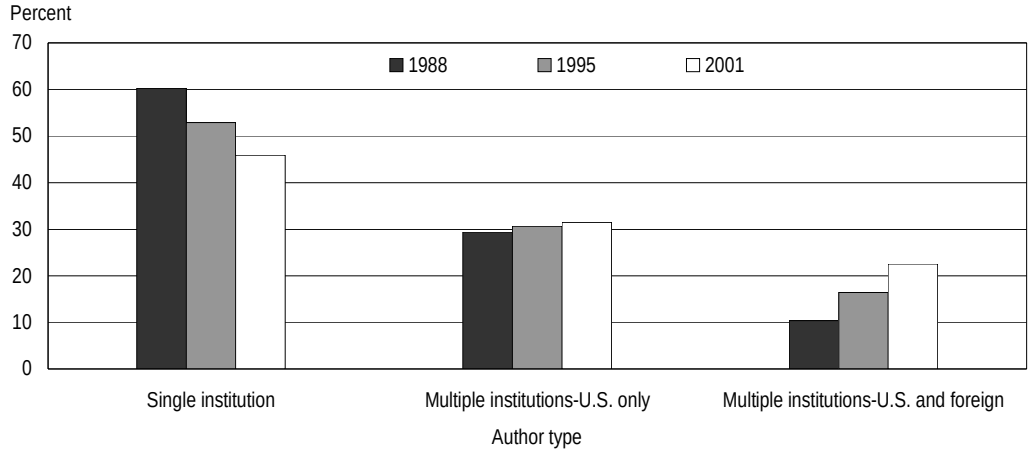


S&E = science and engineering.

NOTES: Articles on whole-count basis, i.e., for articles with collaborating institutions, the combined group of top 200 research universities receives one credit for its participation, regardless of the number of participating institutions. Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, Science Citation Index and Social Sciences Citation Index, http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 20.

FIGURE 18. S&E articles (whole counts) with authors at top 200 academic research universities, by institutional author type: 1988, 1995, and 2001

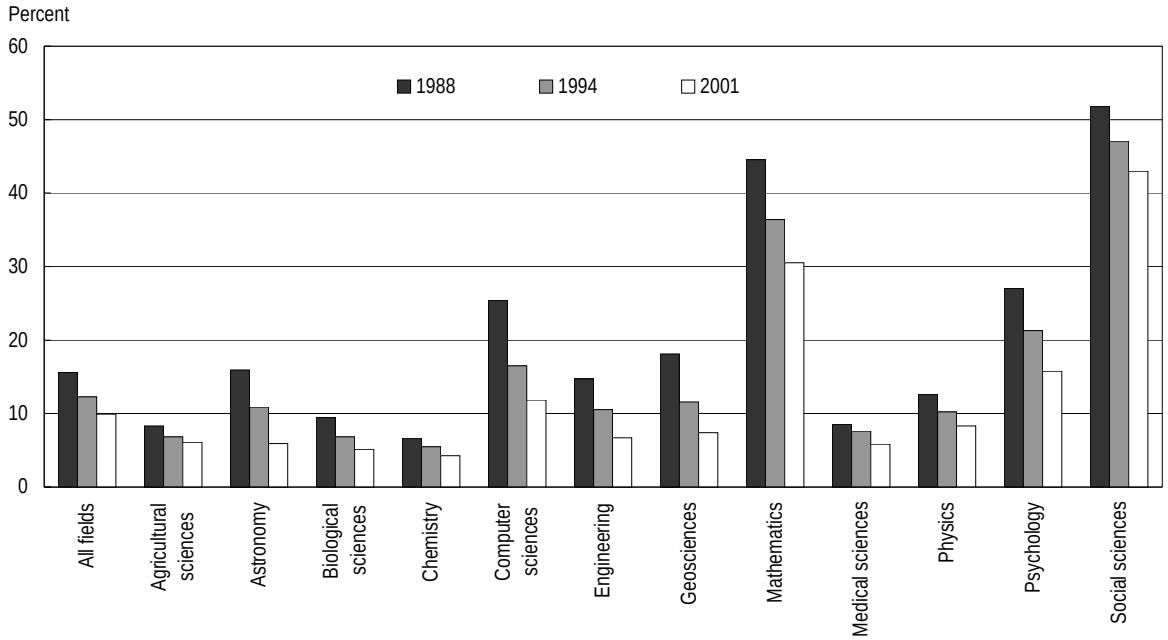


S&E = science and engineering.

NOTES: Articles on whole-count basis, i.e., for articles with collaborating institutions, the combined group of top 200 research universities receives one credit for its participation, regardless of the number of participating institutions. Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, Science Citation Index and Social Sciences Citation Index, http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 20.

FIGURE 19. S&E articles (whole counts) with single author at a top 200 academic research university, by field: 1988, 1994, and 2001

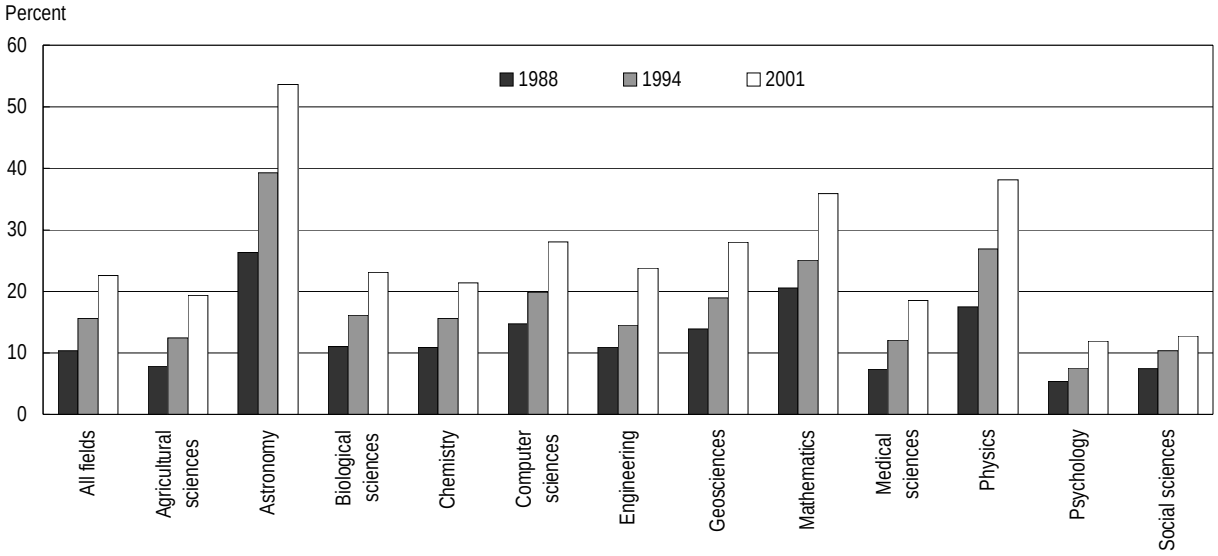


S&E = science and engineering.

NOTES: Articles on whole-count basis, i.e., for articles with collaborating institutions, the combined group of top 200 research universities receives one credit for its participation, regardless of the number of participating institutions. "All fields" includes health sciences and professional fields. Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, Science Citation Index and Social Sciences Citation Index, http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 20.

FIGURE 20. S&E articles (whole counts) with at least one author at a top 200 research university and one author at a foreign institution, by field: 1988, 1994, and 2001

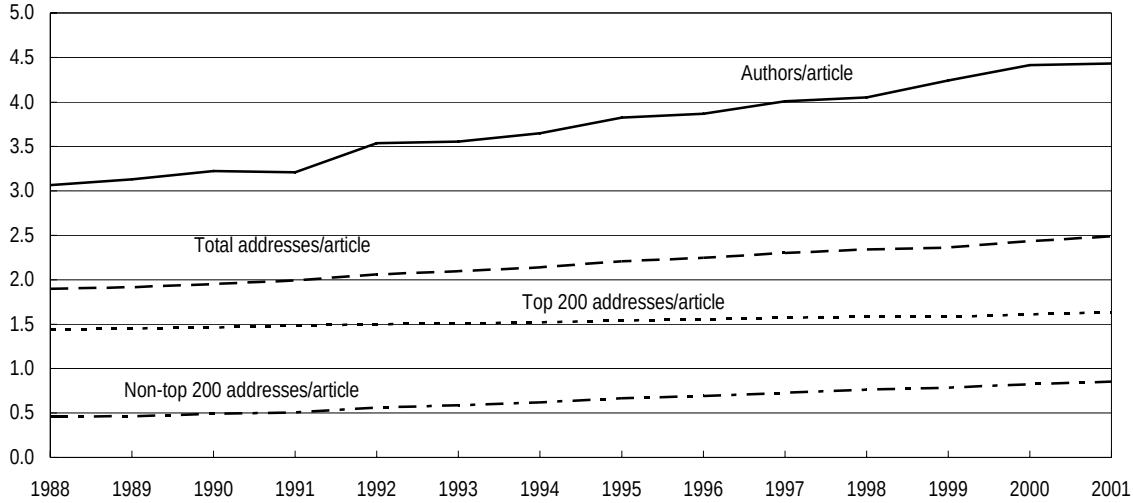


S&E = science and engineering.

NOTES: Articles on whole-count basis, i.e., for articles with collaborating institutions, the combined group of top 200 research universities receives one credit for its participation, regardless of the number of participating institutions. "All fields" includes health sciences and professional fields. Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, Science Citation Index and Social Sciences Citation Index, http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations. See appendix table 20.

FIGURE 21. Institutional addresses and authors per article for S&E articles (whole counts) with participation by a top 200 research university: 1988–2001



S&E = science and engineering.

NOTES: Articles on whole-count basis, i.e., for articles with collaborating institutions, the combined group of top 200 research universities receives one credit for its participation, regardless of the number of participating institutions. Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, Science Citation Index and Social Sciences Citation Index, http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

CONCLUSION

The descriptive information in this report leaves many questions about changing publication practices unanswered. Some are descriptive. For example, what were the trends in manuscript submission during the period studied, and how do they relate to publication trends? Although journal editors have told SRS that submissions from other countries have increased more rapidly than those from the United States, the systematic quantitative data needed to make international comparisons are not available.

Other questions relate to the causes for the observed trends and thus go beyond the purpose and scope of this report. Readers seeking insight into the causes of the trends reported here should consult the following two SRS reports:

- ***The Changing Research and Publication Environment in American Research Universities.*** This report, a working paper (http://www.nsf.gov/statistics/srs07204) being released concomitantly with the present report, summarizes the views of experienced observers and practitioners in research universities about how the worlds of academic S&E research and publication changed during the 15-year period between 1988 and 2003. The qualitative data in this exploratory report cannot answer these causal questions. But, in discussing some of the changes that occurred in how research is performed and disseminated, how universities function, and how researchers in universities divide their time among their various activities, this exploratory report may suggest some causal hypotheses that warrant further examination.

- ***U.S. Academic Scientific Publishing.*** Scheduled for release as an SRS working paper, this report will also have implications for causal analysis of the changing trends in S&E article output. By examining quantifiable relationships among publications, resource inputs, and institutional characteristics, this report will address how various institutional characteristics (e.g., quality, R&D funding, institutional control, availability of S&E graduate students and doctorate holders, and patenting activity) relate to article production, how changes over time in these institutional characteristics relate to changes in article production, and how the variables related to an institution's article production differ for various S&E fields.

List of Appendix Tables

APPENDIX TABLE 1. S&E article output in selected journal databases, by publishing center: 1987–2002

Database and publishing center	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Chemical Abstract Service																
United States	107,620	106,654	110,485	110,006	132,256	117,838	126,207	158,188	152,191	160,266	151,577	136,617	141,286	136,339	139,284	na
Selected EU-15 countries	81,275	83,333	84,717	83,079	100,711	95,910	107,165	121,197	134,403	139,931	135,898	128,852	133,806	127,821	134,705	na
France	16,236	16,785	16,756	16,398	19,178	19,080	21,163	23,852	26,153	26,846	26,817	24,810	25,602	23,917	24,726	na
Germany	23,622	24,413	24,673	24,420	31,468	26,699	33,435	35,933	43,130	43,671	44,917	43,781	44,146	40,242	42,270	na
Italy	8,702	9,292	9,306	9,030	10,758	11,362	11,858	13,980	15,338	16,563	11,362	11,858	13,980	15,338	16,563	na
Netherlands	5,508	5,686	5,844	5,810	6,960	7,050	7,295	8,514	8,633	9,097	8,898	8,565	8,389	7,936	8,552	na
Spain	5,237	5,407	5,450	5,845	6,546	7,078	7,627	9,130	10,125	10,744	11,484	10,543	11,798	11,521	12,296	na
United Kingdom	21,970	21,750	22,688	21,576	25,801	24,641	25,787	29,788	31,024	33,010	32,420	29,295	29,891	28,867	30,298	na
Japan	45,026	44,635	47,056	47,646	56,637	56,958	59,582	69,116	72,285	72,544	76,553	75,684	79,939	76,928	79,213	na
East Asia-4	16,699	17,673	19,543	22,217	24,364	27,397	27,819	44,967	47,922	49,112	56,102	61,289	71,704	73,413	80,496	na
All other	135,846	137,390	135,357	131,997	139,672	132,147	127,963	149,046	156,154	157,254	165,400	156,567	164,357	158,968	172,981	na
Compendex																
United States	na	17,148	37,289	39,573	40,260	33,960	59,085	69,422	60,568	66,487	73,820	69,558	63,109	59,480	65,430	28,102
All other	na	35,192	69,045	66,206	79,965	66,033	105,198	138,083	115,930	145,504	178,797	175,645	159,152	160,261	194,740	93,068
Inspec																
United States	na	73,452	73,968	77,141	77,108	76,835	79,695	83,028	84,190	85,100	83,571	81,945	80,054	77,117	71,568	na
Selected EU-15 countries	na	47,980	47,728	51,160	51,369	52,599	56,095	61,600	69,666	73,438	74,051	73,589	73,183	71,040	64,938	na
Germany	na	14,936	14,597	16,189	15,938	15,884	16,805	18,112	22,142	23,620	23,397	24,068	23,012	21,723	19,631	na
United Kingdom	na	15,366	14,912	15,726	15,488	15,267	16,353	18,104	19,511	19,633	19,370	18,492	18,751	18,086	15,519	na
France	na	10,116	10,307	10,473	10,593	11,462	12,337	13,373	14,750	15,304	15,679	15,128	14,849	14,663	13,384	na
Italy	na	5,618	5,986	6,474	6,943	7,262	7,357	8,483	9,228	10,247	10,515	10,348	10,598	10,774	10,469	na
Spain	na	1,944	1,926	2,298	2,407	2,724	3,243	3,528	4,035	4,634	5,090	5,553	5,973	5,794	5,935	na
Japan	na	20,608	21,868	23,599	23,375	24,270	25,588	27,511	29,950	32,809	32,372	33,534	35,564	34,879	32,647	na
China	na	6,820	6,790	7,131	7,019	7,373	8,327	9,126	9,847	12,715	13,692	16,212	18,009	25,980	27,347	na
All other	na	97,847	97,411	98,549	91,318	91,052	89,992	98,409	106,297	116,280	122,094	125,867	125,451	124,428	119,292	na
PASCAL																
United States	na	na	156,979	168,348	180,495	185,087	145,502	124,853	135,786	146,848	152,192	149,478	144,943	na	na	na
All other	na	na	331,365	360,108	394,411	395,267	379,007	335,733	340,973	352,103	358,500	359,277	355,419	na	na	na

na = not available.

S&E = science and engineering; EU = European Union; Inspec = Information Service for Physics, Electronics and Computing.

NOTES: Compendex is a comprehensive database of engineering scholarly journals, trade magazines, and conference proceedings; PASCAL, a multilingual, multidisciplinary database, covers core scientific literature in science, technology, and medicine, with special emphasis on European literature; Inspec is a comprehensive database covering physics, electronics, and computer sciences. Articles assigned to publishing center or country on basis of institutional address of first author listed on article. Data not available for all years for some databases. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: American Chemical Society (ACS), Chemical Abstract Service, http://www.cas.org; Elsevier Engineering Information, Inc., Compendex, http://www.ei.org/compendex.html; Inspec, http://www.ei.org/inspec.html; and Institut de l'Information Scientifique et Technique du Centre National de la Recherche Scientifique (INIST-CNRS), PASCAL, http://www.inist.fr/en/PRODUITS/pascal.php (to search database: http://stneasy.cas.org).

APPENDIX TABLE 2. S&E article output (fixed journal set, fractional counts) of major S&E publishing centers, by field: 1988–2003

Field and publishing center	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	Number															
All fields																
All publishing centers	454,627	480,966	485,626	487,942	508,926	496,449	512,235	517,323	520,192	514,260	525,227	529,575	519,350	523,837	512,662	550,636
United States	172,288	180,448	181,322	182,254	183,129	180,186	178,665	179,327	174,073	167,166	165,673	163,727	159,089	160,901	154,268	165,607
EU-15	131,311	140,516	142,415	144,666	154,097	152,489	162,140	165,002	169,336	169,081	174,383	174,680	170,980	170,119	164,312	173,970
Japan	33,622	35,589	36,821	37,457	41,281	40,108	42,454	42,618	44,950	44,154	47,201	47,855	46,481	47,492	45,614	48,526
East Asia-4	7,093	8,347	9,595	10,109	12,038	13,144	14,751	17,108	18,968	22,046	24,351	27,501	29,646	33,903	35,865	41,514
All other	110,314	116,066	115,473	113,456	118,381	110,522	114,225	113,269	112,865	111,813	113,619	115,813	113,154	111,422	112,602	121,018
Clinical medicine																
All publishing centers	133,860	141,971	142,060	142,707	146,427	143,779	148,053	146,992	148,803	148,291	150,553	153,602	149,061	147,781	142,866	152,672
United States	53,512	55,592	55,516	55,428	55,516	55,794	55,362	55,535	54,220	52,948	52,421	52,631	50,186	50,569	47,782	51,278
EU-15	45,555	48,928	49,395	49,115	51,780	50,517	53,159	52,941	54,291	54,758	55,612	56,339	54,822	53,494	51,374	54,319
Japan	8,700	10,038	9,848	10,756	11,811	11,764	12,312	12,139	13,347	13,203	14,094	14,339	13,850	13,630	12,918	13,043
East Asia-4	1,295	1,523	1,797	1,692	2,036	2,054	2,403	2,618	3,080	3,248	3,866	4,283	4,537	5,264	5,490	6,533
All other	24,798	25,889	25,505	25,716	25,283	23,650	24,818	23,758	23,865	24,134	24,560	26,010	25,666	24,825	25,301	27,499
Biomedical research																
All publishing centers	68,568	73,462	73,613	74,529	77,302	75,817	76,958	78,543	77,511	76,448	79,115	77,511	76,055	76,471	72,845	78,173
United States	26,552	28,401	28,536	28,935	29,810	29,688	29,730	30,408	29,454	28,605	28,597	27,818	27,667	28,160	26,422	28,037
EU-15	19,932	21,705	21,975	22,533	23,697	23,868	24,830	25,529	25,519	24,940	25,902	25,730	24,265	24,593	23,175	24,395
Japan	5,017	5,564	5,721	5,847	6,339	6,318	6,469	6,683	6,366	6,614	7,085	6,960	6,605	6,830	6,480	6,706
East Asia-4	512	523	523	654	794	872	930	1,134	1,393	1,491	2,138	2,449	2,716	3,122	3,245	4,023
All other	16,555	17,269	16,857	16,559	16,662	15,072	14,999	14,789	14,778	14,797	15,394	14,553	14,802	13,766	13,522	15,012
Biology																
All publishing centers	34,571	36,281	37,860	36,608	37,089	36,270	36,767	37,445	36,690	37,227	37,893	37,301	38,806	37,660	39,681	41,468
United States	12,730	13,421	13,922	13,664	12,885	12,061	12,134	11,857	11,266	11,050	11,057	10,059	10,970	10,864	11,416	11,824
EU-15	8,720	9,387	9,903	9,391	10,146	10,023	10,467	11,261	11,075	11,689	11,808	11,877	12,180	11,384	11,859	12,203
Japan	2,349	2,415	2,514	2,640	2,607	2,609	2,754	2,706	2,707	2,466	2,735	2,802	2,859	2,878	2,832	3,096
East Asia-4	315	383	412	429	497	549	561	722	733	969	1,061	1,207	1,206	1,404	1,718	1,939
All other	10,457	10,676	11,110	10,483	10,954	11,028	10,851	10,899	10,909	11,053	11,231	11,356	11,592	11,130	11,855	12,405
Chemistry																
All publishing centers	56,707	58,809	60,507	59,926	62,502	61,141	63,263	64,365	65,519	64,356	65,944	66,347	64,106	64,489	62,864	68,063
United States	13,059	13,172	13,483	14,018	13,779	14,024	13,445	13,709	13,941	13,082	12,816	12,458	12,308	12,166	11,761	13,131
EU-15	17,453	17,693	18,243	18,472	19,236	19,880	20,689	20,962	21,476	21,350	21,903	21,537	20,183	20,315	19,162	20,049
Japan	6,052	6,070	6,808	6,435	6,802	6,320	6,836	6,967	7,056	6,898	7,573	7,670	7,546	7,244	6,909	7,268
East Asia-4	1,042	1,404	1,824	2,006	2,339	2,688	2,919	3,608	3,964	4,651	5,188	5,901	6,440	7,237	7,606	8,658
All other	19,101	20,469	20,148	18,995	20,346	18,228	19,373	19,119	19,083	18,375	18,464	18,782	17,630	17,527	17,426	18,957
Physics																
All publishing centers	61,760	65,482	66,262	68,203	73,950	70,244	76,879	77,449	78,799	77,970	78,427	80,726	77,992	79,226	79,881	85,958
United States	17,883	18,923	18,907	20,098	19,632	18,946	19,652	18,815	17,992	17,146	16,945	17,017	15,965	16,376	15,809	17,115
EU-15	17,252	18,496	18,541	20,016	21,725	20,953	24,204	24,496	25,749	25,309	25,815	26,094	25,679	25,086	25,340	26,628
Japan	6,505	6,500	6,905	6,581	8,341	7,657	8,445	8,615	9,730	9,378	9,241	10,148	9,747	10,205	10,095	11,446
East Asia-4	1,999	2,176	2,474	2,495	3,163	3,355	4,016	4,592	4,643	5,829	5,648	6,469	6,653	7,725	8,394	9,387
All other	18,121	19,386	19,434	19,013	21,089	19,333	20,562	20,930	20,685	20,308	20,777	20,998	19,948	19,834	20,244	21,383

APPENDIX TABLE 2. S&E article output (fixed journal set, fractional counts) of major S&E publishing centers, by field: 1988–2003

Field and publishing center	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Earth/space sciences																
All publishing centers	18,815	21,086	22,036	22,595	24,074	23,265	25,441	25,742	27,825	26,612	26,875	29,014	28,212	29,856	29,023	32,402
United States	7,951	8,422	8,658	8,896	9,070	9,239	9,656	10,000	10,156	9,567	9,145	10,101	9,522	9,796	9,209	10,858
EU-15	4,835	5,773	6,021	6,190	6,836	6,611	7,641	7,785	9,208	8,847	9,345	9,704	9,666	10,313	9,934	10,783
Japan	636	773	782	780	858	832	977	1,010	1,061	1,014	1,277	1,208	1,442	1,509	1,440	1,687
East Asia-4	241	229	249	385	350	341	441	480	689	909	940	1,005	1,185	1,539	1,654	1,897
All other	5,152	5,889	6,327	6,345	6,961	6,242	6,725	6,466	6,711	6,275	6,168	6,995	6,396	6,699	6,786	7,176
Engineering/technology																
All publishing centers	29,405	30,162	31,733	32,538	35,653	34,896	35,229	36,234	35,346	35,845	37,564	36,137	36,381	38,987	37,410	40,410
United States	10,978	11,277	12,077	11,719	12,894	11,825	11,897	11,877	11,110	10,533	10,385	9,550	9,176	9,743	8,721	9,623
EU-15	7,143	7,500	7,861	8,325	9,111	8,981	9,323	9,609	9,336	9,733	10,606	9,984	10,166	11,008	10,324	10,825
Japan	3,500	3,288	3,469	3,536	3,693	3,831	3,793	3,697	3,815	3,721	4,207	3,769	3,463	4,143	3,987	4,207
East Asia-4	1,121	1,473	1,626	1,762	2,094	2,491	2,634	2,945	3,295	3,657	4,171	4,687	5,230	5,669	5,902	6,810
All other	6,664	6,624	6,699	7,197	7,860	7,768	7,581	8,107	7,790	8,200	8,195	8,147	8,346	8,425	8,476	8,945
Mathematics																
All publishing centers	9,624	10,128	7,933	8,113	9,212	8,927	8,663	8,738	9,180	8,830	10,172	10,340	10,553	10,997	10,251	11,495
United States	3,856	3,972	3,239	3,329	3,429	3,394	3,185	3,013	3,076	2,788	3,072	3,017	2,984	2,834	2,771	2,895
EU-15	2,770	3,083	2,275	2,397	2,903	2,890	2,929	3,144	3,175	3,197	3,722	3,880	3,893	4,086	3,761	4,271
Japan	484	483	301	390	358	335	355	301	382	355	489	470	494	594	462	596
East Asia-4	252	318	286	310	409	405	410	458	565	636	704	771	919	1,025	962	1,203
All other	2,263	2,273	1,831	1,687	2,112	1,903	1,784	1,822	1,982	1,853	2,185	2,202	2,263	2,459	2,294	2,531
Psychology																
All publishing centers	11,282	11,289	11,529	10,931	11,206	10,529	10,774	11,300	10,875	10,424	10,705	10,502	10,191	10,489	10,279	10,873
United States	6,900	6,777	6,975	6,526	6,784	6,080	5,968	6,367	5,959	5,705	5,550	5,514	5,130	5,329	5,326	5,442
EU-15	2,085	2,200	2,257	2,180	2,277	2,289	2,431	2,543	2,587	2,568	2,833	2,761	2,771	2,893	2,733	3,078
Japan	168	174	190	208	192	188	234	228	253	219	225	212	211	199	204	168
East Asia-4	40	64	88	47	63	55	66	83	93	96	119	118	117	139	131	154
All other	2,089	2,074	2,019	1,970	1,890	1,917	2,075	2,079	1,982	1,836	1,979	1,897	1,962	1,929	1,884	2,031
Social sciences																
All publishing centers	15,167	16,147	16,226	16,002	16,013	15,908	15,192	15,047	14,854	14,389	14,154	14,179	14,047	14,287	13,534	14,615
United States	8,303	9,041	8,917	8,682	8,535	8,389	7,719	7,704	7,383	7,047	6,984	6,917	6,612	6,826	6,369	6,778
EU-15	3,383	3,489	3,547	3,578	3,887	3,974	3,784	3,880	4,024	3,947	4,047	3,904	4,325	4,026	3,913	4,224
Japan	162	191	215	198	222	181	207	191	164	198	205	186	190	185	190	214
East Asia-4	188	154	186	222	185	192	213	248	263	291	242	291	305	378	329	409
All other	3,130	3,273	3,360	3,322	3,183	3,172	3,270	3,024	3,019	2,906	2,676	2,882	2,615	2,871	2,733	2,989
	Percent distribution															
All fields																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	37.9	37.5	37.3	37.4	36.0	36.3	34.9	34.7	33.5	32.5	31.5	30.9	30.6	30.7	30.1	30.1
EU-15	28.9	29.2	29.3	29.6	30.3	30.7	31.7	31.9	32.6	32.9	33.2	33.0	32.9	32.5	32.1	31.6
Japan	7.4	7.4	7.6	7.7	8.1	8.1	8.3	8.2	8.6	8.6	9.0	9.0	8.9	9.1	8.9	8.8
East Asia-4	1.6	1.7	2.0	2.1	2.4	2.6	2.9	3.3	3.6	4.3	4.6	5.2	5.7	6.5	7.0	7.5
All other	24.3	24.1	23.8	23.3	23.3	22.3	22.3	21.9	21.7	21.7	21.6	21.9	21.8	21.3	22.0	22.0

APPENDIX TABLE 2. S&E article output (fixed journal set, fractional counts) of major S&E publishing centers, by field: 1988–2003

Field and publishing center	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Clinical medicine																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	40.0	39.2	39.1	38.8	37.9	38.8	37.4	37.8	36.4	35.7	34.8	34.3	33.7	34.2	33.4	33.6
EU-15	34.0	34.5	34.8	34.4	35.4	35.1	35.9	36.0	36.5	36.9	36.9	36.7	36.8	36.2	36.0	35.6
Japan	6.5	7.1	6.9	7.5	8.1	8.2	8.3	8.3	9.0	8.9	9.4	9.3	9.3	9.2	9.0	8.5
East Asia-4	1.0	1.1	1.3	1.2	1.4	1.4	1.6	1.8	2.1	2.2	2.6	2.8	3.0	3.6	3.8	4.3
All other	18.5	18.2	18.0	18.0	17.3	16.4	16.8	16.2	16.0	16.3	16.3	16.9	17.2	16.8	17.7	18.0
Biomedical research																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	38.7	38.7	38.8	38.8	38.6	39.2	38.6	38.7	38.0	37.4	36.1	35.9	36.4	36.8	36.3	35.9
EU-15	29.1	29.5	29.9	30.2	30.7	31.5	32.3	32.5	32.9	32.6	32.7	33.2	31.9	32.2	31.8	31.2
Japan	7.3	7.6	7.8	7.8	8.2	8.3	8.4	8.5	8.2	8.7	9.0	9.0	8.7	8.9	8.9	8.6
East Asia-4	0.7	0.7	0.7	0.9	1.0	1.1	1.2	1.4	1.8	2.0	2.7	3.2	3.6	4.1	4.5	5.1
All other	24.1	23.5	22.9	22.2	21.6	19.9	19.5	18.8	19.1	19.4	19.5	18.8	19.5	18.0	18.6	19.2
Biology																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	36.8	37.0	36.8	37.3	34.7	33.3	33.0	31.7	30.7	29.7	29.2	27.0	28.3	28.8	28.8	28.5
EU-15	25.2	25.9	26.2	25.7	27.4	27.6	28.5	30.1	30.2	31.4	31.2	31.8	31.4	30.2	29.9	29.4
Japan	6.8	6.7	6.6	7.2	7.0	7.2	7.5	7.2	7.4	6.6	7.2	7.5	7.4	7.6	7.1	7.5
East Asia-4	0.9	1.1	1.1	1.2	1.3	1.5	1.5	1.9	2.0	2.6	2.8	3.2	3.1	3.7	4.3	4.7
All other	30.2	29.4	29.3	28.6	29.5	30.4	29.5	29.1	29.7	29.7	29.6	30.4	29.9	29.6	29.9	29.9
Chemistry																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	23.0	22.4	22.3	23.4	22.0	22.9	21.3	21.3	21.3	20.3	19.4	18.8	19.2	18.9	18.7	19.3
EU-15	30.8	30.1	30.2	30.8	30.8	32.5	32.7	32.6	32.8	33.2	33.2	32.5	31.5	31.5	30.5	29.5
Japan	10.7	10.3	11.3	10.7	10.9	10.3	10.8	10.8	10.8	10.7	11.5	11.6	11.8	11.2	11.0	10.7
East Asia-4	1.8	2.4	3.0	3.3	3.7	4.4	4.6	5.6	6.0	7.2	7.9	8.9	10.0	11.2	12.1	12.7
All other	33.7	34.8	33.3	31.7	32.6	29.8	30.6	29.7	29.1	28.6	28.0	28.3	27.5	27.2	27.7	27.9
Physics																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	29.0	28.9	28.5	29.5	26.5	27.0	25.6	24.3	22.8	22.0	21.6	21.1	20.5	20.7	19.8	19.9
EU-15	27.9	28.2	28.0	29.3	29.4	29.8	31.5	31.6	32.7	32.5	32.9	32.3	32.9	31.7	31.7	31.0
Japan	10.5	9.9	10.4	9.6	11.3	10.9	11.0	11.1	12.3	12.0	11.8	12.6	12.5	12.9	12.6	13.3
East Asia-4	3.2	3.3	3.7	3.7	4.3	4.8	5.2	5.9	5.9	7.5	7.2	8.0	8.5	9.8	10.5	10.9
All other	29.3	29.6	29.3	27.9	28.5	27.5	26.7	27.0	26.3	26.0	26.5	26.0	25.6	25.0	25.3	24.9
Earth/space sciences																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	42.3	39.9	39.3	39.4	37.7	39.7	38.0	38.8	36.5	36.0	34.0	34.8	33.8	32.8	31.7	33.5
EU-15	25.7	27.4	27.3	27.4	28.4	28.4	30.0	30.2	33.1	33.2	34.8	33.4	34.3	34.5	34.2	33.3
Japan	3.4	3.7	3.5	3.5	3.6	3.6	3.8	3.9	3.8	3.8	4.8	4.2	5.1	5.1	5.0	5.2
East Asia-4	1.3	1.1	1.1	1.7	1.5	1.5	1.7	1.9	2.5	3.4	3.5	3.5	4.2	5.2	5.7	5.9
All other	27.4	27.9	28.7	28.1	28.9	26.8	26.4	25.1	24.1	23.6	23.0	24.1	22.7	22.4	23.4	22.1

APPENDIX TABLE 2. S&E article output (fixed journal set, fractional counts) of major S&E publishing centers, by field: 1988–2003

Field and publishing center	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Engineering/technology																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	37.3	37.4	38.1	36.0	36.2	33.9	33.8	32.8	31.4	29.4	27.6	26.4	25.2	25.0	23.3	23.8
EU-15	24.3	24.9	24.8	25.6	25.6	25.7	26.5	26.5	26.4	27.2	28.2	27.6	27.9	28.2	27.6	26.8
Japan	11.9	10.9	10.9	10.9	10.4	11.0	10.8	10.2	10.8	10.4	11.2	10.4	9.5	10.6	10.7	10.4
East Asia-4	3.8	4.9	5.1	5.4	5.9	7.1	7.5	8.1	9.3	10.2	11.1	13.0	14.4	14.5	15.8	16.9
All other	22.7	22.0	21.1	22.1	22.0	22.3	21.5	22.4	22.0	22.9	21.8	22.5	22.9	21.6	22.7	22.1
Mathematics																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	40.1	39.2	40.8	41.0	37.2	38.0	36.8	34.5	33.5	31.6	30.2	29.2	28.3	25.8	27.0	25.2
EU-15	28.8	30.4	28.7	29.5	31.5	32.4	33.8	36.0	34.6	36.2	36.6	37.5	36.9	37.2	36.7	37.2
Japan	5.0	4.8	3.8	4.8	3.9	3.8	4.1	3.4	4.2	4.0	4.8	4.5	4.7	5.4	4.5	5.2
East Asia-4	2.6	3.1	3.6	3.8	4.4	4.5	4.7	5.2	6.2	7.2	6.9	7.5	8.7	9.3	9.4	10.5
All other	23.5	22.4	23.1	20.8	22.9	21.3	20.6	20.8	21.6	21.0	21.5	21.3	21.4	22.4	22.4	22.0
Psychology																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	61.2	60.0	60.5	59.7	60.5	57.7	55.4	56.3	54.8	54.7	51.8	52.5	50.3	50.8	51.8	50.0
EU-15	18.5	19.5	19.6	19.9	20.3	21.7	22.6	22.5	23.8	24.6	26.5	26.3	27.2	27.6	26.6	28.3
Japan	1.5	1.5	1.6	1.9	1.7	1.8	2.2	2.0	2.3	2.1	2.1	2.0	2.1	1.9	2.0	1.5
East Asia-4	0.4	0.6	0.8	0.4	0.6	0.5	0.6	0.7	0.9	0.9	1.1	1.1	1.2	1.3	1.3	1.4
All other	18.5	18.4	17.5	18.0	16.9	18.2	19.3	18.4	18.2	17.6	18.5	18.1	19.3	18.4	18.3	18.7
Social sciences																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	54.7	56.0	55.0	54.3	53.3	52.7	50.8	51.2	49.7	49.0	49.3	48.8	47.1	47.8	47.1	46.4
EU-15	22.3	21.6	21.9	22.4	24.3	25.0	24.9	25.8	27.1	27.4	28.6	27.5	30.8	28.2	28.9	28.9
Japan	1.1	1.2	1.3	1.2	1.4	1.1	1.4	1.3	1.1	1.4	1.5	1.3	1.4	1.3	1.4	1.5
East Asia-4	1.2	1.0	1.1	1.4	1.2	1.2	1.4	1.6	1.8	2.0	1.7	2.1	2.2	2.6	2.4	2.8
All other	20.6	20.3	20.7	20.8	19.9	19.9	21.5	20.1	20.3	20.2	18.9	20.3	18.6	20.1	20.2	20.5

S&E = science and engineering; EU = European Union.

NOTES: Data drawn from fixed set of journals restricted to those in Thomson ISI data set existing in 1985. Articles on fractional-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives fractional credit on basis of proportion of its participating institutions."All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *Science Citation Index* and S*ocial Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 3. S&E article output (fractional counts) of major S&E publishing centers, by field: 1988–2003

Field and publishing center	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	Number															
All fields																
All publishing centers	466,419	497,102	508,795	515,530	547,617	540,491	567,204	580,809	593,568	594,467	617,762	632,059	632,781	649,795	641,388	698,726
United States	177,662	187,224	191,559	194,015	198,864	197,397	199,769	202,887	201,798	197,531	197,890	198,524	196,221	200,870	195,792	211,233
EU-15	134,551	145,337	149,032	152,761	166,230	166,540	179,710	185,842	193,172	195,060	205,479	209,006	208,128	211,177	204,769	220,002
Japan	34,435	36,569	38,570	39,590	44,143	43,339	46,692	47,603	50,392	50,171	54,658	56,134	55,413	57,420	55,085	60,067
East Asia-4	7,214	8,687	10,146	10,638	12,807	14,297	16,220	19,097	21,675	25,381	28,980	33,405	36,837	42,699	46,132	55,324
All other	112,557	119,285	119,488	118,526	125,572	118,918	124,814	125,380	126,532	126,324	130,755	134,990	136,182	137,629	139,610	152,100
Clinical medicine																
All publishing centers	136,878	147,368	149,656	152,165	160,471	158,323	167,091	168,009	172,482	174,852	180,416	183,822	182,033	184,825	179,724	194,937
United States	55,016	58,133	58,850	59,488	61,097	61,312	62,610	63,367	63,057	62,676	63,077	63,190	61,745	63,709	60,785	65,933
EU-15	46,451	50,722	52,030	52,436	57,239	56,198	60,497	61,153	63,483	64,926	67,329	68,068	67,468	67,204	64,900	69,558
Japan	8,820	10,219	10,289	11,364	12,565	12,775	13,833	13,697	15,004	15,182	16,366	16,618	16,435	16,502	15,744	16,309
East Asia-4	1,313	1,560	1,856	1,763	2,166	2,215	2,588	2,893	3,570	3,886	4,571	5,107	5,500	6,531	6,816	8,253
All other	25,278	26,734	26,632	27,115	27,404	25,822	27,563	26,899	27,368	28,182	29,073	30,838	30,886	30,878	31,480	34,883
Biomedical research																
All publishing centers	70,723	76,228	78,150	79,594	84,192	83,616	86,926	89,424	88,371	88,553	92,429	91,704	91,463	92,078	88,735	95,633
United States	27,455	29,427	30,703	31,177	32,906	33,117	33,750	35,048	33,991	33,661	33,978	33,423	33,482	34,041	32,407	34,427
EU-15	20,599	22,647	23,322	24,140	25,772	26,342	28,052	29,216	29,142	29,034	30,530	30,640	29,388	29,774	28,366	30,138
Japan	5,219	5,794	5,990	6,170	6,791	6,824	7,070	7,352	7,054	7,424	7,997	7,962	7,756	8,016	7,638	7,996
East Asia-4	521	536	542	680	856	937	1,017	1,295	1,629	1,759	2,546	2,957	3,306	3,838	4,099	5,070
All other	16,929	17,824	17,593	17,427	17,866	16,396	17,037	16,512	16,555	16,675	17,377	16,723	17,531	16,409	16,225	18,002
Biology																
All publishing centers	35,167	36,992	38,598	37,562	38,768	38,395	39,224	40,530	40,325	40,785	42,283	42,075	44,973	44,292	46,745	49,589
United States	12,862	13,544	14,028	13,898	13,366	12,671	12,845	12,664	12,310	12,027	12,126	11,271	12,496	12,499	13,122	13,855
EU-15	8,968	9,673	10,215	9,734	10,701	10,733	11,266	12,223	12,183	12,766	13,295	13,442	14,304	13,805	14,270	14,956
Japan	2,388	2,457	2,565	2,673	2,699	2,779	3,041	3,144	3,153	2,917	3,250	3,311	3,427	3,490	3,455	3,764
East Asia-4	320	388	422	447	527	593	598	789	795	1,053	1,188	1,379	1,402	1,641	1,995	2,331
All other	10,629	10,929	11,369	10,810	11,474	11,618	11,474	11,709	11,883	12,023	12,424	12,672	13,343	12,858	13,902	14,682
Chemistry																
All publishing centers	57,434	60,056	62,550	62,686	66,182	65,768	67,767	70,419	71,618	70,501	74,628	76,688	75,724	77,051	76,419	83,483
United States	13,186	13,398	13,990	14,681	14,647	15,089	14,577	14,915	15,219	14,375	14,414	14,491	14,560	14,342	14,043	15,763
EU-15	17,677	18,143	18,833	19,376	20,418	21,397	22,194	23,162	23,862	23,614	25,165	25,299	23,944	24,018	23,076	24,363
Japan	6,083	6,143	7,106	6,806	7,273	6,989	7,423	7,842	7,841	7,709	8,828	8,853	8,698	8,544	8,153	8,837
East Asia-4	1,054	1,446	1,885	2,081	2,476	2,882	3,102	3,906	4,286	5,008	5,822	7,105	7,804	8,909	9,752	11,181
All other	19,434	20,925	20,735	19,741	21,367	19,412	20,472	20,593	20,411	19,795	20,399	20,940	20,718	21,238	21,395	23,339
Physics																
All publishing centers	62,246	66,224	67,313	69,627	76,207	73,325	80,854	82,111	84,021	82,859	85,010	87,302	84,367	86,758	88,412	96,953
United States	18,023	19,067	19,196	20,515	20,158	19,602	20,427	19,709	18,906	18,048	17,966	18,074	16,897	17,385	17,301	18,657
EU-15	17,423	18,736	18,806	20,391	22,480	21,859	25,411	25,704	27,127	26,621	27,523	27,979	27,292	27,206	27,438	29,228
Japan	6,568	6,573	7,049	6,843	8,705	7,968	8,805	9,074	10,287	9,778	10,030	10,777	10,430	10,978	10,866	12,507
East Asia-4	2,013	2,310	2,692	2,650	3,299	3,730	4,565	5,213	5,474	6,763	6,979	7,640	8,015	9,221	10,199	12,455
All other	18,218	19,538	19,570	19,228	21,564	20,166	21,646	22,412	22,227	21,649	22,513	22,832	21,734	21,966	22,608	24,105

APPENDIX TABLE 3. S&E article output (fractional counts) of major S&E publishing centers, by field: 1988–2003

Field and publishing center	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Earth/space sciences																
All publishing centers	19,315	21,685	22,904	23,393	24,926	24,854	27,019	28,245	30,564	29,453	30,252	32,543	32,696	35,190	34,280	38,559
United States	8,053	8,572	8,936	9,113	9,305	9,830	10,139	10,886	11,024	10,540	10,294	11,209	10,748	11,272	10,623	12,530
EU-15	5,055	5,982	6,321	6,452	7,148	7,095	8,151	8,587	10,113	9,739	10,400	10,951	11,116	11,857	11,510	12,648
Japan	651	782	799	797	873	857	1,039	1,121	1,169	1,114	1,390	1,337	1,600	1,714	1,618	1,885
East Asia-4	250	269	293	431	401	374	469	544	748	978	1,022	1,106	1,275	1,709	1,840	2,186
All other	5,306	6,079	6,555	6,599	7,199	6,699	7,221	7,107	7,511	7,083	7,146	7,941	7,957	8,638	8,690	9,310
Engineering/technology																
All publishing centers	31,315	32,209	34,367	35,402	39,577	38,918	40,470	42,308	41,495	43,831	47,389	51,020	52,031	58,158	56,681	62,661
United States	11,817	12,051	13,090	12,838	14,395	13,303	13,862	13,801	12,843	12,907	12,904	13,564	12,796	13,889	13,677	14,777
EU-15	7,536	7,969	8,410	8,863	9,912	9,954	10,529	11,348	11,073	11,969	13,571	14,357	14,598	17,040	15,765	16,725
Japan	3,816	3,634	3,966	4,029	4,351	4,334	4,532	4,514	4,859	5,010	5,601	6,003	5,724	6,682	6,306	7,269
East Asia-4	1,168	1,531	1,756	1,880	2,293	2,731	2,961	3,361	3,802	4,386	5,192	6,179	7,349	8,184	8,778	10,597
All other	6,979	7,024	7,145	7,793	8,626	8,597	8,586	9,284	8,918	9,560	10,122	10,916	11,564	12,364	12,155	13,293
Mathematics																
All publishing centers	9,707	10,215	8,118	8,282	9,465	9,079	9,110	9,282	9,881	9,719	11,539	12,274	13,488	14,176	13,504	15,170
United States	3,880	3,990	3,304	3,382	3,538	3,453	3,346	3,190	3,272	3,051	3,483	3,561	3,758	3,657	3,556	3,760
EU-15	2,800	3,127	2,347	2,457	2,991	2,950	3,056	3,280	3,396	3,507	4,144	4,555	4,940	5,140	4,849	5,544
Japan	486	485	306	391	363	335	364	312	402	380	527	557	646	780	604	756
East Asia-4	253	319	288	312	414	409	419	463	591	665	805	892	1,095	1,261	1,259	1,547
All other	2,288	2,294	1,872	1,739	2,158	1,932	1,926	2,038	2,220	2,116	2,581	2,709	3,049	3,338	3,237	3,563
Psychology																
All publishing centers	11,809	11,836	12,501	11,977	12,572	11,976	12,809	13,522	14,599	14,350	14,315	14,439	14,237	14,821	14,492	15,474
United States	7,171	7,088	7,587	7,194	7,626	6,986	7,184	7,830	8,258	8,130	7,736	7,806	7,499	7,809	7,691	7,892
EU-15	2,246	2,337	2,470	2,410	2,595	2,621	2,888	2,965	3,368	3,427	3,622	3,693	3,715	3,889	3,769	4,291
Japan	172	177	191	210	204	195	244	231	316	290	289	278	272	293	256	256
East Asia-4	41	65	90	49	68	60	74	100	118	123	146	163	166	189	182	258
All other	2,179	2,169	2,163	2,115	2,079	2,115	2,419	2,395	2,539	2,380	2,522	2,499	2,586	2,641	2,594	2,777
Social sciences																
All publishing centers	15,902	16,925	17,293	17,508	17,719	18,161	17,987	17,879	18,960	18,623	18,571	18,999	19,612	20,093	19,415	21,532
United States	8,738	9,551	9,651	9,595	9,521	9,690	9,275	9,150	9,425	9,163	9,086	9,171	9,149	9,384	9,040	9,764
EU-15	3,546	3,627	3,702	3,873	4,241	4,459	4,424	4,635	5,139	5,117	5,368	5,393	6,135	5,880	5,809	6,570
Japan	170	195	228	215	236	200	253	218	207	244	277	297	303	304	291	322
East Asia-4	191	158	189	233	193	214	243	281	337	375	319	400	420	534	489	575
All other	3,257	3,394	3,523	3,592	3,529	3,597	3,792	3,594	3,853	3,725	3,521	3,738	3,605	3,991	3,786	4,301
	Percent distribution															
All fields																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	38.1	37.7	37.6	37.6	36.3	36.5	35.2	34.9	34.0	33.2	32.0	31.4	31.0	30.9	30.5	30.2
EU-15	28.8	29.2	29.3	29.6	30.4	30.8	31.7	32.0	32.5	32.8	33.3	33.1	32.9	32.5	31.9	31.5
Japan	7.4	7.4	7.6	7.7	8.1	8.0	8.2	8.2	8.5	8.4	8.8	8.9	8.8	8.8	8.6	8.6
East Asia-4	1.5	1.7	2.0	2.1	2.3	2.6	2.9	3.3	3.7	4.3	4.7	5.3	5.8	6.6	7.2	7.9
All other	24.1	24.0	23.5	23.0	22.9	22.0	22.0	21.6	21.3	21.2	21.2	21.4	21.5	21.2	21.8	21.8

APPENDIX TABLE 3. S&E article output (fractional counts) of major S&E publishing centers, by field: 1988–2003

Field and publishing center	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Clinical medicine																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	40.2	39.4	39.3	39.1	38.1	38.7	37.5	37.7	36.6	35.8	35.0	34.4	33.9	34.5	33.8	33.8
EU-15	33.9	34.4	34.8	34.5	35.7	35.5	36.2	36.4	36.8	37.1	37.3	37.0	37.1	36.4	36.1	35.7
Japan	6.4	6.9	6.9	7.5	7.8	8.1	8.3	8.2	8.7	8.7	9.1	9.0	9.0	8.9	8.8	8.4
East Asia-4	1.0	1.1	1.2	1.2	1.4	1.4	1.5	1.7	2.1	2.2	2.5	2.8	3.0	3.5	3.8	4.2
All other	18.5	18.1	17.8	17.8	17.1	16.3	16.5	16.0	15.9	16.1	16.1	16.8	17.0	16.7	17.5	17.9
Biomedical research																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	38.8	38.6	39.3	39.2	39.1	39.6	38.8	39.2	38.5	38.0	36.8	36.4	36.6	37.0	36.5	36.0
EU-15	29.1	29.7	29.8	30.3	30.6	31.5	32.3	32.7	33.0	32.8	33.0	33.4	32.1	32.3	32.0	31.5
Japan	7.4	7.6	7.7	7.8	8.1	8.2	8.1	8.2	8.0	8.4	8.7	8.7	8.5	8.7	8.6	8.4
East Asia-4	0.7	0.7	0.7	0.9	1.0	1.1	1.2	1.4	1.8	2.0	2.8	3.2	3.6	4.2	4.6	5.3
All other	23.9	23.4	22.5	21.9	21.2	19.6	19.6	18.5	18.7	18.8	18.8	18.2	19.2	17.8	18.3	18.8
Biology																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	36.6	36.6	36.3	37.0	34.5	33.0	32.7	31.2	30.5	29.5	28.7	26.8	27.8	28.2	28.1	27.9
EU-15	25.5	26.1	26.5	25.9	27.6	28.0	28.7	30.2	30.2	31.3	31.4	31.9	31.8	31.2	30.5	30.2
Japan	6.8	6.6	6.6	7.1	7.0	7.2	7.8	7.8	7.8	7.2	7.7	7.9	7.6	7.9	7.4	7.6
East Asia-4	0.9	1.0	1.1	1.2	1.4	1.5	1.5	1.9	2.0	2.6	2.8	3.3	3.1	3.7	4.3	4.7
All other	30.2	29.5	29.5	28.8	29.6	30.3	29.3	28.9	29.5	29.5	29.4	30.1	29.7	29.0	29.7	29.6
Chemistry																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	23.0	22.3	22.4	23.4	22.1	22.9	21.5	21.2	21.2	20.4	19.3	18.9	19.2	18.6	18.4	18.9
EU-15	30.8	30.2	30.1	30.9	30.9	32.5	32.8	32.9	33.3	33.5	33.7	33.0	31.6	31.2	30.2	29.2
Japan	10.6	10.2	11.4	10.9	11.0	10.6	11.0	11.1	10.9	10.9	11.8	11.5	11.5	11.1	10.7	10.6
East Asia-4	1.8	2.4	3.0	3.3	3.7	4.4	4.6	5.5	6.0	7.1	7.8	9.3	10.3	11.6	12.8	13.4
All other	33.8	34.8	33.1	31.5	32.3	29.5	30.2	29.2	28.5	28.1	27.3	27.3	27.4	27.6	28.0	28.0
Physics																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	29.0	28.8	28.5	29.5	26.5	26.7	25.3	24.0	22.5	21.8	21.1	20.7	20.0	20.0	19.6	19.2
EU-15	28.0	28.3	27.9	29.3	29.5	29.8	31.4	31.3	32.3	32.1	32.4	32.0	32.3	31.4	31.0	30.1
Japan	10.6	9.9	10.5	9.8	11.4	10.9	10.9	11.1	12.2	11.8	11.8	12.3	12.4	12.7	12.3	12.9
East Asia-4	3.2	3.5	4.0	3.8	4.3	5.1	5.6	6.3	6.5	8.2	8.2	8.8	9.5	10.6	11.5	12.8
All other	29.3	29.5	29.1	27.6	28.3	27.5	26.8	27.3	26.5	26.1	26.5	26.2	25.8	25.3	25.6	24.9
Earth/space sciences																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	41.7	39.5	39.0	39.0	37.3	39.6	37.5	38.5	36.1	35.8	34.0	34.4	32.9	32.0	31.0	32.5
EU-15	26.2	27.6	27.6	27.6	28.7	28.5	30.2	30.4	33.1	33.1	34.4	33.6	34.0	33.7	33.6	32.8
Japan	3.4	3.6	3.5	3.4	3.5	3.4	3.8	4.0	3.8	3.8	4.6	4.1	4.9	4.9	4.7	4.9
East Asia-4	1.3	1.2	1.3	1.8	1.6	1.5	1.7	1.9	2.4	3.3	3.4	3.4	3.9	4.9	5.4	5.7
All other	27.5	28.0	28.6	28.2	28.9	27.0	26.7	25.2	24.6	24.0	23.6	24.4	24.3	24.5	25.3	24.1

APPENDIX TABLE 3. S&E article output (fractional counts) of major S&E publishing centers, by field: 1988–2003

Field and publishing center	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Engineering/technology																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	37.7	37.4	38.1	36.3	36.4	34.2	34.3	32.6	31.0	29.4	27.2	26.6	24.6	23.9	24.1	23.6
EU-15	24.1	24.7	24.5	25.0	25.0	25.6	26.0	26.8	26.7	27.3	28.6	28.1	28.1	29.3	27.8	26.7
Japan	12.2	11.3	11.5	11.4	11.0	11.1	11.2	10.7	11.7	11.4	11.8	11.8	11.0	11.5	11.1	11.6
East Asia-4	3.7	4.8	5.1	5.3	5.8	7.0	7.3	7.9	9.2	10.0	11.0	12.1	14.1	14.1	15.5	16.9
All other	22.3	21.8	20.8	22.0	21.8	22.1	21.2	21.9	21.5	21.8	21.4	21.4	22.2	21.3	21.4	21.2
Mathematics																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	40.0	39.1	40.7	40.8	37.4	38.0	36.7	34.4	33.1	31.4	30.2	29.0	27.9	25.8	26.3	24.8
EU-15	28.8	30.6	28.9	29.7	31.6	32.5	33.5	35.3	34.4	36.1	35.9	37.1	36.6	36.3	35.9	36.5
Japan	5.0	4.7	3.8	4.7	3.8	3.7	4.0	3.4	4.1	3.9	4.6	4.5	4.8	5.5	4.5	5.0
East Asia-4	2.6	3.1	3.6	3.8	4.4	4.5	4.6	5.0	6.0	6.8	7.0	7.3	8.1	8.9	9.3	10.2
All other	23.6	22.5	23.1	21.0	22.8	21.3	21.1	22.0	22.5	21.8	22.4	22.1	22.6	23.5	24.0	23.5
Psychology																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	60.7	59.9	60.7	60.1	60.7	58.3	56.1	57.9	56.6	56.7	54.0	54.1	52.7	52.7	53.1	51.0
EU-15	19.0	19.7	19.8	20.1	20.6	21.9	22.6	21.9	23.1	23.9	25.3	25.6	26.1	26.2	26.0	27.7
Japan	1.5	1.5	1.5	1.8	1.6	1.6	1.9	1.7	2.2	2.0	2.0	1.9	1.9	2.0	1.8	1.7
East Asia-4	0.3	0.5	0.7	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.3	1.7
All other	18.5	18.3	17.3	17.7	16.5	17.7	18.9	17.7	17.4	16.6	17.6	17.3	18.2	17.8	17.9	17.9
Social sciences																
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	55.0	56.4	55.8	54.8	53.7	53.4	51.6	51.2	49.7	49.2	48.9	48.3	46.6	46.7	46.6	45.3
EU-15	22.3	21.4	21.4	22.1	23.9	24.6	24.6	25.9	27.1	27.5	28.9	28.4	31.3	29.3	29.9	30.5
Japan	1.1	1.2	1.3	1.2	1.3	1.1	1.4	1.2	1.1	1.3	1.5	1.6	1.5	1.5	1.5	1.5
East Asia-4	1.2	0.9	1.1	1.3	1.1	1.2	1.4	1.6	1.8	2.0	1.7	2.1	2.1	2.7	2.5	2.7
All other	20.5	20.1	20.4	20.5	19.9	19.8	21.1	20.1	20.3	20.0	19.0	19.7	18.4	19.9	19.5	20.0

S&E = science and engineering; EU = European Union.

NOTES: Data drawn from expanding Thomson ISI journal set. Articles on fractional-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives fractional credit on basis of proportion of its participating institutions. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 4. S&E article output (whole counts) of major S&E publishing centers, by field: 1988–2003

Field and publishing center	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	Number															
All fields																
All publishing centers	466,419	497,102	508,795	515,530	547,617	540,491	567,204	580,809	593,568	594,467	617,762	632,059	632,781	649,795	641,388	698,726
United States	187,225	197,930	203,194	207,116	213,624	212,903	216,862	221,335	221,414	218,274	220,182	222,474	221,207	228,015	223,521	242,397
EU-15	144,157	156,306	160,964	166,394	182,099	183,266	198,561	206,578	215,494	219,143	231,534	237,022	237,255	242,529	236,780	255,262
Japan	36,041	38,419	40,717	41,997	47,079	46,499	50,309	51,625	54,614	54,952	59,963	61,908	61,421	64,073	61,717	67,728
East Asia-4	8,194	9,892	11,522	12,314	14,808	16,520	18,675	22,066	24,923	29,051	33,068	38,151	41,919	48,918	52,751	63,400
Biology																
All publishing centers	35,167	36,992	38,598	37,562	38,768	38,395	39,224	40,530	40,325	40,785	42,283	42,075	44,973	44,292	46,745	49,589
United States	13,522	14,308	14,807	14,743	14,235	13,615	13,791	13,696	13,367	13,177	13,361	12,566	14,002	14,049	14,863	15,810
EU-15	9,614	10,358	10,989	10,551	11,592	11,653	12,298	13,415	13,418	14,170	14,864	15,122	16,183	15,770	16,452	17,347
Japan	2,506	2,589	2,706	2,821	2,865	2,964	3,235	3,380	3,366	3,159	3,507	3,601	3,750	3,854	3,813	4,201
East Asia-4	400	499	532	585	652	734	741	977	981	1,275	1,433	1,650	1,721	2,033	2,448	2,868
Biomedical research																
All publishing centers	70,723	76,228	78,150	79,594	84,192	83,616	86,926	89,424	88,371	88,553	92,429	91,704	91,463	92,078	88,735	95,633
United States	29,198	31,388	32,924	33,656	35,740	36,111	37,052	38,626	37,719	37,546	38,325	37,913	38,139	39,001	37,319	39,848
EU-15	22,389	24,646	25,543	26,590	28,661	29,365	31,428	32,943	32,996	33,182	35,053	35,433	34,171	34,838	33,413	35,719
Japan	5,521	6,183	6,417	6,651	7,366	7,438	7,748	8,160	7,841	8,319	9,035	9,041	8,826	9,222	8,834	9,287
East Asia-4	627	653	679	849	1,063	1,170	1,251	1,577	1,957	2,132	2,985	3,510	3,874	4,556	4,872	6,040
Chemistry																
All publishing centers	57,434	60,056	62,550	62,686	66,182	65,768	67,767	70,419	71,618	70,501	74,628	76,688	75,724	77,051	76,419	83,483
United States	13,896	14,187	14,866	15,677	15,742	16,236	15,833	16,223	16,654	15,852	16,001	16,185	16,282	16,146	15,874	17,807
EU-15	18,694	19,306	20,052	20,820	22,073	23,128	24,101	25,312	26,116	26,067	27,951	28,215	26,879	27,135	26,314	27,783
Japan	6,236	6,307	7,333	7,048	7,544	7,292	7,758	8,198	8,257	8,176	9,365	9,445	9,288	9,135	8,769	9,580
East Asia-4	1,147	1,562	2,019	2,264	2,717	3,119	3,362	4,198	4,606	5,393	6,247	7,609	8,340	9,578	10,457	12,047
Clinical medicine																
All publishing centers	136,878	147,368	149,656	152,165	160,471	158,323	167,091	168,009	172,482	174,852	180,416	183,822	182,033	184,825	179,724	194,937
United States	57,378	60,790	61,704	62,643	64,767	65,243	67,027	68,110	68,148	68,205	68,964	69,618	68,407	70,989	68,111	74,240
EU-15	48,755	53,383	54,885	55,599	60,864	60,141	64,852	65,894	68,594	70,505	73,228	74,356	74,087	74,370	72,055	77,638
Japan	9,226	10,692	10,825	11,988	13,313	13,607	14,817	14,683	16,077	16,353	17,583	17,965	17,864	18,047	17,208	17,958
East Asia-4	1,512	1,788	2,122	2,042	2,517	2,620	3,018	3,395	4,099	4,465	5,249	5,866	6,338	7,552	7,851	9,551
Earth/space sciences																
All publishing centers	19,315	21,685	22,904	23,393	24,926	24,854	27,019	28,245	30,564	29,453	30,252	32,543	32,696	35,190	34,280	38,559
United States	8,783	9,423	9,922	10,215	10,535	11,093	11,617	12,523	12,904	12,411	12,288	13,506	13,078	13,926	13,386	15,757
EU-15	5,776	6,882	7,392	7,595	8,458	8,429	9,736	10,315	12,213	11,869	12,633	13,548	13,779	14,841	14,582	16,082
Japan	755	896	936	951	1,041	1,020	1,258	1,355	1,468	1,414	1,738	1,698	1,993	2,188	2,117	2,485
East Asia-4	325	351	388	557	537	488	638	742	1,000	1,222	1,286	1,434	1,635	2,189	2,321	2,829
Engineering/technology																
All publishing centers	31,315	32,209	34,367	35,402	39,577	38,918	40,470	42,308	41,495	43,831	47,389	51,020	52,031	58,158	56,681	62,661
United States	12,430	12,730	13,826	13,709	15,353	14,272	14,950	15,013	13,983	14,221	14,407	15,185	14,514	15,938	15,671	17,119
EU-15	8,024	8,505	9,021	9,592	10,747	10,857	11,529	12,459	12,234	13,359	15,166	16,224	16,484	19,435	18,115	19,196
Japan	3,963	3,802	4,134	4,225	4,591	4,596	4,811	4,846	5,162	5,397	6,048	6,547	6,277	7,362	6,995	8,042
East Asia-4	1,322	1,745	1,984	2,148	2,598	3,060	3,332	3,807	4,262	4,940	5,793	6,901	8,096	9,129	9,796	11,798

APPENDIX TABLE 4. S&E article output (whole counts) of major S&E publishing centers, by field: 1988–2003

Field and publishing center	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Mathematics																
All publishing centers	9,707	10,215	8,118	8,282	9,465	9,079	9,110	9,282	9,881	9,719	11,539	12,274	13,488	14,176	13,504	15,170
United States	4,301	4,428	3,698	3,811	4,052	3,925	3,811	3,646	3,812	3,567	4,097	4,254	4,523	4,459	4,375	4,651
EU-15	3,152	3,524	2,692	2,839	3,461	3,377	3,508	3,767	3,926	4,055	4,808	5,352	5,877	6,076	5,749	6,620
Japan	525	525	342	430	407	368	398	348	442	419	589	627	739	889	708	881
East Asia-4	302	375	347	371	498	495	496	551	699	783	965	1,088	1,320	1,530	1,515	1,881
Physics																
All publishing centers	62,246	66,224	67,313	69,627	76,207	73,325	80,854	82,111	84,021	82,859	85,010	87,302	84,367	86,758	88,412	96,953
United States	19,683	20,905	21,204	22,923	22,840	22,437	23,559	23,062	22,389	21,709	21,803	22,144	21,081	21,801	21,902	23,582
EU-15	19,321	20,936	21,212	23,419	26,110	25,701	29,920	30,542	32,344	32,151	33,293	34,062	33,569	33,609	34,120	36,361
Japan	6,867	6,891	7,467	7,310	9,363	8,678	9,637	10,037	11,288	10,978	11,320	12,173	11,906	12,545	12,453	14,429
East Asia-4	2,189	2,529	2,966	3,016	3,752	4,285	5,192	6,007	6,305	7,726	8,016	8,775	9,235	10,607	11,719	14,292
Psychology																
All publishing centers	11,809	11,836	12,501	11,977	12,572	11,976	12,809	13,522	14,599	14,350	14,315	14,439	14,237	14,821	14,492	15,474
United States	7,342	7,294	7,788	7,407	7,864	7,219	7,432	8,137	8,587	8,500	8,116	8,211	7,892	8,270	8,168	8,472
EU-15	2,356	2,465	2,596	2,547	2,751	2,791	3,064	3,194	3,620	3,692	3,941	4,001	4,048	4,291	4,170	4,780
Japan	185	191	206	226	231	211	264	252	350	317	326	314	300	336	294	300
East Asia-4	47	78	105	61	87	82	101	130	158	160	188	219	216	246	252	336
Social sciences																
All publishing centers	15,902	16,925	17,293	17,508	17,719	18,161	17,987	17,879	18,960	18,623	18,571	18,999	19,612	20,093	19,415	21,532
United States	9,043	9,863	10,002	9,959	9,927	10,121	9,731	9,615	9,945	9,662	9,575	9,695	9,676	9,988	9,671	10,510
EU-15	3,724	3,816	3,896	4,091	4,498	4,728	4,705	4,951	5,479	5,473	5,760	5,778	6,579	6,373	6,311	7,191
Japan	188	220	257	241	268	230	278	247	237	273	322	330	331	351	334	365
East Asia-4	213	184	220	268	231	260	304	358	424	458	399	492	506	651	607	699
	Percent															
All fields																
United States	40.1	39.8	39.9	40.2	39.0	39.4	38.2	38.1	37.3	36.7	35.6	35.2	35.0	35.1	34.8	34.7
EU-15	30.9	31.4	31.6	32.3	33.3	33.9	35.0	35.6	36.3	36.9	37.5	37.5	37.5	37.3	36.9	36.5
Japan	7.7	7.7	8.0	8.1	8.6	8.6	8.9	8.9	9.2	9.2	9.7	9.8	9.7	9.9	9.6	9.7
East Asia-4	1.8	2.0	2.3	2.4	2.7	3.1	3.3	3.8	4.2	4.9	5.4	6.0	6.6	7.5	8.2	9.1
Biology																
United States	38.5	38.7	38.4	39.2	36.7	35.5	35.2	33.8	33.1	32.3	31.6	29.9	31.1	31.7	31.8	31.9
EU-15	27.3	28.0	28.5	28.1	29.9	30.4	31.4	33.1	33.3	34.7	35.2	35.9	36.0	35.6	35.2	35.0
Japan	7.1	7.0	7.0	7.5	7.4	7.7	8.2	8.3	8.3	7.7	8.3	8.6	8.3	8.7	8.2	8.5
East Asia-4	1.1	1.3	1.4	1.6	1.7	1.9	1.9	2.4	2.4	3.1	3.4	3.9	3.8	4.6	5.2	5.8
Biomedical research																
United States	41.3	41.2	42.1	42.3	42.5	43.2	42.6	43.2	42.7	42.4	41.5	41.3	41.7	42.4	42.1	41.7
EU-15	31.7	32.3	32.7	33.4	34.0	35.1	36.2	36.8	37.3	37.5	37.9	38.6	37.4	37.8	37.7	37.4
Japan	7.8	8.1	8.2	8.4	8.7	8.9	8.9	9.1	8.9	9.4	9.8	9.9	9.6	10.0	10.0	9.7
East Asia-4	0.9	0.9	0.9	1.1	1.3	1.4	1.4	1.8	2.2	2.4	3.2	3.8	4.2	4.9	5.5	6.3
Chemistry																
United States	24.2	23.6	23.8	25.0	23.8	24.7	23.4	23.0	23.3	22.5	21.4	21.1	21.5	21.0	20.8	21.3
EU-15	32.5	32.1	32.1	33.2	33.4	35.2	35.6	35.9	36.5	37.0	37.5	36.8	35.5	35.2	34.4	33.3
Japan	10.9	10.5	11.7	11.2	11.4	11.1	11.4	11.6	11.5	11.6	12.5	12.3	12.3	11.9	11.5	11.5

APPENDIX TABLE 4. S&E article output (whole counts) of major S&E publishing centers, by field: 1988–2003

Field and publishing center	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
East Asia-4	2.0	2.6	3.2	3.6	4.1	4.7	5.0	6.0	6.4	7.6	8.4	9.9	11.0	12.4	13.7	14.4
Clinical medicine																
United States	41.9	41.3	41.2	41.2	40.4	41.2	40.1	40.5	39.5	39.0	38.2	37.9	37.6	38.4	37.9	38.1
EU-15	35.6	36.2	36.7	36.5	37.9	38.0	38.8	39.2	39.8	40.3	40.6	40.5	40.7	40.2	40.1	39.8
Japan	6.7	7.3	7.2	7.9	8.3	8.6	8.9	8.7	9.3	9.4	9.7	9.8	9.8	9.8	9.6	9.2
East Asia-4	1.1	1.2	1.4	1.3	1.6	1.7	1.8	2.0	2.4	2.6	2.9	3.2	3.5	4.1	4.4	4.9
Earth/space sciences																
United States	45.5	43.5	43.3	43.7	42.3	44.6	43.0	44.3	42.2	42.1	40.6	41.5	40.0	39.6	39.0	40.9
EU-15	29.9	31.7	32.3	32.5	33.9	33.9	36.0	36.5	40.0	40.3	41.8	41.6	42.1	42.2	42.5	41.7
Japan	3.9	4.1	4.1	4.1	4.2	4.1	4.7	4.8	4.8	4.8	5.7	5.2	6.1	6.2	6.2	6.4
East Asia-4	1.7	1.6	1.7	2.4	2.2	2.0	2.4	2.6	3.3	4.1	4.3	4.4	5.0	6.2	6.8	7.3
Engineering/technology																
United States	39.7	39.5	40.2	38.7	38.8	36.7	36.9	35.5	33.7	32.4	30.4	29.8	27.9	27.4	27.6	27.3
EU-15	25.6	26.4	26.2	27.1	27.2	27.9	28.5	29.4	29.5	30.5	32.0	31.8	31.7	33.4	32.0	30.6
Japan	12.7	11.8	12.0	11.9	11.6	11.8	11.9	11.5	12.4	12.3	12.8	12.8	12.1	12.7	12.3	12.8
East Asia-4	4.2	5.4	5.8	6.1	6.6	7.9	8.2	9.0	10.3	11.3	12.2	13.5	15.6	15.7	17.3	18.8
Mathematics																
United States	44.3	43.3	45.6	46.0	42.8	43.2	41.8	39.3	38.6	36.7	35.5	34.7	33.5	31.5	32.4	30.7
EU-15	32.5	34.5	33.2	34.3	36.6	37.2	38.5	40.6	39.7	41.7	41.7	43.6	43.6	42.9	42.6	43.6
Japan	5.4	5.1	4.2	5.2	4.3	4.1	4.4	3.7	4.5	4.3	5.1	5.1	5.5	6.3	5.2	5.8
East Asia-4	3.1	3.7	4.3	4.5	5.3	5.5	5.4	5.9	7.1	8.1	8.4	8.9	9.8	10.8	11.2	12.4
Physics																
United States	31.6	31.6	31.5	32.9	30.0	30.6	29.1	28.1	26.6	26.2	25.6	25.4	25.0	25.1	24.8	24.3
EU-15	31.0	31.6	31.5	33.6	34.3	35.1	37.0	37.2	38.5	38.8	39.2	39.0	39.8	38.7	38.6	37.5
Japan	11.0	10.4	11.1	10.5	12.3	11.8	11.9	12.2	13.4	13.2	13.3	13.9	14.1	14.5	14.1	14.9
East Asia-4	3.5	3.8	4.4	4.3	4.9	5.8	6.4	7.3	7.5	9.3	9.4	10.1	10.9	12.2	13.3	14.7
Psychology																
United States	62.2	61.6	62.3	61.8	62.6	60.3	58.0	60.2	58.8	59.2	56.7	56.9	55.4	55.8	56.4	54.7
EU-15	20.0	20.8	20.8	21.3	21.9	23.3	23.9	23.6	24.8	25.7	27.5	27.7	28.4	29.0	28.8	30.9
Japan	1.6	1.6	1.6	1.9	1.8	1.8	2.1	1.9	2.4	2.2	2.3	2.2	2.1	2.3	2.0	1.9
East Asia-4	0.4	0.7	0.8	0.5	0.7	0.7	0.8	1.0	1.1	1.1	1.3	1.5	1.5	1.7	1.7	2.2
Social sciences																
United States	56.9	58.3	57.8	56.9	56.0	55.7	54.1	53.8	52.5	51.9	51.6	51.0	49.3	49.7	49.8	48.8
EU-15	23.4	22.5	22.5	23.4	25.4	26.0	26.2	27.7	28.9	29.4	31.0	30.4	33.5	31.7	32.5	33.4
Japan	1.2	1.3	1.5	1.4	1.5	1.3	1.5	1.4	1.3	1.5	1.7	1.7	1.7	1.7	1.7	1.7
East Asia-4	1.3	1.1	1.3	1.5	1.3	1.4	1.7	2.0	2.2	2.5	2.1	2.6	2.6	3.2	3.1	3.2

S&E = science and engineering; EU = European Union.

NOTES: Articles on whole-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives one count for its participation, regardless of the number of its participating institutions. Shares may add to more than 100% because articles with institutional authors from multiple publishing centers are counted once for each publishing center. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 5. Average annual growth rate of S&E article output (fractional and whole counts) of major S&E publishing centers, by field: 1988–2003

(Percent)

Publishing center and field	Fractional counts		Whole counts	
	1988–92	1992–2003	1988–92	1992–2003
United States				
All fields	3.8	0.6	4.5	1.3
Biology	1.3	0.4	1.7	1.1
Biomedical research	6.2	0.5	7.0	1.1
Chemistry	3.6	0.7	4.2	1.2
Clinical medicine	3.6	0.8	4.1	1.4
Earth/space sciences	4.9	3.0	6.3	4.1
Engineering/technology	6.8	0.3	7.3	1.1
Mathematics	-3.0	0.6	-2.0	1.4
Physics	3.8	-0.8	5.1	0.3
Psychology	2.1	0.3	2.3	0.7
Social sciences	2.9	0.3	3.2	0.6
EU-15				
All fields	7.3	2.8	8.1	3.4
Biology	6.1	3.4	6.4	4.1
Biomedical research	7.8	1.6	8.6	2.2
Chemistry	4.9	1.8	5.7	2.3
Clinical medicine	7.2	2.0	7.7	2.5
Earth/space sciences	12.2	5.9	13.6	6.6
Engineering/technology	9.6	5.4	10.2	6.0
Mathematics	2.2	6.4	3.2	6.7
Physics	8.9	2.7	10.6	3.4
Psychology	4.9	5.2	5.3	5.7
Social sciences	6.1	4.5	6.5	4.8
Japan				
All fields	8.6	3.1	9.3	3.7
Biology	4.2	3.4	4.6	3.9
Biomedical research	9.2	1.6	10.1	2.3
Chemistry	6.1	2.0	6.6	2.4
Clinical medicine	12.5	2.6	13.0	3.0
Earth/space sciences	10.3	8.0	11.3	9.1
Engineering/technology	4.5	5.3	5.0	5.8
Mathematics	-9.3	7.6	-8.1	8.0
Physics	9.8	3.7	10.9	4.4
Psychology	5.9	2.3	7.7	2.6
Social sciences	11.6	3.2	12.5	3.1
East Asia-4				
All fields	21.1	15.8	21.8	15.7
Biology	18.1	16.0	17.7	16.0
Biomedical research	18.0	19.5	19.2	19.0
Chemistry	32.9	16.3	33.3	16.1
Clinical medicine	18.2	14.3	18.5	14.3
Earth/space sciences	17.0	18.5	18.2	18.1
Engineering/technology	25.2	16.5	25.3	16.3
Mathematics	17.9	14.1	18.1	14.2
Physics	17.9	14.2	19.7	14.3
Psychology	18.3	14.3	22.8	14.5
Social sciences	0.3	11.6	2.7	11.7

S&E = science and engineering; EU = European Union.

NOTES: For articles with collaborating institutions from multiple publishing centers, fractional counts assign each publishing center fractional credit on basis of proportion of its participating institutions, and whole counts assign each publishing center one credit for its participation, regardless of the number of its participating institutions. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong. "All fields" includes health sciences and professional fields. Biology includes agriculture sciences. Engineering/technology includes computer sciences.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 6. World share of top 1% cited articles (fractional counts) of major S&E publishing centers, by field: 1992–2003
(Percent distribution)

Field and publishing center	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
All fields												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	64.6	63.8	63.0	62.1	62.0	61.6	61.8	60.6	59.8	58.2	57.2	56.6
EU-15	23.3	23.8	24.3	24.5	24.6	25.1	24.7	25.2	25.6	27.0	27.5	27.7
Japan	4.2	4.5	4.5	4.6	4.5	4.4	4.3	4.6	5.0	5.1	5.1	5.3
East Asia-4	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.4	0.4	0.5	0.8	1.1
All other	7.8	7.8	8.0	8.6	8.7	8.8	8.9	9.1	9.2	9.2	9.3	9.3
Clinical medicine												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	62.9	62.5	61.0	60.5	60.7	60.8	60.6	60.4	59.1	57.2	56.7	57.5
EU-15	25.5	25.9	26.3	26.7	26.9	27.1	26.7	26.2	27.1	28.6	29.3	28.0
Japan	3.3	3.6	4.1	4.1	4.1	3.8	3.6	3.6	3.7	3.7	3.6	4.1
East Asia-4	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.4	0.4	0.5	0.7	0.9
All other	8.2	7.8	8.3	8.5	8.0	8.1	8.9	9.5	9.7	10.0	9.7	9.5
Biomedical research												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	67.8	68.3	68.1	68.5	68.1	67.9	68.5	66.9	66.7	64.4	64.2	63.5
EU-15	21.1	21.2	21.2	20.2	20.9	20.6	19.9	20.6	20.1	21.8	22.4	22.9
Japan	4.7	4.0	4.3	4.5	4.0	3.8	4.0	4.6	5.1	4.8	4.8	5.1
East Asia-4	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.4	0.5
All other	6.4	6.5	6.3	6.7	6.9	7.6	7.3	7.5	7.8	8.5	8.1	8.1
Biology												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	58.6	56.3	53.6	54.7	53.7	53.2	50.5	48.8	47.4	46.8	44.1	43.9
EU-15	22.5	24.9	26.6	26.5	28.6	27.7	31.9	32.3	32.4	34.0	35.8	35.8
Japan	2.5	2.7	3.0	2.5	2.7	3.0	2.7	2.8	4.0	3.3	4.2	4.2
East Asia-4	0.1	0.0	0.1	0.1	0.1	0.3	0.7	1.0	0.8	0.4	0.5	0.9
All other	16.3	16.1	16.7	16.1	14.8	15.9	14.2	15.0	15.4	15.5	15.4	15.2
Chemistry												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	59.1	57.0	56.0	54.3	50.5	47.4	50.7	47.5	47.3	44.8	44.3	43.4
EU-15	23.1	25.3	25.4	26.8	29.8	31.3	29.4	32.1	30.4	32.3	32.3	32.2
Japan	7.5	7.7	7.5	7.4	7.3	7.3	7.6	7.1	8.9	8.8	9.5	8.5
East Asia-4	0.2	0.4	0.4	0.5	0.6	0.7	0.8	1.2	1.4	1.8	2.7	3.8
All other	10.1	9.6	10.7	11.0	11.7	13.3	11.6	12.1	12.0	12.3	11.2	12.1
Physics												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	60.4	57.5	57.3	53.5	51.0	48.4	48.0	45.9	43.0	43.0	42.2	40.4
EU-15	23.9	25.5	26.5	28.8	29.5	30.2	30.2	32.5	34.1	34.1	34.8	33.8
Japan	6.2	7.3	6.5	6.0	6.6	7.3	7.9	9.0	9.7	9.7	8.4	9.6
East Asia-4	0.4	0.3	0.3	0.4	0.5	0.8	0.8	1.1	1.6	1.3	1.8	4.0
All other	9.1	9.5	9.4	11.2	12.4	13.3	13.1	11.5	11.6	12.0	12.9	12.2

APPENDIX TABLE 6. World share of top 1% cited articles (fractional counts) of major S&E publishing centers, by field: 1992–2003
(Percent distribution)

Field and publishing center	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Earth/space sciences												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	60.1	58.7	63.9	63.0	64.2	62.4	61.5	57.9	56.0	55.8	55.2	53.5
EU-15	22.4	24.1	21.5	21.8	22.6	25.1	25.6	28.9	30.2	31.3	31.6	32.6
Japan	2.7	2.7	1.5	1.6	1.5	1.9	2.1	2.6	3.2	2.0	2.2	1.9
East Asia-4	0.0	0.3	0.1	0.1	0.2	0.1	0.3	0.2	0.3	0.2	0.2	0.8
All other	14.9	14.1	13.1	13.4	11.6	10.4	10.5	10.5	10.4	10.7	10.8	11.2
Engineering/technology												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	63.3	61.7	65.4	58.2	53.1	49.2	52.6	46.8	50.2	46.0	45.3	45.4
EU-15	17.9	23.5	19.0	22.7	23.9	27.0	23.6	27.2	25.6	29.2	25.5	25.9
Japan	8.6	7.7	8.4	10.6	10.6	10.1	10.6	11.5	10.9	10.2	11.7	9.5
East Asia-4	0.9	0.8	1.1	0.8	1.5	1.7	2.7	4.2	2.6	3.2	6.4	7.2
All other	9.4	6.3	6.1	7.6	10.9	12.1	10.6	10.3	10.7	11.4	11.2	11.9
Mathematics												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	60.2	62.8	63.5	53.0	56.5	57.6	62.3	54.2	59.0	50.1	49.7	51.2
EU-15	28.0	25.6	26.4	29.7	32.3	26.4	23.7	31.7	28.9	35.5	34.9	33.9
Japan	2.4	3.7	2.8	4.3	1.0	2.1	0.5	0.5	1.2	2.1	1.5	1.7
East Asia-4	1.3	1.2	0.5	0.9	0.9	0.2	1.5	3.0	1.2	2.3	3.4	5.6
All other	8.1	6.7	6.8	12.1	9.4	13.6	12.0	10.6	9.7	10.0	10.5	7.6
Psychology												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	82.5	74.8	76.6	78.6	77.6	77.8	75.2	73.2	71.6	73.7	71.2	68.4
EU-15	8.6	13.4	13.7	10.0	10.4	11.8	13.6	16.1	16.5	15.5	18.1	23.4
Japan	0.1	0.0	0.0	0.1	0.3	0.4	0.0	0.2	0.4	0.8	0.7	0.3
East Asia-4	0.0	0.2	0.1	0.0	0.0	0.0	0.1	0.4	0.2	0.3	0.3	0.3
All other	8.8	11.7	9.6	11.3	11.7	10.0	11.0	10.1	11.2	9.7	9.7	7.6
Social sciences												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	82.9	84.2	80.4	79.3	78.1	79.4	74.5	75.2	72.3	73.6	75.2	71.5
EU-15	10.7	9.3	13.1	13.7	15.9	13.2	18.4	18.6	20.4	19.2	19.0	22.7
Japan	0.7	0.2	0.4	0.2	0.2	0.5	0.3	0.2	0.2	0.3	0.1	0.1
East Asia-4	0.0	0.2	0.1	0.4	0.4	0.7	0.5	0.6	1.0	0.8	0.8	0.6
All other	5.7	6.2	6.0	6.4	5.4	6.3	6.3	5.5	6.2	6.1	4.9	5.0

S&E = science and engineering; EU = European Union.

NOTES: Citations are references to scientific articles in journals covered by *Science Citation Index (SCI)* and *Social Sciences Citation Index (SSCI).* Top 1% of cited articles based on a 3-year period with a 2-year lag (e.g., for 2003, top 1% cited articles are articles published in 1999–2001 that were among the top 1% in citations in articles published in 2003). Actual number of articles in top 1% is ordinarily less than 1% because articles with same frequency of citation that exceed top 1% are not included. Articles on fractional-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives fractional credit on basis of proportion of its participating institutions. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *SCI* and *SSCI,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 7. World share of top 10% cited articles (fractional counts) of major S&E publishing centers, by field: 1992–2003
(Percent distribution)

Field and publishing center	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
All fields												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	56.0	55.6	54.6	53.7	52.7	51.5	50.8	49.7	48.9	47.2	46.7	46.5
EU-15	27.3	27.9	28.4	29.0	29.8	30.5	30.9	31.5	31.8	32.7	32.5	32.3
Japan	5.7	5.6	5.8	5.7	5.7	5.9	5.9	6.1	6.4	6.6	6.6	6.6
East Asia-4	0.4	0.4	0.5	0.6	0.7	0.7	0.9	1.1	1.3	1.4	2.0	2.4
All other	10.6	10.5	10.7	11.0	11.1	11.4	11.5	11.6	11.7	12.0	12.2	12.2
Clinical medicine												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	55.7	55.5	55.8	54.5	53.4	53.2	52.2	51.6	50.5	49.4	49.0	48.7
EU-15	29.0	29.4	29.0	29.9	30.8	31.1	31.7	32.0	32.3	33.1	33.3	33.2
Japan	4.5	4.6	4.8	4.8	5.1	5.0	5.1	5.3	5.4	5.6	5.5	5.5
East Asia-4	0.3	0.3	0.4	0.5	0.5	0.5	0.5	0.6	0.8	0.9	1.2	1.5
All other	10.4	10.2	9.9	10.3	10.2	10.2	10.4	10.5	11.0	11.0	11.0	11.2
Biomedical research												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	61.8	61.5	60.9	60.5	60.1	59.4	60.4	59.3	59.0	56.9	56.8	55.8
EU-15	24.5	24.8	25.2	25.2	25.6	26.3	25.6	26.1	26.2	27.3	27.4	27.4
Japan	5.5	5.3	5.3	5.1	5.2	5.1	4.8	5.1	5.4	5.9	5.6	6.0
East Asia-4	0.1	0.2	0.2	0.3	0.2	0.3	0.3	0.4	0.5	0.6	0.8	1.1
All other	8.1	8.3	8.3	8.9	8.9	9.0	8.9	9.0	8.9	9.2	9.4	9.7
Biology												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	45.9	46.2	44.9	43.2	42.9	40.0	38.8	37.9	39.0	37.0	36.8	37.6
EU-15	28.0	28.0	28.2	30.3	31.1	32.6	34.6	35.5	36.1	37.1	37.3	36.3
Japan	4.5	4.3	5.1	4.8	4.6	5.0	4.8	4.9	4.4	4.8	4.7	4.8
East Asia-4	0.5	0.5	0.5	0.5	0.6	0.8	0.9	1.1	1.0	1.1	1.5	1.4
All other	21.2	21.0	21.3	21.3	20.8	21.5	20.9	20.6	19.5	20.0	19.7	19.9
Chemistry												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	47.7	47.4	45.5	45.6	43.7	41.0	39.9	38.3	37.0	38.2	37.5	37.1
EU-15	29.8	30.4	31.0	30.8	32.2	34.0	34.5	34.3	34.7	34.6	33.7	33.2
Japan	9.5	9.5	9.7	9.8	9.1	9.8	10.1	10.1	10.6	10.1	10.0	9.9
East Asia-4	1.0	1.3	1.5	1.4	1.8	2.1	2.6	3.4	3.7	3.5	4.9	6.0
All other	11.9	11.4	12.4	12.4	13.1	13.2	13.0	14.0	14.0	13.7	13.8	13.8
Physics												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	48.5	47.4	45.7	44.4	41.7	39.2	38.2	36.9	35.1	33.4	32.8	32.2
EU-15	30.2	30.7	32.0	32.9	34.8	35.4	35.8	37.0	37.8	37.5	37.2	36.2
Japan	8.8	8.9	8.7	8.7	8.6	8.7	8.9	9.4	9.6	10.4	10.2	11.1
East Asia-4	0.7	1.0	1.0	1.3	1.5	1.9	2.1	2.6	2.9	3.5	4.6	5.7
All other	11.8	12.1	12.6	12.9	13.4	14.8	14.9	14.1	14.6	15.1	15.1	14.7
Earth/space sciences												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	57.0	57.0	56.0	58.9	55.8	53.9	53.4	51.5	50.8	49.1	46.7	46.6
EU-15	24.9	25.8	26.3	24.4	27.2	28.7	29.3	30.4	30.5	32.6	33.0	33.1
Japan	2.5	2.5	2.1	1.9	2.3	2.3	2.3	2.6	3.2	3.0	3.4	3.6
East Asia-4	0.3	0.4	0.3	0.3	0.3	0.5	0.7	0.6	1.0	1.0	1.3	1.9
All other	15.3	14.3	15.3	14.5	14.4	14.6	14.3	14.9	14.5	14.4	15.6	14.7
Engineering/technology												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	52.5	51.1	49.6	47.9	45.0	42.8	42.9	39.2	38.4	35.9	33.7	33.0
EU-15	23.7	25.1	25.3	25.9	27.5	28.3	27.7	29.8	29.7	31.0	30.2	29.5
Japan	10.4	9.3	10.1	10.3	10.3	10.0	10.8	10.6	10.9	10.8	11.6	11.4
East Asia-4	1.9	3.1	2.8	3.4	3.6	4.5	5.2	5.8	7.2	7.5	9.3	11.2
All other	11.6	11.4	12.3	12.5	13.5	14.4	13.4	14.5	13.8	14.8	15.3	14.9

APPENDIX TABLE 7. World share of top 10% cited articles (fractional counts) of major S&E publishing centers, by field: 1992–2003
(Percent distribution)

Field and publishing center	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Mathematics												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	53.6	55.3	55.2	52.2	51.6	49.8	49.7	45.3	43.3	40.5	39.2	39.8
EU-15	29.3	29.2	28.0	29.4	30.2	30.7	31.6	35.0	33.9	36.9	37.2	36.7
Japan	2.1	2.7	2.1	2.6	1.8	2.6	2.4	2.4	2.8	2.9	2.8	2.7
East Asia-4	1.3	1.0	1.4	2.2	2.4	2.5	3.1	3.2	4.9	5.2	5.9	7.2
All other	13.7	11.8	13.3	13.6	14.0	14.3	13.2	14.1	15.0	14.6	14.9	13.7
Psychology												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	71.2	73.1	70.7	69.2	69.2	68.2	67.4	67.0	66.5	64.3	62.0	60.5
EU-15	15.2	15.2	17.5	17.5	17.8	18.3	18.5	19.9	20.3	22.0	23.7	25.2
Japan	0.5	0.2	0.3	0.2	0.4	0.4	0.6	0.5	0.5	0.4	0.5	0.7
East Asia-4	0.4	0.2	0.1	0.1	0.2	0.3	0.2	0.3	0.4	0.4	0.6	0.5
All other	12.8	11.4	11.5	12.9	12.4	12.9	13.2	12.3	12.4	12.8	13.2	13.1
Social sciences												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	76.7	77.4	74.2	72.0	69.4	69.3	66.5	66.7	65.3	64.9	63.4	61.5
EU-15	12.8	12.9	15.1	17.5	19.8	20.2	22.2	21.8	23.8	24.2	25.7	26.5
Japan	0.6	0.5	0.6	0.4	0.4	0.3	0.2	0.4	0.4	0.3	0.3	0.4
East Asia-4	0.3	0.4	0.5	0.4	0.5	0.8	0.8	1.0	1.2	1.2	1.5	1.6
All other	9.6	8.8	9.7	9.7	9.9	9.5	10.2	10.0	9.3	9.5	9.1	10.0

S&E = science and engineering; EU = European Union.

NOTES: Citations are references to scientific articles in journals covered by *Science Citation Index (SCI)* and *Social Sciences Citation Index (SSCI).* Top 10% of cited articles based on a 3-year period with a 2-year lag (e.g., for 2003, top 10% cited articles are articles published in 1999–2001 that were among the top 10% in citations in articles published in 2003). Actual number of articles in top 10% is ordinarily less than 10% because articles with same frequency of citation that exceed top 10% are not included. Articles on fractional-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives fractional credit on basis of proportion of its participating institutions. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *SCI* and *SSCI,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 8. World share of highly influential S&E articles (fractional counts) of major S&E publishing centers, by field: 1992–2003
(Percent distribution)

Field and publishing center	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
All fields												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	58.5	58.0	58.2	57.3	56.2	55.2	54.8	54.0	52.8	51.1	50.5	50.3
EU-15	26.2	26.7	26.8	27.1	28.0	28.8	29.0	29.4	29.8	30.9	31.1	30.7
Japan	5.3	5.3	5.2	5.2	5.2	5.2	5.2	5.4	5.7	6.0	5.9	6.0
East Asia-4	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.7	0.9	1.1	1.5	1.9
All other	9.8	9.7	9.5	10.0	10.1	10.4	10.4	10.5	10.8	10.9	11.0	11.0
Clinical medicine												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	58.2	58.2	58.3	57.5	56.1	55.8	55.3	54.6	53.4	52.1	51.6	51.5
EU-15	27.7	28.0	27.9	28.2	29.1	29.8	30.2	30.2	30.7	31.8	32.1	31.8
Japan	4.1	4.2	4.4	4.5	4.6	4.5	4.4	4.6	4.8	5.1	4.9	4.8
East Asia-4	0.2	0.3	0.3	0.4	0.4	0.4	0.4	0.6	0.6	0.7	0.9	1.2
All other	9.8	9.3	9.1	9.4	9.7	9.5	9.8	10.0	10.5	10.3	10.5	10.7
Biomedical research												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	64.9	64.2	63.7	63.5	63.2	62.5	63.1	61.7	62.1	59.5	59.4	58.8
EU-15	22.8	23.2	23.9	23.5	23.7	24.2	24.0	24.7	24.0	25.9	25.7	25.9
Japan	4.9	4.9	4.8	4.7	4.7	4.8	4.5	4.8	5.2	5.5	5.4	5.8
East Asia-4	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.7	0.8
All other	7.4	7.5	7.6	8.1	8.1	8.4	8.2	8.5	8.3	8.7	8.8	8.7
Biology												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	47.7	47.8	49.0	47.5	46.8	43.5	42.0	41.0	40.4	38.5	39.7	39.0
EU-15	27.2	28.3	27.5	29.3	30.5	32.5	34.1	34.8	35.7	36.7	37.1	36.3
Japan	4.1	3.8	4.3	3.9	3.8	4.1	4.0	4.5	4.1	4.5	4.3	4.6
East Asia-4	0.4	0.4	0.3	0.3	0.4	0.4	0.7	0.9	1.0	1.1	1.2	1.2
All other	20.6	19.7	18.9	19.0	18.5	19.5	19.2	18.8	18.8	19.2	17.7	18.9
Chemistry												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	51.6	54.9	52.6	52.0	50.0	47.4	46.3	44.3	46.4	43.7	43.0	42.3
EU-15	28.0	27.3	28.0	28.0	29.1	31.1	31.2	31.9	30.5	31.8	31.7	31.5
Japan	8.7	7.9	8.1	8.4	7.9	8.3	9.0	8.7	8.8	9.1	8.8	8.9
East Asia-4	0.9	0.7	0.9	0.9	1.3	1.5	1.7	2.4	2.3	2.9	3.7	5.0
All other	10.8	9.2	10.4	10.8	11.7	11.7	11.8	12.7	11.9	12.6	12.7	12.3
Physics												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	51.9	51.9	49.8	48.5	46.1	42.4	41.5	39.8	37.7	36.5	37.1	34.9
EU-15	28.9	28.8	30.6	31.8	33.0	34.0	34.8	36.2	37.3	37.0	36.3	35.7
Japan	7.9	8.0	7.4	7.5	7.7	8.2	8.1	8.9	9.2	10.0	9.5	10.9
East Asia-4	0.5	0.7	0.6	0.9	1.0	1.3	1.7	2.0	2.5	2.8	3.5	4.9
All other	10.8	10.5	11.5	11.4	12.1	14.2	13.9	13.1	13.4	13.7	13.6	13.7
Earth/space sciences												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	60.0	59.1	59.5	61.6	59.7	56.4	55.8	54.9	53.1	52.1	50.8	49.3
EU-15	22.9	24.8	24.4	23.2	25.0	28.9	28.1	28.9	30.0	31.8	32.1	32.8
Japan	2.3	2.1	1.7	1.5	1.9	1.9	2.4	2.5	3.1	2.8	2.5	3.2
East Asia-4	0.2	0.3	0.2	0.4	0.4	0.4	0.3	0.4	0.6	0.6	1.1	1.5
All other	14.6	13.8	14.1	13.3	13.0	12.3	13.3	13.3	13.2	12.7	13.5	13.3
Engineering/technology												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	55.3	54.6	53.2	51.1	46.9	45.4	44.9	41.1	40.7	38.5	36.6	35.7
EU-15	23.7	24.4	23.7	25.8	27.6	28.4	27.4	30.1	29.8	30.6	29.3	28.9
Japan	9.8	9.2	9.7	9.5	10.3	9.8	10.9	10.5	10.9	11.1	11.7	11.5
East Asia-4	1.4	2.1	2.2	2.3	3.1	3.6	4.2	5.0	5.9	6.4	8.7	10.3
All other	9.9	9.7	11.3	11.3	12.1	12.7	12.5	13.3	12.7	13.4	13.7	13.6

APPENDIX TABLE 8. World share of highly influential S&E articles (fractional counts) of major S&E publishing centers, by field: 1992–2003
(Percent distribution)

Field and publishing center	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Mathematics												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	53.6	55.3	55.2	52.2	51.6	52.2	54.4	48.5	47.7	42.8	43.0	42.1
EU-15	29.3	29.2	28.0	29.4	30.2	30.7	30.1	33.9	32.1	35.9	36.6	36.6
Japan	2.1	2.7	2.1	2.6	1.8	2.5	2.0	1.7	2.5	2.9	1.8	2.3
East Asia-4	1.3	1.0	1.4	2.2	2.4	2.2	2.3	2.5	4.5	5.4	5.2	7.0
All other	13.7	11.8	13.3	13.6	14.0	12.4	11.2	13.3	13.2	13.0	13.4	12.0
Psychology												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	73.5	74.6	72.8	73.3	71.7	72.2	70.4	68.9	69.3	67.4	65.5	63.2
EU-15	14.2	14.7	17.0	14.2	15.9	15.8	16.4	18.7	18.0	19.4	22.2	24.3
Japan	0.3	0.0	0.2	0.1	0.4	0.4	0.3	0.5	0.3	0.4	0.4	0.5
East Asia-4	0.2	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.4	0.5	0.4	0.4
All other	11.8	10.5	9.8	12.3	11.9	11.4	12.6	11.6	12.0	12.2	11.5	11.6
Social sciences												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	79.5	79.9	77.0	74.5	72.2	72.4	69.3	68.9	67.8	68.0	67.0	64.3
EU-15	11.5	11.9	13.5	16.5	18.6	18.7	20.4	21.5	22.5	22.9	23.5	26.1
Japan	0.8	0.5	0.4	0.2	0.4	0.2	0.2	0.3	0.2	0.4	0.3	0.2
East Asia-4	0.2	0.1	0.4	0.4	0.4	0.5	0.7	0.9	1.2	0.9	1.2	1.2
All other	8.0	7.6	8.7	8.3	8.4	8.1	9.4	8.4	8.4	7.7	8.0	8.2

S&E = science and engineering; EU = European Union.

NOTES: Citations are references to scientific articles in journals covered by *Science Citation Index (SCI)* and *Social Sciences Citation Index (SSCI).* Highly influential articles are top 5% of cited articles based on a 3-year period with a 2-year lag (e.g., for 2003, highly influential articles are articles published in 1999–2001 that were among the top 5% in citations in articles published in 2003). Actual number of articles in top 5% is ordinarily less than 5% because articles with same frequency of citation that exceed top 5% are not included. Articles on fractional-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives fractional credit on basis of proportion of its participating institutions. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *SCI* and *SSCI,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 9. World share of highly influential S&E articles (whole counts) of major S&E publishing centers, by field: 1992–2003
(Percent)

Field and publishing center	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
All fields												
United States	62.8	62.5	63.2	62.7	62.0	61.2	61.3	60.8	59.9	58.5	58.1	58.0
EU-15	30.1	31.0	31.5	32.1	33.5	34.7	35.3	36.1	36.8	38.2	38.4	38.2
Japan	6.0	6.1	6.1	6.2	6.3	6.4	6.5	6.8	7.2	7.6	7.5	7.7
East Asia-4	0.4	0.5	0.5	0.7	0.7	0.8	0.9	1.2	1.4	1.6	2.2	2.7
Clinical medicine												
United States	62.1	62.2	62.7	62.2	61.2	61.4	61.2	61.0	60.2	59.1	58.9	59.2
EU-15	31.4	31.7	31.9	32.5	34.0	35.0	35.9	36.3	37.2	38.5	39.1	39.0
Japan	4.7	4.8	5.2	5.5	5.6	5.5	5.6	5.8	6.0	6.3	6.3	6.2
East Asia-4	0.3	0.4	0.5	0.6	0.6	0.6	0.6	0.9	0.9	1.2	1.5	1.8
Biomedical research												
United States	69.7	69.4	69.4	69.7	69.8	69.4	70.3	69.2	69.9	67.9	68.1	67.7
EU-15	27.2	27.9	29.0	29.2	29.9	30.7	30.7	31.9	31.5	33.9	33.8	34.3
Japan	5.7	5.9	6.0	5.9	6.0	6.2	6.1	6.5	7.2	7.4	7.4	8.1
East Asia-4	0.2	0.2	0.2	0.3	0.4	0.4	0.6	0.7	0.9	1.0	1.3	1.4
Biology												
United States	51.0	51.4	52.5	51.4	50.9	47.7	46.5	46.2	45.7	43.8	45.5	44.9
EU-15	30.1	31.2	31.3	33.5	34.7	36.9	38.8	40.0	41.4	42.7	43.3	42.4
Japan	4.5	4.2	4.9	4.4	4.3	4.7	4.6	5.3	5.0	5.4	5.2	5.5
East Asia-4	0.6	0.5	0.5	0.6	0.7	0.6	1.0	1.2	1.4	1.7	1.8	1.8
Chemistry												
United States	51.2	53.7	51.5	51.0	48.4	45.5	44.9	43.0	44.1	41.5	41.5	41.0
EU-15	31.6	31.6	33.0	33.2	35.4	37.7	37.8	39.3	38.2	39.5	38.9	38.2
Japan	9.9	9.6	9.7	9.8	9.6	10.0	10.6	10.2	10.9	11.2	10.8	10.7
East Asia-4	1.1	1.0	1.3	1.3	1.8	2.0	2.3	3.2	3.3	4.0	5.1	6.7
Physics												
United States	57.6	58.0	56.7	55.9	53.9	50.6	50.0	48.4	46.4	45.4	45.9	43.4
EU-15	34.2	35.2	37.9	39.5	41.3	42.9	44.1	45.8	47.5	47.5	46.4	45.5
Japan	8.8	9.0	8.7	9.1	9.5	10.2	10.3	11.2	11.8	12.8	12.2	13.4
East Asia-4	0.9	1.0	1.0	1.6	1.9	2.5	2.9	3.3	3.9	4.4	5.3	6.9
Earth/space sciences												
United States	68.4	67.4	73.5	75.0	76.5	75.1	74.9	73.8	71.6	71.5	71.0	71.8
EU-15	31.2	33.3	32.9	33.4	33.2	38.3	39.0	44.5	45.4	47.2	48.2	50.7
Japan	3.7	4.0	2.4	2.8	2.2	3.2	3.7	4.9	5.9	4.0	4.3	4.8
East Asia-4	0.2	1.0	0.5	0.6	0.3	0.4	0.9	0.7	1.0	0.7	0.7	1.9
Engineering/technology												
United States	58.3	57.7	56.6	54.6	50.9	49.4	49.3	45.5	45.5	43.3	41.8	40.5
EU-15	26.3	27.0	26.5	28.9	31.1	32.3	31.3	34.5	34.4	35.4	34.5	33.9
Japan	10.5	9.9	10.5	10.2	11.2	10.8	12.4	11.9	12.5	12.7	13.4	12.9
East Asia-4	1.8	2.6	2.8	3.0	3.8	4.3	5.4	6.2	7.2	7.7	10.0	11.6
Mathematics												
United States	60.3	62.9	62.5	61.6	60.7	60.7	62.9	55.9	56.2	52.6	52.0	51.7
EU-15	35.3	35.3	34.7	37.4	37.7	38.3	37.7	42.3	41.1	45.0	45.0	45.8
Japan	2.8	3.3	2.5	3.4	2.3	3.0	2.5	2.4	3.0	3.4	2.3	3.0
East Asia-4	1.7	1.5	1.9	3.0	3.3	2.7	3.2	3.4	5.6	7.1	7.6	9.4
Psychology												
United States	76.4	77.6	75.5	76.4	75.0	75.7	74.8	73.7	74.2	72.3	70.3	68.0
EU-15	16.3	16.7	18.8	16.1	18.4	18.7	19.3	22.1	21.5	23.1	25.7	28.3
Japan	0.4	0.1	0.4	0.1	0.7	0.7	0.5	0.7	0.7	0.9	0.8	1.0
East Asia-4	0.3	0.2	0.2	0.1	0.2	0.5	0.5	0.6	0.7	1.0	0.7	0.8

APPENDIX TABLE 9. World share of highly influential S&E articles (whole counts) of major S&E publishing centers, by field: 1992–2003
(Percent)

Field and publishing center	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Social sciences												
United States	83.0	83.3	81.4	78.7	76.7	76.8	74.1	73.7	72.2	72.7	71.7	69.1
EU-15	13.4	13.7	16.1	19.2	21.3	21.5	23.4	24.7	25.2	26.3	27.1	30.0
Japan	0.9	0.8	0.8	0.5	0.5	0.4	0.3	0.5	0.5	0.7	0.4	0.3
East Asia-4	0.4	0.2	0.8	0.7	0.8	0.9	1.1	1.3	1.7	1.4	1.6	1.6

S&E = science and engineering; EU = European Union.

NOTES: Citations are references to scientific articles in journals covered by *Science Citation Index (SCI)* and *Social Sciences Citation Index (SSCI).* Highly influential articles are top 5% of cited articles based on a 3-year period with a 2-year lag (e.g., for 2003, highly influential articles are articles published in 1999–2001 that were among the top 5% in citations in articles published in 2003). Actual number of articles in top 5% is ordinarily less than 5% because articles with same frequency of citation that exceed top 5% are not included. Articles on whole-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives one count for its participation, regardless of the number of its participating institutions. Shares may add to more than 100% because articles with institutional authors from multiple publishing centers are counted once for each publishing center. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *SCI* and *SSCI,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 10. World share of S&E articles (fractional counts) published in highly influential journals, by field and major S&E publishing center: 1992–2003

(Percent distribution)

Field and publishing center	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
All fields												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	61.9	61.2	60.2	59.0	57.6	56.7	55.6	54.2	52.4	50.8	49.7	49.1
EU-15	22.4	23.3	23.9	24.7	25.5	26.3	27.1	28.1	29.3	30.2	30.7	30.8
Japan	4.8	4.8	5.0	5.1	5.3	5.3	5.4	5.6	5.9	6.2	6.5	6.7
East Asia 4	0.4	0.4	0.4	0.5	0.6	0.6	0.7	0.8	1.0	1.2	1.5	1.8
All other	10.5	10.4	10.5	10.7	11.0	11.2	11.1	11.3	11.4	11.6	11.6	11.7
Clinical medicine												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	64.6	63.5	62.4	61.2	60.0	58.6	57.1	54.9	53.0	51.6	50.9	50.7
EU-15	20.9	22.0	22.7	23.4	24.1	25.3	26.5	28.3	29.6	30.6	31.1	31.1
Japan	4.8	4.8	4.9	5.1	5.4	5.6	5.9	6.0	6.2	6.3	6.5	6.5
East Asia-4	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.6	0.7	0.9	1.1	1.3
All other	9.4	9.3	9.5	9.8	10.0	10.0	10.0	10.2	10.5	10.7	10.4	10.5
Biomedical research												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	67.7	67.5	67.0	66.3	65.5	65.0	64.4	63.7	62.8	61.7	60.5	59.3
EU-15	21.0	21.2	21.6	21.7	22.5	22.9	23.3	23.5	23.9	24.5	25.2	25.8
Japan	3.0	3.2	3.3	3.4	3.5	3.5	3.5	3.6	4.0	4.3	4.4	4.7
East Asia-4	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8
All other	8.1	8.0	8.0	8.4	8.3	8.4	8.5	8.8	8.9	9.0	9.2	9.4
Biology												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	63.8	61.1	58.4	56.1	53.7	51.4	49.8	48.8	47.2	44.1	42.7	42.4
EU-15	17.3	19.3	21.6	23.6	25.7	27.3	28.8	29.8	31.9	34.1	35.0	35.2
Japan	3.0	3.0	3.1	3.1	3.3	3.4	3.5	3.6	3.7	4.2	4.2	4.4
East Asia-4	0.3	0.5	0.5	0.6	0.6	0.8	0.8	0.9	0.8	1.0	1.4	1.5
All other	15.6	16.1	16.4	16.7	16.7	17.2	17.2	17.0	16.4	16.5	16.7	16.5
Chemistry												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	59.2	59.8	59.2	57.9	54.9	53.7	52.1	51.2	48.4	45.1	42.1	40.9
EU-15	23.8	23.8	24.2	24.9	26.7	27.2	28.1	28.3	30.1	32.9	34.1	34.1
Japan	6.4	6.2	6.1	6.5	6.8	6.9	7.1	7.4	8.4	8.6	9.7	10.0
East Asia-4	0.4	0.4	0.6	0.6	0.7	0.7	1.0	1.3	1.6	1.9	2.4	3.1
All other	10.2	9.7	10.0	10.1	10.9	11.4	11.8	11.7	11.5	11.5	11.7	11.9
Physics												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	58.4	57.1	55.1	52.5	50.0	48.1	45.5	42.7	38.9	37.2	36.1	35.7
EU-15	25.3	26.0	27.2	28.4	29.8	30.8	32.7	34.6	36.9	37.9	38.5	38.4
Japan	4.1	4.4	4.9	5.3	5.4	5.3	5.1	5.2	5.6	5.9	6.1	6.3
East Asia-4	0.5	0.5	0.6	0.9	1.2	1.3	1.6	1.7	2.3	2.5	2.8	3.1
All other	11.7	11.9	12.2	12.9	13.6	14.6	15.1	15.8	16.3	16.5	16.5	16.4
Earth/space sciences												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	71.0	70.5	69.1	68.3	66.3	65.9	65.4	64.2	62.2	59.8	58.1	57.4
EU-15	12.2	13.1	14.2	15.2	16.1	16.4	16.5	17.6	18.8	20.3	20.9	21.4
Japan	2.9	2.9	2.9	2.6	2.8	2.9	3.1	3.4	3.7	4.3	4.7	4.9
East Asia-4	0.4	0.4	0.5	0.5	0.7	0.8	1.1	1.2	1.3	1.6	1.9	2.4
All other	13.5	13.1	13.4	13.4	14.0	14.0	13.9	13.6	13.9	14.0	14.3	14.0
Engineering/technology												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	62.6	61.0	59.4	56.1	54.9	51.3	48.4	45.2	43.2	41.2	38.8	37.8
EU-15	15.9	16.1	17.0	18.4	18.1	19.5	21.7	24.4	25.1	25.1	25.2	25.6
Japan	9.5	9.5	9.7	10.5	11.0	11.1	10.8	10.6	11.3	11.6	12.3	11.8
East Asia-4	3.3	4.1	4.3	4.7	5.5	6.9	7.4	8.0	8.9	10.8	12.3	12.8
All other	8.7	9.3	9.6	10.3	10.6	11.1	11.7	11.8	11.6	11.2	11.4	12.0

APPENDIX TABLE 10. World share of S&E articles (fractional counts) published in highly influential journals, by field and major S&E publishing center: 1992–2003

(Percent distribution)

Field and publishing center	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Mathematics												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	64.2	65.2	64.0	62.0	56.8	54.2	51.2	50.5	51.0	49.8	50.6	48.1
EU-15	20.5	21.2	23.3	22.8	26.0	27.0	29.2	30.7	30.5	32.0	31.3	33.4
Japan	1.8	1.5	0.9	0.9	1.2	1.4	1.3	1.2	1.3	1.5	1.4	1.2
East Asia-4	0.7	0.6	0.7	0.9	1.4	1.5	1.8	2.0	2.3	2.7	3.1	3.8
All other	12.9	11.5	11.1	13.3	14.7	15.9	16.4	15.7	14.9	14.0	13.5	13.4
Psychology												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	75.6	76.1	74.8	75.1	76.2	77.3	75.9	75.3	74.0	73.0	69.9	69.9
EU-15	11.8	11.0	12.2	11.8	11.7	11.3	12.0	12.4	13.7	15.7	18.5	18.3
Japan	0.3	0.2	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.6	0.4	0.5
East Asia-4	0.2	0.1	0.1	0.2	0.2	0.2	0.3	0.4	0.4	0.5	0.5	0.6
All other	12.2	12.5	12.6	12.6	11.5	10.8	11.4	11.4	11.3	10.2	10.7	10.7
Social sciences												
All publishing centers	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
United States	81.0	81.2	80.3	80.0	78.3	77.5	76.8	76.6	76.4	76.3	76.8	76.2
EU-15	9.4	9.4	9.9	10.3	11.0	12.2	12.9	13.8	13.9	14.2	14.2	15.0
Japan	0.4	0.4	0.5	0.4	0.5	0.3	0.3	0.2	0.4	0.5	0.6	0.5
East Asia-4	0.5	0.5	0.4	0.4	0.5	0.6	0.7	0.8	0.9	1.1	1.0	1.0
All other	8.7	8.5	8.9	8.9	9.6	9.3	9.3	8.6	8.3	7.9	7.5	7.3

S&E = science and engineering; EU = European Union.

NOTES: Citations are references to scientific articles in journals covered by *Science Citation Index (SCI)* and *Social Sciences Citation Index (SSCI)*. Highly influential journals are top 5% cited journals. Citations based on a 3-year period with a 2-year lag (e.g., for 2003, citations are references made in articles published in 2003 to articles published in 1999–2001). Journals ranked by average ratio of citations to articles published in each journal and by each citing year; number may vary each year because of changes in total number of cited journals. Articles on fractional-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives fractional credit on basis of proportion of its participating institutions. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *SCI* and *SSCI,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 11. Share of S&E article output classified as highly influential (fractional counts), by major S&E publishing center and field: 1992–2003

(Percent)

Publishing center and field	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
United States												
All fields	7.8	7.7	7.8	7.8	7.8	7.8	7.9	8.0	8.0	7.9	8.0	8.1
Clinical medicine	7.4	7.4	7.5	7.4	7.3	7.4	7.4	7.4	7.5	7.4	7.5	7.5
Biomedical research	8.4	8.3	8.1	8.1	8.0	8.0	8.1	8.0	8.2	8.0	8.1	8.0
Biology	6.6	6.6	6.9	6.9	7.0	6.7	6.7	6.8	6.9	6.8	7.1	7.0
Chemistry	10.8	11.3	10.7	10.5	10.0	9.5	9.7	9.4	10.0	9.6	9.8	9.9
Physics	9.0	9.1	8.9	8.8	8.8	8.4	8.7	8.8	8.6	8.6	8.9	8.6
Earth/space sciences	7.6	7.6	7.7	7.9	7.8	7.4	7.5	7.5	7.5	7.5	7.5	7.5
Engineering/technology	5.8	5.7	6.1	5.8	5.3	5.3	5.4	5.6	5.9	6.1	6.5	6.7
Mathematics	6.7	6.9	7.0	6.7	6.9	7.2	7.9	7.4	7.6	7.2	7.4	7.7
Psychology	6.1	6.2	6.1	6.1	6.1	6.3	6.2	6.1	6.2	6.1	6.1	5.9
Social sciences	7.2	7.2	7.1	6.9	6.8	7.0	6.8	6.9	6.9	7.0	7.0	6.8
EU-15												
All fields	4.5	4.6	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.7	4.7	4.7
Clinical medicine	4.0	4.0	4.0	4.0	4.1	4.1	4.1	4.1	4.1	4.3	4.3	4.3
Biomedical research	3.8	3.9	3.9	3.8	3.7	3.7	3.7	3.8	3.6	3.9	3.9	4.0
Biology	5.2	5.4	5.2	5.4	5.4	5.6	5.7	5.7	5.7	5.8	5.9	5.8
Chemistry	4.8	4.8	4.8	4.8	4.9	5.1	5.1	5.2	5.0	5.2	5.3	5.3
Physics	5.1	5.1	5.3	5.4	5.4	5.4	5.5	5.6	5.8	5.7	5.6	5.6
Earth/space sciences	4.2	4.5	4.4	4.1	4.3	4.8	4.5	4.5	4.5	4.7	4.7	4.9
Engineering/technology	3.8	3.8	4.0	4.1	4.2	4.2	4.1	4.6	4.6	4.8	4.8	4.8
Mathematics	4.9	4.9	4.6	4.7	4.6	4.5	4.4	4.8	4.5	4.9	5.0	5.0
Psychology	3.6	3.7	4.2	3.4	3.7	3.6	3.6	4.0	3.7	3.9	4.4	4.7
Social sciences	2.6	2.7	3.0	3.5	3.8	3.7	3.9	4.0	4.0	4.0	4.0	4.4
Japan												
All fields	3.6	3.5	3.4	3.3	3.2	3.2	3.1	3.2	3.3	3.4	3.4	3.4
Clinical medicine	3.0	3.0	3.0	2.9	2.9	2.8	2.6	2.7	2.7	2.8	2.7	2.7
Biomedical research	3.3	3.2	3.1	2.9	2.9	2.9	2.8	2.9	3.1	3.2	3.1	3.4
Biology	3.1	2.7	3.1	2.7	2.5	2.7	2.6	3.0	2.7	2.9	2.8	3.0
Chemistry	4.5	4.2	4.2	4.2	4.1	4.2	4.5	4.2	4.4	4.5	4.3	4.3
Physics	3.9	3.9	3.5	3.5	3.5	3.7	3.6	3.8	3.8	4.1	3.9	4.3
Earth/space sciences	3.3	3.1	2.4	2.2	2.6	2.6	3.1	3.3	3.8	3.3	2.8	3.4
Engineering/technology	3.4	3.1	3.6	3.4	3.7	3.5	3.8	3.8	4.0	4.2	4.7	4.8
Mathematics	2.4	3.1	2.6	3.3	2.4	3.4	2.6	2.2	2.9	3.3	2.0	2.3
Psychology	0.9	0.1	0.7	0.2	1.3	1.0	0.8	1.2	0.8	1.1	1.0	1.3
Social sciences	3.0	2.0	1.7	1.0	1.5	0.9	1.0	1.3	0.9	1.2	0.9	0.8
East Asia-4												
All fields	0.8	0.9	0.8	0.8	0.8	0.8	0.8	1.0	1.0	1.1	1.4	1.6
Clinical medicine	1.0	1.1	1.4	1.4	1.3	1.2	1.0	1.4	1.2	1.5	1.7	1.9
Biomedical research	0.5	0.9	0.8	0.9	0.8	0.7	0.9	0.9	0.9	0.9	1.0	1.1
Biology	2.1	1.7	1.4	1.2	1.5	1.2	1.9	2.1	1.9	2.0	1.9	1.8
Chemistry	2.0	1.4	1.6	1.4	1.7	1.7	1.8	2.2	2.0	2.1	2.4	2.8

APPENDIX TABLE 11. Share of S&E article output classified as highly influential (fractional counts), by major S&E publishing center and field: 1992–2003

(Percent)

Publishing center and field	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Physics	0.7	0.9	0.8	0.9	1.0	1.1	1.4	1.4	1.6	1.6	2.0	2.5
Earth/space sciences	0.7	0.9	0.6	1.2	1.2	1.2	0.8	0.8	0.9	0.9	1.5	1.7
Engineering/technology	1.2	1.6	1.7	1.5	1.8	1.9	2.0	2.3	2.4	2.5	3.3	3.6
Mathematics	2.0	1.5	1.8	2.5	2.6	2.3	2.3	2.1	3.4	3.8	3.4	4.3
Psychology	2.0	1.4	1.1	0.8	0.8	2.0	1.8	2.0	2.1	2.6	1.6	1.8
Social sciences	1.1	0.6	1.8	1.8	1.8	1.9	2.1	2.4	3.1	2.4	3.0	2.6

S&E = science and engineering; EU = European Union.

NOTES: Citations are references to scientific articles in journals covered by *Science Citation Index (SCI)* and *Social Sciences Citation Index (SSCI).* Highly influential articles are top 5% of cited articles based on a 3-year period with a 2-year lag (e.g., for 2003, highly influential articles are articles published in 1999–2001 that were among the top 5% in citations in articles published in 2003). Top 5% articles counts normalized to equal 5% of total articles. Actual number of articles in top 5% is ordinarily less than 5% because articles with same frequency of citation that exceed top 5% are not included. Articles on fractional-count basis, i.e., for articles with collaborating institutions from multiple publishing centers, each publishing center receives fractional credit on basis of proportion of its participating institutions. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences. East Asia-4 includes China, Singapore, South Korea, and Taiwan. China includes Hong Kong.

SOURCES: Thomson ISI, *SCI* and *SSCI,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 12. U.S. academic article output, by field: 1988–2003

Method of attribution and field	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Fractional counts																
All fields	127,382	134,746	138,018	139,387	143,570	142,318	143,897	146,479	147,020	144,632	145,190	145,503	144,166	147,798	144,865	156,602
Clinical medicine	38,017	40,072	40,808	41,123	42,334	41,904	42,989	43,598	43,325	43,488	43,562	43,648	42,296	43,799	41,954	45,596
Biomedical research	20,587	22,149	22,948	23,266	24,717	24,772	25,214	26,037	25,545	25,290	25,656	25,355	25,361	25,867	24,735	26,363
Biology	9,890	10,344	10,670	10,497	10,069	9,558	9,513	9,397	9,297	9,093	9,158	8,426	9,359	9,328	9,888	10,379
Chemistry	9,364	9,654	10,175	10,561	10,731	10,987	10,436	10,778	11,081	10,712	10,943	10,864	11,021	10,878	10,583	11,839
Physics	11,415	12,230	12,253	13,229	13,201	13,277	14,122	13,661	13,364	12,941	12,746	12,765	12,120	12,349	12,445	13,255
Earth/space sciences	5,204	5,477	5,704	5,762	5,990	6,401	6,533	7,045	7,183	6,917	6,781	7,316	7,110	7,449	7,051	8,556
Engineering/technology	6,799	7,101	7,864	7,635	8,749	8,177	8,553	8,691	8,294	8,050	8,153	8,649	8,201	9,111	9,111	9,932
Mathematics	3,529	3,696	2,996	3,113	3,261	3,149	3,093	2,953	3,033	2,830	3,210	3,265	3,450	3,393	3,306	3,524
Psychology	6,271	6,262	6,693	6,303	6,619	6,090	6,216	6,860	7,113	7,048	6,753	6,842	6,570	6,867	6,794	7,056
Social sciences	7,297	8,053	8,113	8,093	7,981	8,144	7,787	7,712	8,030	7,814	7,863	7,958	8,020	8,252	7,943	8,583
Whole counts																
All fields	148,642	157,430	162,095	164,854	171,256	170,562	173,992	178,224	179,876	178,254	180,222	182,158	181,518	187,791	184,882	200,727
Clinical medicine	46,385	48,905	49,886	50,460	52,222	52,130	53,818	54,648	54,661	55,028	55,548	56,093	54,859	57,222	55,045	60,019
Biomedical research	23,938	25,837	26,926	27,608	29,550	29,622	30,512	31,714	31,181	31,038	31,886	31,709	31,749	32,733	31,430	33,585
Biology	11,153	11,731	12,116	11,999	11,652	11,135	11,127	11,121	11,010	10,880	11,056	10,374	11,576	11,630	12,409	13,184
Chemistry	10,433	10,820	11,465	12,007	12,266	12,591	12,135	12,582	12,998	12,655	12,943	12,957	13,194	13,108	12,807	14,260
Physics	13,914	14,884	15,128	16,576	16,882	17,078	18,186	17,884	17,783	17,474	17,347	17,596	16,937	17,418	17,578	18,806
Earth/space sciences	6,469	6,843	7,301	7,410	7,784	8,308	8,651	9,426	9,802	9,518	9,454	10,345	10,164	10,811	10,425	12,675
Engineering/technology	7,990	8,350	9,299	9,114	10,508	9,836	10,392	10,682	10,193	10,225	10,442	11,130	10,667	11,954	12,001	13,091
Mathematics	4,025	4,207	3,461	3,599	3,852	3,707	3,624	3,485	3,648	3,406	3,904	4,030	4,292	4,268	4,206	4,474
Psychology	6,807	6,806	7,247	6,861	7,203	6,667	6,797	7,532	7,915	7,831	7,521	7,662	7,357	7,725	7,654	8,022
Social sciences	7,853	8,614	8,736	8,684	8,645	8,828	8,510	8,437	8,841	8,608	8,612	8,716	8,813	9,119	8,828	9,581

NOTES: For articles with collaborating institutions, fractional counts assign the academic sector fractional credit on basis of proportion of its participating institutions, and whole counts assign the academic sector one credit for its participation, regardless of the number of participating institutions. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 13. U.S. article output (fractional counts), by field and sector: 1988–2003

Field and sector	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
All fields																
All sectors	177,662	187,224	191,559	194,015	198,864	197,397	199,769	202,887	201,798	197,531	197,890	198,524	196,221	200,870	195,792	211,233
Academic	127,382	134,746	138,018	139,387	143,570	142,318	143,897	146,479	147,020	144,632	145,190	145,503	144,166	147,798	144,865	156,602
Nonacademic	50,280	52,478	53,541	54,628	55,294	55,079	55,872	56,408	54,778	52,899	52,700	53,021	52,055	53,072	50,927	54,631
FFRDCs	4,855	5,017	5,053	5,094	5,012	4,731	5,116	5,396	5,110	5,173	5,049	5,161	4,990	5,174	4,806	5,660
Federal government	14,386	14,956	15,179	15,226	15,263	15,337	15,562	15,505	14,978	14,263	14,126	13,877	13,755	14,015	13,411	14,145
Joint	111	138	151	150	175	192	241	211	225	233	191	313	314	322	361	361
Private for profit	15,138	15,559	16,401	16,935	16,884	16,363	16,715	16,374	15,559	14,611	14,433	14,486	14,107	14,210	13,645	14,523
Private nonprofit	12,436	13,232	13,209	13,536	14,040	14,575	14,771	15,403	15,203	14,953	15,014	15,437	15,649	16,021	15,204	16,273
State/local government	2,105	2,194	2,128	2,075	2,108	2,028	2,074	1,986	1,929	1,878	1,920	1,896	1,828	1,933	1,890	1,901
Unknown	1,248	1,382	1,419	1,612	1,812	1,851	1,393	1,532	1,772	1,788	1,966	1,851	1,413	1,397	1,611	1,768
Clinical medicine																
All sectors	55,016	58,133	58,850	59,488	61,097	61,312	62,610	63,367	63,057	62,676	63,077	63,190	61,745	63,709	60,785	65,933
Academic	38,017	40,072	40,808	41,123	42,334	41,904	42,989	43,598	43,325	43,488	43,562	43,648	42,296	43,799	41,954	45,596
Nonacademic	16,999	18,061	18,042	18,364	18,763	19,408	19,622	19,769	19,732	19,187	19,514	19,542	19,449	19,910	18,831	20,337
FFRDCs	227	211	225	218	224	217	262	250	265	234	241	214	199	182	184	189
Federal government	5,286	5,368	5,354	5,305	5,211	5,313	5,286	5,098	5,202	4,888	4,906	4,720	4,656	4,759	4,429	4,651
Joint	2	9	9	12	12	13	14	15	11	13	12	17	27	23	23	18
Private for profit	2,503	2,869	3,006	3,201	3,344	3,409	3,697	3,811	3,754	3,647	3,767	3,677	3,769	3,785	3,724	3,965
Private nonprofit	7,438	7,956	7,815	8,000	8,174	8,728	8,836	9,097	8,977	8,869	9,004	9,338	9,397	9,710	9,065	9,979
State/local government	1,099	1,102	1,067	1,017	1,057	967	1,011	912	852	874	876	861	842	889	767	826
Unknown	443	547	566	612	741	761	516	586	671	662	708	715	558	563	639	708
Biomedical research																
All sectors	27,455	29,427	30,703	31,177	32,906	33,117	33,750	35,048	33,991	33,661	33,978	33,423	33,482	34,041	32,407	34,427
Academic	20,587	22,149	22,948	23,266	24,717	24,772	25,214	26,037	25,545	25,290	25,656	25,355	25,361	25,867	24,735	26,363
Nonacademic	6,869	7,278	7,755	7,911	8,189	8,345	8,536	9,011	8,445	8,372	8,322	8,068	8,121	8,174	7,672	8,064
FFRDCs	424	419	451	516	468	440	487	560	506	544	479	465	442	454	460	467
Federal government	2,456	2,653	2,645	2,615	2,683	2,786	2,775	2,787	2,654	2,539	2,572	2,408	2,477	2,477	2,330	2,452
Joint	2	3	8	4	8	5	5	6	6	3	7	7	8	22	16	26
Private for profit	1,545	1,587	1,905	2,008	2,050	2,128	2,217	2,313	2,075	2,033	1,990	2,079	1,973	1,952	1,797	1,924
Private nonprofit	2,105	2,269	2,360	2,390	2,579	2,571	2,729	2,963	2,856	2,866	2,871	2,758	2,862	2,927	2,740	2,843
State/local government	266	267	285	274	272	289	237	266	248	244	243	231	250	238	216	222
Unknown	70	80	100	104	129	125	85	116	102	141	160	120	108	105	113	131
Biology																
All sectors	12,862	13,544	14,028	13,898	13,366	12,671	12,845	12,664	12,310	12,027	12,126	11,271	12,496	12,499	13,122	13,855
Academic	9,890	10,344	10,670	10,497	10,069	9,558	9,513	9,397	9,297	9,093	9,158	8,426	9,359	9,328	9,888	10,379
Nonacademic	2,972	3,201	3,358	3,401	3,297	3,113	3,332	3,267	3,013	2,935	2,967	2,845	3,137	3,171	3,234	3,475
FFRDCs	103	99	96	64	73	72	83	79	103	83	68	52	78	61	58	68
Federal government	1,816	1,923	2,042	2,036	1,919	1,818	1,952	1,917	1,724	1,696	1,698	1,615	1,779	1,712	1,781	1,935
Joint	0	0	2	1	0	1	1	1	*	0	2	1	7	7	6	7
Private for profit	377	396	467	479	452	446	545	535	441	405	390	386	456	480	468	476
Private nonprofit	437	484	461	492	507	459	449	437	406	440	449	467	507	536	552	612
State/local government	185	222	210	210	221	205	225	222	234	221	252	215	237	290	268	277

APPENDIX TABLE 13. U.S. article output (fractional counts), by field and sector: 1988–2003

Field and sector	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Unknown	55	78	80	119	125	112	77	77	104	91	108	110	72	84	100	100
Chemistry																
All sectors	13,186	13,398	13,990	14,681	14,647	15,089	14,577	14,915	15,219	14,375	14,414	14,491	14,560	14,342	14,043	15,763
Academic	9,364	9,654	10,175	10,561	10,731	10,987	10,436	10,778	11,081	10,712	10,943	10,864	11,021	10,878	10,583	11,839
Nonacademic	3,823	3,744	3,815	4,121	3,915	4,102	4,141	4,137	4,138	3,663	3,471	3,626	3,539	3,464	3,460	3,924
FFRDCs	508	526	512	541	484	496	487	611	655	617	607	658	690	681	619	730
Federal government	750	745	729	779	769	719	790	766	765	698	649	607	613	655	647	673
Joint	0	0	1	1	1	1	1	1	3	2	4	3	5	6	6	4
Private for profit	2,287	2,213	2,305	2,443	2,351	2,506	2,487	2,423	2,341	2,012	1,841	1,947	1,804	1,745	1,827	2,116
Private nonprofit	208	198	187	252	221	293	300	275	293	270	281	325	343	308	298	314
State/local government	38	32	33	48	35	29	49	26	27	29	27	28	35	25	21	24
Unknown	31	30	48	57	54	57	28	34	54	36	62	58	50	45	41	64
Physics																
All sectors	18,023	19,067	19,196	20,515	20,158	19,602	20,427	19,709	18,906	18,048	17,966	18,074	16,897	17,385	17,301	18,657
Academic	11,415	12,230	12,253	13,229	13,201	13,277	14,122	13,661	13,364	12,941	12,746	12,765	12,120	12,349	12,445	13,255
Nonacademic	6,608	6,837	6,943	7,286	6,958	6,326	6,304	6,047	5,542	5,107	5,220	5,308	4,776	5,037	4,855	5,402
FFRDCs	2,178	2,276	2,256	2,340	2,159	2,065	2,202	2,331	2,032	2,009	2,074	2,143	1,977	2,043	2,026	2,377
Federal government	987	1,046	1,059	1,180	1,181	1,193	1,230	1,193	1,024	991	993	1,070	884	942	903	977
Joint	24	20	21	27	26	35	45	36	44	38	37	51	46	53	59	56
Private for profit	3,221	3,253	3,358	3,457	3,318	2,741	2,568	2,237	2,184	1,812	1,883	1,805	1,676	1,808	1,643	1,766
Private nonprofit	160	196	200	214	201	208	210	180	186	163	125	148	145	131	147	155
State/local government	5	4	4	7	6	2	3	5	6	7	6	4	2	6	2	2
Unknown	33	41	46	61	67	82	47	65	67	86	103	88	45	54	76	71
Earth/space sciences																0
All sectors	8,053	8,572	8,936	9,113	9,305	9,830	10,139	10,886	11,024	10,540	10,294	11,209	10,748	11,272	10,623	12,530
Academic	5,204	5,477	5,704	5,762	5,990	6,401	6,533	7,045	7,183	6,917	6,781	7,316	7,110	7,449	7,051	8,556
Nonacademic	2,849	3,095	3,232	3,351	3,315	3,429	3,606	3,841	3,841	3,623	3,513	3,892	3,638	3,823	3,572	3,974
FFRDCs	519	540	597	579	567	593	656	738	774	704	671	756	737	744	658	861
Federal government	1,188	1,231	1,329	1,311	1,303	1,377	1,416	1,545	1,543	1,448	1,421	1,512	1,426	1,439	1,359	1,550
Joint	82	101	107	100	123	130	162	146	157	161	116	215	188	194	225	219
Private for profit	548	664	600	726	712	664	742	708	622	660	639	655	571	673	580	577
Private nonprofit	349	358	423	417	430	465	443	499	534	463	462	513	507	533	541	522
State/local government	118	145	120	153	116	119	116	137	118	107	112	137	126	166	124	142
Unknown	46	55	57	64	64	81	70	69	92	79	92	106	83	74	85	104
Engineering/technology																
All sectors	11,817	12,051	13,090	12,838	14,395	13,303	13,862	13,801	12,843	12,907	12,904	13,564	12,796	13,889	13,677	14,777
Academic	6,799	7,101	7,864	7,635	8,749	8,177	8,553	8,691	8,294	8,050	8,153	8,649	8,201	9,111	9,111	9,932
Nonacademic	5,017	4,950	5,225	5,203	5,646	5,127	5,310	5,110	4,549	4,857	4,751	4,915	4,595	4,779	4,566	4,844
FFRDCs	793	835	815	727	953	742	841	748	699	903	834	813	772	941	740	904
Federal government	761	807	828	872	1,022	909	972	1,022	833	915	861	917	805	883	835	864
Joint	1	4	1	3	3	2	10	1	3	12	6	10	22	10	15	20
Private for profit	3,092	2,982	3,229	3,251	3,223	3,055	3,147	2,991	2,706	2,692	2,702	2,755	2,681	2,655	2,575	2,685
Private nonprofit	247	226	221	212	262	233	204	214	146	165	170	177	185	161	128	141

APPENDIX TABLE 13. U.S. article output (fractional counts), by field and sector: 1988–2003

Field and sector	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
State/local government	34	22	32	22	36	33	36	42	29	36	31	92	29	28	160	91
Unknown	91	73	100	118	147	153	99	92	134	134	149	152	100	100	112	140
Mathematics																
All sectors	3,880	3,990	3,304	3,382	3,538	3,453	3,346	3,190	3,272	3,051	3,483	3,561	3,758	3,657	3,556	3,760
Academic	3,529	3,696	2,996	3,113	3,261	3,149	3,093	2,953	3,033	2,830	3,210	3,265	3,450	3,393	3,306	3,524
Nonacademic	350	294	308	270	277	304	253	237	240	221	273	296	308	264	250	236
FFRDCs	51	53	39	46	39	48	44	32	41	41	41	38	67	35	37	39
Federal government	91	68	84	67	53	78	51	56	51	45	55	68	59	48	54	47
Joint	0	*	1	0	1	0	1	0	0	0	*	1	*	2	*	1
Private for profit	161	132	132	108	140	129	113	104	100	89	126	126	120	124	112	106
Private nonprofit	36	30	41	38	40	40	32	36	35	37	42	46	50	45	37	28
State/local government	2	2	1	2	1	3	4	1	4	3	2	5	2	1	1	1
Unknown	9	9	10	9	5	6	8	8	9	6	7	11	10	9	10	14
Psychology																
All sectors	7,171	7,088	7,587	7,194	7,626	6,986	7,184	7,830	8,258	8,130	7,736	7,806	7,499	7,809	7,691	7,892
Academic	6,271	6,262	6,693	6,303	6,619	6,090	6,216	6,860	7,113	7,048	6,753	6,842	6,570	6,867	6,794	7,056
Nonacademic	900	826	895	890	1,006	896	968	971	1,144	1,081	984	965	930	942	896	835
FFRDCs	1	6	5	6	3	3	5	5	*	2	4	2	1	1	3	1
Federal government	206	174	214	216	222	192	217	224	279	246	225	241	236	220	217	218
Joint	0	0	0	0	*	0	0	1	0	1	1	2	1	1	2	3
Private for profit	150	117	128	134	174	164	174	169	189	168	143	162	156	172	139	121
Private nonprofit	287	304	312	300	329	296	300	309	387	369	345	344	348	370	352	332
State/local government	94	99	97	93	99	98	118	111	118	118	106	90	75	69	65	58
Unknown	161	127	139	141	180	144	154	151	171	178	159	126	114	110	118	102
Social sciences																
All sectors	8,738	9,551	9,651	9,595	9,521	9,690	9,275	9,150	9,425	9,163	9,086	9,171	9,149	9,384	9,040	9,764
Academic	7,297	8,053	8,113	8,093	7,981	8,144	7,787	7,712	8,030	7,814	7,863	7,958	8,020	8,252	7,943	8,583
Nonacademic	1,441	1,498	1,539	1,503	1,540	1,546	1,489	1,438	1,395	1,349	1,223	1,213	1,129	1,132	1,097	1,181
FFRDCs	36	31	44	42	33	38	41	32	29	26	25	16	20	28	14	16
Federal government	435	505	487	474	503	503	486	461	404	363	322	340	344	330	357	332
Joint	0	1	*	0	1	0	*	*	0	0	*	0	1	2	1	1
Private for profit	275	246	295	250	254	231	201	207	233	250	191	191	171	160	124	135
Private nonprofit	544	559	566	594	622	625	622	603	594	563	538	534	502	512	495	565
State/local government	55	63	55	48	45	61	67	49	46	58	45	43	38	38	35	42
Unknown	95	94	91	93	83	89	71	86	89	89	102	90	54	62	71	89

* = less than .5.

FFRDC = federally funded research and development center.

NOTES: Articles on fractional-count basis, i.e., for articles with collaborating institutions, each sector receives fractional credit on basis of proportion of its participating institutions. "All fields" includes health sciences and professional fields. Biology includes agricultural sciences. Engineering/technology includes computer sciences.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 14. Crosswalk of WebCASPAR and ipIQ field classification

WebCASPAR broad field	WebCASPAR fine field	ipIQ fine field	ipIQ broad field
Engineering			
	Aerospace engineering	Aerospace technology	Engineering/technology
	Chemical engineering	Chemical engineering	Engineering/technology
	Civil engineering	Civil engineering	Engineering/technology
	Electrical engineering	Electrical engineering and electronics	Engineering/technology
	Mechanical engineering	Mechanical engineer	Engineering/technology
	Materials engineering	Materials science	Engineering/technology
	Materials engineering	Metals and metallurgy	Engineering/technology
	Industrial engineering	Industrial engineer	Engineering/technology
	Other engineering	Operations research and management	Engineering/technology
	Other engineering	Biomedical engineering	Biomedical research
	Other engineering	Nuclear technology	Engineering/technology
	Other engineering	General engineering	Engineering/technology
	Other engineering	Miscellaneous engineering and technology	Engineering/technology
Astronomy			
	Astronomy	Astronomy and astrophysics	Earth/space sciences
Chemistry			
	Chemistry	Analytical chemistry	Chemistry
	Chemistry	Organic chemistry	Chemistry
	Chemistry	Physical chemistry	Chemistry
	Chemistry	Polymers	Chemistry
	Chemistry	General chemistry	Chemistry
	Chemistry	Applied chemistry	Chemistry
	Chemistry	Inorganic and nuclear chemistry	Chemistry
Physics			
	Physics	Acoustics	Physics
	Physics	Chemical physics	Physics
	Physics	Nuclear and particle physics	Physics
	Physics	Optics	Physics
	Physics	Solid state physics	Physics
	Physics	Applied physics	Physics
	Physics	Fluids and plasmas	Physics
	Physics	General physics	Physics
	Physics	Miscellaneous physics	Physics
Geosciences			
	Atmospheric sciences	Meteorology and atmospheric sciences	Earth/space sciences
	Earth sciences	Geology	Earth/space sciences
	Earth sciences	Earth and planetary sciences	Earth/space sciences
	Oceanography	Oceanography and limnology	Earth/space sciences
	Oceanography	Marine biology and hydrobiology	Biology
	Other geosciences	Environmental sciences	Earth/space sciences
Mathematics			
	Mathematics	Applied mathematics	Mathematics
	Mathematics	Probability and statistics	Mathematics
	Mathematics	General mathematics	Mathematics
	Mathematics	Miscellaneous mathematics	Mathematics
Computer sciences	Computer sciences	Computers	Engineering/technology
Agricultural sciences			
	Agricultural sciences	Dairy and animal sciences	Biology
	Agricultural sciences	Agricultural and food sciences	Biology

APPENDIX TABLE 14. Crosswalk of WebCASPAR and ipIQ field classification

WebCASPAR broad field	WebCASPAR fine field	ipIQ fine field	ipIQ broad field
Biological sciences			
	Biological sciences	General biomedical research	Biomedical research
	Biological sciences	Miscellaneous biomedical research	Biomedical research
	Biological sciences	Biophysics	Biomedical research
	Biological sciences	Botany	Biology
	Biological sciences	Anatomy and morphology	Biomedical research
	Biological sciences	Cell biology, cytology, and histology	Biomedical research
	Biological sciences	Ecology	Biology
	Biological sciences	Entomology	Biology
	Biological sciences	Immunology	Clinical medicine
	Biological sciences	Microbiology	Biomedical research
	Biological sciences	Nutrition and dietetics	Biomedical research
	Biological sciences	Parasitology	Biomedical research
	Biological sciences	Genetics and heredity	Biomedical research
	Biological sciences	Pathology	Clinical medicine
	Biological sciences	Pharmacology	Clinical medicine
	Biological sciences	Physiology	Biomedical research
	Biological sciences	General zoology	Biology
	Biological sciences	Miscellaneous zoology	Biology
	Biological sciences	General biology	Biology
	Biological sciences	Miscellaneous biology	Biology
	Biological sciences	Biochemistry and molecular biology	Biomedical research
	Biological sciences	Virology	Biomedical research
Medical sciences			
	Medical sciences	Endocrinology	Clinical medicine
	Medical sciences	Neurology and neurosurgery	Clinical medicine
	Medical sciences	Dentistry	Clinical medicine
	Medical sciences	Environmental and occupational health	Clinical medicine
	Medical sciences	Public health	Health sciences
	Medical sciences	Surgery	Clinical medicine
	Medical sciences	General and Internal medicine	Clinical medicine
	Medical sciences	Ophthalmology	Clinical medicine
	Medical sciences	Pharmacy	Clinical medicine
	Medical sciences	Veterinary medicine	Clinical medicine
	Medical sciences	Miscellaneous clinical medicine	Clinical medicine
	Medical sciences	Anesthesiology	Clinical medicine
	Medical sciences	Cardiovascular system	Clinical medicine
	Medical sciences	Cancer	Clinical medicine
	Medical sciences	Gastroenterology	Clinical medicine
	Medical sciences	Hematology	Clinical medicine
	Medical sciences	Obstetrics and gynecology	Clinical medicine
	Medical sciences	Otorhinolaryngology	Clinical medicine
	Medical sciences	Pediatrics	Clinical medicine
	Medical sciences	Psychiatry	Clinical medicine
	Medical sciences	Radiology and nuclear medicine	Clinical medicine
	Medical sciences	Dermatology and venereal disease	Clinical medicine
	Medical sciences	Orthopedics	Clinical medicine
	Medical sciences	Arthritis and rheumatism	Clinical medicine
	Medical sciences	Respiratory system	Clinical medicine
	Medical sciences	Urology	Clinical medicine
	Medical sciences	Nephrology	Clinical medicine
	Medical sciences	Allergy	Clinical medicine
	Medical sciences	Fertility	Clinical medicine
	Medical sciences	Geriatrics	Clinical medicine
	Medical sciences	Embryology	Biomedical research
	Medical sciences	Tropical medicine	Clinical medicine
	Medical sciences	Addictive diseases	Clinical medicine
	Medical sciences	Microscopy	Biomedical research

APPENDIX TABLE 14. Crosswalk of WebCASPAR and ipIQ field classification

WebCASPAR broad field	WebCASPAR fine field	ipIQ fine field	ipIQ broad field
Other life sciences			
	Other life sciences	Speech/language pathology and audiology	Health sciences
	Other life sciences	Nursing	Health sciences
	Other life sciences	Rehabilitation	Health sciences
	Other life sciences	Health policy and services	Health sciences
Psychology			
	Psychology	Clinical psychology	Psychology
	Psychology	Behavioral and comparative psychology	Psychology
	Psychology	Developmental and child psychology	Psychology
	Psychology	Experimental psychology	Psychology
	Psychology	Human factors	Psychology
	Psychology	Social psychology	Psychology
	Psychology	General psychology	Psychology
	Psychology	Miscellaneous psychology	Psychology
	Psychology	Psychoanalysis	Psychology
Social sciences			
	Economics	Economics	Social sciences
	Political science and public administration	International relations	Social sciences
	Political science and public administration	Political science and public administration	Social sciences
	Sociology	Demography	Social sciences
	Sociology	Sociology	Social sciences
	Anthropology	Anthropology and archaeology	Social sciences
	Area and ethnic studies	Area studies	Social sciences
	Other social sciences	Criminology	Social sciences
	Other social sciences	Geography and regional sciences	Social sciences
	Other social sciences	Planning and urban studies	Social sciences
	Other social sciences	General social sciences	Social sciences
	Other social sciences	Miscellaneous social sciences	Social sciences
	Other social sciences	Science studies	Social sciences
	Other social sciences	Gerontology and aging	Health sciences
	Other social sciences	Social studies of medicine	Social sciences
Professional fields			
	Non-science education	Education	Professional fields
	Business and management	Management and business	Professional fields
	Communication and librarianship	Communication	Professional fields
	Communication and librarianship	Information and library science	Professional fields
	Law	Law	Professional fields
	Social service professions	Social work	Professional fields
	Other nonsciences or unknown disciplines	Miscellaneous professional fields	Professional fields

SOURCES: ipIQ, Inc., and National Science Foundation, Division of Science Resources Statistics, Integrated Science and Engineering Resources Data System (WebCASPAR) database system, http://caspar.nsf.gov.

APPENDIX TABLE 15. S&E article output (fractional counts) of top 200 research universities, by Carnegie institution type and administrative control of institution: 1988–2001

Institution type and administrative control	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
All top 200	111,442	117,562	120,430	121,813	125,745	124,427	126,965	128,884	128,972	127,084	127,719	127,778	126,591	130,230
Research I	87,974	92,639	94,774	95,427	98,351	97,360	99,225	100,828	100,745	99,344	99,598	99,799	98,610	101,316
Research II	10,118	10,399	10,596	11,053	11,353	11,070	11,425	11,232	11,078	10,941	10,981	11,049	11,114	11,504
Doctorate granting I	2,343	2,463	2,542	2,645	2,726	2,656	2,723	2,687	2,787	2,640	2,691	2,665	2,761	2,814
Doctorate granting II	2,780	3,191	3,276	3,392	3,498	3,521	3,580	3,673	3,754	3,790	3,962	3,926	3,799	3,824
Masters and liberal arts	307	337	350	379	393	404	407	425	470	429	444	439	450	441
Engineering	39	45	33	35	55	52	50	44	42	43	42	57	56	49
Medical	7,774	8,361	8,722	8,750	9,229	9,209	9,390	9,804	9,921	9,735	9,804	9,649	9,602	10,070
Other Carnegie	59	80	81	92	86	93	69	90	75	69	75	58	59	64
Not classified	48	47	55	39	55	62	97	98	98	92	123	136	139	148
Private	34,657	36,414	36,861	37,472	38,861	38,897	39,930	40,589	41,027	40,793	40,988	41,495	40,989	42,404
Research I	28,357	29,739	30,136	30,330	31,507	31,318	32,232	32,882	33,350	33,220	33,313	34,013	33,461	34,669
Research II	2,597	2,553	2,559	2,716	2,759	2,735	2,837	2,721	2,682	2,612	2,618	2,622	2,650	2,812
Doctorate granting I	452	529	529	541	571	588	604	604	653	616	596	596	639	609
Doctorate granting II	799	983	980	1,084	1,049	1,149	1,246	1,233	1,251	1,256	1,348	1,234	1,117	1,115
Masters and liberal arts	65	67	65	75	82	65	75	83	75	66	73	82	67	58
Medical	2,388	2,542	2,592	2,727	2,893	3,044	2,937	3,065	3,015	3,023	3,039	2,948	3,056	3,141
Public	76,785	81,148	83,569	84,341	86,883	85,530	86,983	88,239	87,892	86,233	86,665	86,202	85,534	87,748
Research I	59,618	62,900	64,638	65,097	66,844	66,043	66,993	67,946	67,395	66,124	66,285	65,786	65,149	66,647
Research II	7,521	7,846	8,038	8,337	8,594	8,335	8,588	8,511	8,396	8,330	8,362	8,427	8,464	8,693
Doctorate granting I	1,892	1,934	2,014	2,104	2,155	2,068	2,119	2,083	2,135	2,024	2,096	2,069	2,122	2,205
Doctorate granting II	1,982	2,208	2,295	2,308	2,448	2,372	2,334	2,440	2,503	2,534	2,614	2,692	2,683	2,709
Masters and liberal arts	242	270	284	304	311	340	331	342	395	363	371	357	383	383
Engineering	39	45	33	35	55	52	50	44	42	43	42	57	56	49
Medical	5,386	5,819	6,130	6,023	6,336	6,166	6,453	6,739	6,907	6,712	6,764	6,701	6,547	6,929
Other Carnegie	59	80	81	92	86	93	69	90	75	69	75	58	59	64
Not classified	48	47	55	39	55	62	45	42	45	35	56	56	71	70

S&E = science and engineering.

NOTES: Articles on fractional-count basis, i.e., for articles with collaborating institutions, each institution type receives fractional credit on basis of proportion of its participating institutions. Institutions designated by 1994 Carnegie classification code. For information on these institutional categories, see Carnegie Foundation for the Advancement of Teaching, *A Classification of Institutions of Higher Education,* Princeton University Press (1994). Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 16. S&E article output (fractional counts) of top 200 research universities, by field and National Research Council scholarly quality rating: 1988–2001

Field and NRC rating[a]	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Astronomy														
All top 200	1,081	1,102	1,161	1,152	1,297	1,246	1,441	1,523	1,607	1,553	1,163	1,697	1,515	1,643
≥4	360	341	373	373	405	435	483	489	552	496	365	575	495	564
3 < 4	334	368	374	368	435	369	418	422	439	428	328	440	414	431
2 < 3	94	81	95	90	103	99	122	142	142	144	104	162	135	134
<2	14	22	27	21	26	27	38	30	35	43	23	35	25	32
No rating	279	290	292	301	329	316	380	440	439	441	344	486	447	483
Biological sciences														
All top 200	31,337	33,504	34,341	34,851	35,896	35,550	36,339	36,849	36,714	35,651	36,137	35,640	35,250	36,658
≥4	7,970	8,589	8,496	8,719	9,021	9,257	9,282	9,618	9,565	9,249	9,433	9,300	8,915	9,275
3 < 4	14,429	15,248	15,901	16,001	16,570	16,359	16,772	16,781	16,703	16,225	16,377	16,130	16,138	16,832
2 < 3	6,923	7,494	7,843	7,980	8,058	7,816	8,084	8,332	8,140	7,884	8,045	7,941	7,910	8,133
<2	919	966	890	922	1,021	976	1,050	981	1,101	1,088	1,059	1,087	1,047	1,202
No rating	1,096	1,206	1,210	1,228	1,227	1,142	1,151	1,136	1,205	1,205	1,223	1,183	1,240	1,216
Chemistry														
All top 200	8,357	8,609	9,092	9,399	9,570	9,775	9,399	9,665	9,823	9,528	9,738	9,674	9,857	9,751
≥4	1,947	1,874	2,042	2,075	2,096	2,123	2,078	2,106	2,120	2,075	2,083	2,009	2,081	2,105
3 < 4	3,070	3,171	3,335	3,504	3,478	3,616	3,457	3,575	3,592	3,482	3,633	3,595	3,659	3,590
2 < 3	2,395	2,525	2,682	2,714	2,841	2,874	2,845	2,836	2,887	2,785	2,798	2,864	2,849	2,812
<2	486	583	552	615	652	640	573	639	678	635	688	697	715	672
No rating	459	456	481	491	503	522	447	509	546	552	536	510	552	572
Computer sciences														
All top 200	941	1,114	1,074	1,120	1,158	1,232	1,368	1,287	1,289	1,247	1,249	1,306	1,348	1,365
≥4	251	281	265	270	251	297	302	297	335	291	305	326	364	310
3 < 4	289	365	359	374	418	379	389	393	361	349	383	412	402	440
2 < 3	195	232	217	222	235	282	316	287	275	292	280	275	279	305
<2	97	99	99	122	121	122	167	135	139	136	112	117	111	119
No rating	110	135	134	132	133	152	194	174	178	179	169	176	193	190
Engineering														
All top 200	5,598	5,760	6,490	6,238	7,351	6,662	7,019	7,182	6,827	6,667	6,848	7,181	6,761	7,509
≥4	1,165	1,143	1,350	1,262	1,418	1,284	1,290	1,303	1,281	1,220	1,277	1,347	1,272	1,482
3 < 4	1,958	1,997	2,305	2,205	2,597	2,317	2,443	2,433	2,356	2,246	2,359	2,502	2,242	2,486
2 < 3	1,085	1,052	1,176	1,102	1,328	1,239	1,251	1,333	1,274	1,238	1,242	1,338	1,222	1,425
<2	171	202	197	228	216	256	265	256	278	229	250	262	277	285
No rating	1,219	1,366	1,462	1,441	1,791	1,567	1,770	1,857	1,638	1,733	1,720	1,732	1,748	1,830
Geosciences														
All top 200	4,534	4,820	4,963	5,018	5,036	5,557	5,467	5,837	6,060	5,647	5,925	5,937	5,970	6,078
≥4	808	802	832	864	815	886	858	837	832	738	782	733	790	747
3 < 4	1,012	1,068	1,135	1,182	1,108	1,227	1,227	1,266	1,160	1,143	1,165	1,143	1,136	1,149
2 < 3	611	631	644	672	577	636	647	686	682	670	658	653	621	668
<2	31	45	42	41	39	34	50	32	36	64	47	41	43	76
No rating	2,061	2,278	2,313	2,258	2,498	2,764	2,686	3,011	3,346	3,039	3,268	3,357	3,370	3,452
Mathematics														
All top 200	3,112	3,247	2,671	2,758	2,916	2,770	2,751	2,620	2,674	2,506	2,840	2,925	3,064	2,995
≥4	678	742	687	679	729	650	681	631	647	565	675	732	730	786
3 < 4	1,230	1,245	1,041	1,040	1,180	1,096	1,095	1,080	1,082	1,061	1,114	1,208	1,225	1,140
2 < 3	833	891	652	697	677	731	662	628	642	577	712	641	745	723
<2	156	143	109	137	130	99	123	100	98	108	110	108	117	97
No rating	215	227	182	206	200	194	190	183	205	196	229	237	247	249
Physics														
All top 200	10,727	11,511	11,446	12,374	12,357	12,420	13,265	12,814	12,474	12,029	11,922	11,890	11,285	11,492
≥4	3,933	4,248	3,990	4,258	4,311	4,295	4,498	4,313	4,228	4,155	4,095	3,934	3,711	3,783
3 < 4	4,281	4,629	4,680	5,088	5,026	5,077	5,563	5,280	5,047	4,833	4,732	4,790	4,475	4,581
2 < 3	1,947	1,996	2,073	2,231	2,222	2,219	2,342	2,338	2,298	2,208	2,267	2,295	2,233	2,271
<2	148	157	182	185	171	193	201	213	199	194	203	195	222	205
No rating	418	482	520	612	626	636	662	671	703	639	625	676	644	653

APPENDIX TABLE 16. S&E article output (fractional counts) of top 200 research universities, by field and National Research Council scholarly quality rating: 1988–2001

Field and NRC rating[a]	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Psychology														
All top 200	4,984	4,893	5,215	4,891	5,185	4,671	4,811	5,319	5,609	5,539	5,262	5,446	5,222	5,570
≥4	1,183	1,157	1,256	1,129	1,195	1,096	1,169	1,190	1,303	1,268	1,168	1,286	1,198	1,262
3 < 4	2,191	2,127	2,256	2,129	2,314	2,039	2,078	2,268	2,416	2,405	2,288	2,359	2,238	2,468
2 < 3	1,086	1,088	1,143	1,119	1,164	1,015	1,069	1,290	1,250	1,230	1,226	1,222	1,214	1,247
<2	155	142	163	141	127	137	148	165	177	191	160	165	147	135
No rating	369	379	396	373	385	385	346	407	463	445	420	416	425	458
Social sciences														
All top 200	6,302	6,754	6,839	6,893	6,778	6,809	6,616	6,558	6,904	6,772	6,793	6,803	6,988	6,988
≥4	1,189	1,269	1,240	1,251	1,237	1,242	1,166	1,141	1,214	1,197	1,213	1,173	1,208	1,200
3 < 4	1,333	1,392	1,363	1,460	1,449	1,426	1,437	1,426	1,468	1,350	1,383	1,381	1,491	1,522
2 < 3	1,158	1,257	1,297	1,239	1,202	1,235	1,189	1,197	1,211	1,240	1,230	1,190	1,224	1,294
<2	462	460	520	537	472	453	442	452	468	483	465	461	454	464
No rating	2,160	2,377	2,419	2,407	2,418	2,454	2,382	2,343	2,542	2,502	2,503	2,598	2,611	2,507

S&E = science and engineering; NRC = National Research Council.

[a]1994 NRC ratings of scholarly quality of graduate departments at U.S. universities used as measure of university quality in corresponding field in Integrated Science and Engineering Resources Data System (WebCASPAR), http://caspar.nsf.gov. Higher ratings signify higher scholarly quality.

NOTES: Articles on fractional-count basis, i.e., for articles with collaborating institutions, each institution receives fractional credit on basis of proportion of its participation. For more information about data and methods, see M.L. Goldberger, B.A. Maher, and P.E. Flattau, editors, *Research-Doctorate Programs in the United States: Continuity and Change,* National Academies Press (1995). Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 17. Growth in R&D and article output (fractional counts) of top 200 research universities, by R&D quartile: 1988–2001 and 1992–2001
(Percent)

	R&D growth		Article growth		R&D quartile	
Academic institution	1988–2001	1992–2001	1988–2001	1992–2001	1988–2001	1992–2001
C. R. Drew U. of Medicine & Science	1,199	367	37	127	1	1
George Mason U.	758	176	59	6	1	1
U. TX El Paso	729	116	13	-21	1	1
ND State U.	651	88	-1	-14	1	2
U. MD Baltimore County	646	289	36	0	1	1
U. Central FL	601	187	164	22	1	1
GA State U.	567	289	82	44	1	1
U. LA Lafayette	530	197	44	18	1	1
Medical U. SC	457	266	47	46	1	1
NJ Institute of Technology	431	109	266	71	1	1
U. AR for Medical Sciences	427	227	51	42	1	1
Medical C. GA	426	144	-8	-20	1	1
Boston C.	401	196	106	32	1	1
U. MT	390	230	64	89	1	1
Loyola U. Chicago	346	23	51	10	1	4
C. of William & Mary	346	90	41	48	1	2
U. PR Medical Sciences Campus	333	31	-27	-17	1	4
U. South FL	325	150	23	-5	1	1
U. NE Medical Center	313	92	18	-16	1	2
OR Health & Science U.	310	152	86	21	1	1
U. NH	298	160	21	-4	1	1
Eastern VA Medical School	297	134	-11	-27	1	1
Emory U.	289	134	92	50	1	1
U. of Medicine and Dentistry NJ	286	92	24	1	1	2
U. MS, all campuses	281	147	45	27	1	1
U. ME	269	176	10	-3	1	1
Thomas Jefferson U.	267	115	61	18	1	1
U. NV Las Vegas	267	103	258	99	1	2
U. Memphis	259	142	10	2	1	1
SUNY Albany	257	96	-20	-18	1	2
Baylor C. of Medicine	257	127	38	16	1	1
Mount Sinai School of Medicine	256	134	42	10	1	1
Rush U.	254	168	23	29	1	1
U. Pittsburgh	254	122	27	5	1	1
IN U.	253	121	26	7	1	1
U. SC	249	104	20	19	1	2
Wayne State U.	248	117	44	13	1	1
U. MD Baltimore	247	138	50	35	1	1
Washington U. in St Louis	245	139	39	4	1	1
Old Dominion U.	240	127	25	1	1	1
Wright State U.	235	91	7	-17	1	2
Saint Louis U.	234	63	16	-2	1	3
U. NV Reno	231	58	65	18	1	3
U. CA Los Angeles	231	156	8	-3	1	1
Duke U.	229	99	32	13	1	2
U. NM	228	115	20	0	1	1
MS State U.	226	123	43	5	1	1
U. FL	225	148	2	-8	1	1
Wake Forest U.	222	97	41	21	2	2
U. Cincinnati	219	114	5	-6	2	1

APPENDIX TABLE 17. Growth in R&D and article output (fractional counts) of top 200 research universities, by R&D quartile: 1988–2001 and 1992–2001
(Percent)

	R&D growth		Article growth		R&D quartile	
Academic institution	1988–2001	1992–2001	1988–2001	1992–2001	1988–2001	1992–2001
U. Louisville	218	319	26	7	2	1
U. TX Southwestern Medical Center Dallas	216	117	36	-3	2	1
George Washington U.	214	88	-4	1	2	2
U. Akron	213	50	32	0	2	3
U. TX Medical Branch Galveston	211	78	31	8	2	2
U. WA	209	88	28	15	2	2
Vanderbilt U.	208	95	27	24	2	2
U. IL Chicago	207	128	6	20	2	1
U. KY	207	130	30	5	2	1
Dartmouth C.	207	103	78	37	2	2
U. KS	203	109	12	0	2	1
San Diego State U.	201	90	0	4	2	2
AZ State U.	201	71	20	6	2	3
U. CA Irvine	199	101	15	-6	2	2
U. OK	197	61	22	1	2	3
U. PA	195	111	31	27	2	1
U. TX Health Science Center San Antonio	190	77	6	-7	2	2
U. CA Santa Cruz	190	76	46	10	2	2
Northeastern U.	190	117	22	-7	2	1
U. MD Center for Environmental Science	189	97	3	12	2	2
U. CO	185	107	26	14	2	1
U. TX Health Science Center Houston	184	102	43	36	2	2
U. NC Chapel Hill	184	88	29	11	2	2
Boston U.	180	106	39	33	2	1
U. CA Davis	180	107	16	1	2	1
U. AR, main campus	179	75	45	8	2	2
U. CA San Diego	178	97	31	13	2	2
MT State U. Bozeman	176	102	16	4	2	2
U. AL Birmingham	172	97	52	21	2	2
U. CA San Francisco	172	77	4	-7	2	2
CO State U.	171	50	7	5	2	3
NC State U.	171	109	12	-5	2	1
U. IA	170	89	2	-2	2	2
Clark Atlanta U.	169	50	47	101	2	3
Johns Hopkins U.	168	90	39	19	2	2
CO School of Mines	168	85	90	72	2	2
Naval Postgraduate School	164	100	8	-26	2	2
U. MO Columbia	163	80	28	7	2	2
U. UT	161	82	-1	4	2	2
U. NE Lincoln	159	72	25	7	2	3
U. Notre Dame	158	103	52	45	2	2
Case Western Reserve U.	156	67	19	0	2	3
Ohio State U.	153	92	12	2	2	2
Medical C. WI	152	92	9	-10	2	2
Northwestern U.	151	82	30	14	2	2
Clemson U.	151	60	25	13	2	3
OH U.	150	83	67	53	2	2
U. CA Santa Barbara	150	76	19	-8	2	2
WV U.	148	36	10	-4	3	4
U. HI Manoa	144	96	10	-10	3	2

APPENDIX TABLE 17. Growth in R&D and article output (fractional counts) of top 200 research universities, by R&D quartile: 1988–2001 and 1992–2001
(Percent)

	R&D growth		Article growth		R&D quartile	
Academic institution	1988–2001	1992–2001	1988–2001	1992–2001	1988–2001	1992–2001
PA State U.	143	65	35	13	3	3
U. DE	142	58	32	14	3	3
VA Polytech Institute and State U.	140	65	-23	-31	3	3
U. MI	140	53	23	5	3	3
U. CA Berkeley	139	57	4	-3	3	3
TX Tech U.	138	90	32	31	3	2
U. MA	137	78	19	-4	3	2
U. AZ	136	65	10	-4	3	3
U. AL Huntsville	135	37	22	8	3	4
LA State U., all campuses	134	77	-5	-4	3	2
Tulane U.	134	38	32	16	3	4
CA Institute of Technology	132	92	5	5	3	2
VA Commonwealth U.	131	43	7	-7	3	4
SD State U.	129	55	19	12	3	3
MI State U.	129	87	5	-3	3	2
U. TX Arlington	128	26	-22	-20	3	4
U. Southern CA	127	75	-3	-12	3	2
Rice U.	126	45	25	3	3	4
City U. NY	125	58	-6	-8	3	3
Rutgers the State U. NJ	125	46	27	3	3	4
San Jose State U.	125	24	-10	-24	3	4
FL State U.	125	127	39	12	3	1
U. ID	124	53	22	-15	3	3
U. WI Madison	123	71	-3	-6	3	3
Georgetown U.	122	53	41	-4	3	3
U. AK Fairbanks	121	62	23	18	3	3
Brown U.	121	65	20	8	3	3
Columbia U. in the City of NY	120	78	29	16	3	2
U. North TX	120	73	25	10	3	3
KS State U.	118	63	10	3	3	3
U. Miami	117	48	21	-4	3	3
SUNY C. of Environmental Science and Forestry	116	51	-8	-26	3	3
Purdue U.	115	82	-12	-17	3	2
GA Institute of Technology	114	70	99	64	3	3
SUNY Buffalo	113	45	-5	-15	3	4
SUNY Binghamton	113	48	8	-16	3	3
Southern IL U. Carbondale	113	54	-18	-21	3	3
Rockefeller U.	112	94	-31	-12	3	2
SUNY Stony Brook	112	70	-5	-3	3	3
WA State U.	110	27	7	4	3	4
U. AL	109	47	45	14	3	3
MI Tech U.	107	63	7	14	3	3
IA State U.	107	35	15	10	3	4
U. Rochester	105	67	-9	-12	3	3
U. VT	105	53	21	-2	3	3
UT State U.	105	35	3	-8	3	4
TX A&M U.	104	52	18	0	3	3
U. WY	104	38	1	-12	3	4
Auburn U.	102	59	0	-16	4	3
Desert Research Institute	101	44	295	60	4	4

APPENDIX TABLE 17. Growth in R&D and article output (fractional counts) of top 200 research universities, by R&D quartile: 1988–2001 and 1992–2001
(Percent)

	R&D growth		Article growth		R&D quartile	
Academic institution	1988–2001	1992–2001	1988–2001	1992–2001	1988–2001	1992–2001
U. VA	101	36	24	3	4	4
U. OR	99	22	-3	-17	4	4
Brandeis U.	98	50	-20	-21	4	3
Yale U.	98	52	10	-3	4	3
U. IL Urbana-Champaign	98	55	-8	-8	4	3
U. GA	98	65	0	-5	4	3
FL A&M U.	98	7	152	116	4	4
U. MD College Park	97	22	13	0	4	4
U. Chicago	97	64	1	-8	4	3
Yeshiva U.	97	70	17	-5	4	3
U. MN	96	46	12	-9	4	4
Harvard U.	95	47	37	20	4	3
Tufts U.	95	74	39	23	4	3
Princeton U.	94	59	20	14	4	3
U. Houston	92	15	7	1	4	4
U. WI Milwaukee	89	27	-3	-10	4	4
NY U.	89	56	37	24	4	3
U. CT	83	33	21	6	4	4
Howard U.	79	72	-23	-19	4	3
U. CA Riverside	78	64	8	-10	4	3
NY Medical C.	76	45	-6	-21	4	4
Brigham Young U.	75	32	52	37	4	4
Stanford U.	74	31	13	7	4	4
OR State U.	73	43	-9	-7	4	4
Drexel U.	73	19	-25	-28	4	4
SUNY Health Sciences Center Brooklyn	72	31	-14	-28	4	4
U. TX Austin	71	29	-4	-17	4	4
Cornell U.	63	48	-11	-13	4	3
MA Institute of Technology	61	30	2	1	4	4
OK State U.	56	27	19	10	4	4
U. TN System	55	23	12	-10	4	4
Carnegie Mellon U.	54	31	-3	4	4	4
U. MO Rolla	53	84	31	10	4	2
Temple U.	47	12	1	-4	4	4
Uniformed Services U. of the Health Sciences	45	-17	-29	-26	4	4
U. TX Dallas	43	21	1	-25	4	4
NM State U.	43	4	15	-1	4	4
U. RI	41	24	-8	-21	4	4
NM Institute of Mining and Technology	39	13	26	-10	4	4
MCP Hahnemann U.	36	-26	-15	-46	4	4
U. Dayton	31	1	-9	-29	4	4
Syracuse U.	26	32	-25	-14	4	4
U. ND	25	8	45	26	4	4
Rensselaer Polytechnic Institute	23	-11	-17	-15	4	4
Lehigh U.	7	-9	8	-6	4	4

APPENDIX TABLE 17. Growth in R&D and article output (fractional counts) of top 200 research universities, by R&D quartile: 1988–2001 and 1992–2001
(Percent)

	R&D growth		Article growth		R&D quartile	
Academic institution	1988–2001	1992–2001	1988–2001	1992–2001	1988–2001	1992–2001
SUNY Upstate Medical U.	-30	33	-16	-21	4	4
U. PR Mayaguez	-31	-26	41	44	4	4
Eastern KY U.	NA	NA	66	5	NA	NA
FL International U.	NA	NA	154	33	NA	NA
U. MD Biotech Institute	NA	NA	NA	NA	NA	NA

NA = not available; either R&D data or article data not reported until after 1992.

R&D = research and development.

NOTES: Articles on fractional-count basis, i.e., for articles with collaborating institutions, each institution receives fractional credit on basis of proportion of its participation. Quartiles based on constant dollar R&D growth during periods 1988–2001 and 1992–2001. Universities are listed in descending order of R&D growth during 1988–2001 period. Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, Integrated Science and Engineering Resources Data System (WebCASPAR), http://caspar.nsf.gov, special tabulations.

APPENDIX TABLE 18. S&E article output of top 200 research universities, by field: 1988–2001

Method of attribution and field	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Fractional counts														
All fields	116,952	123,461	126,425	127,814	131,780	130,423	132,504	134,625	134,938	132,444	133,165	133,383	132,245	135,745
Agricultural sciences	2,930	2,968	3,098	3,188	2,736	2,780	2,698	2,517	2,402	2,530	2,448	1,971	2,546	2,173
Astronomy	1,081	1,102	1,161	1,152	1,297	1,246	1,441	1,523	1,607	1,553	1,163	1,697	1,515	1,643
Biological sciences	31,337	33,504	34,341	34,851	35,896	35,550	36,339	36,849	36,714	35,651	36,137	35,640	35,250	36,658
Chemistry	8,357	8,609	9,092	9,399	9,570	9,775	9,399	9,665	9,823	9,528	9,738	9,674	9,857	9,751
Computer sciences	941	1,114	1,074	1,120	1,158	1,232	1,368	1,287	1,289	1,247	1,249	1,306	1,348	1,365
Engineering	5,797	5,939	6,682	6,408	7,560	6,837	7,189	7,321	6,981	6,791	6,956	7,333	6,913	7,656
Geosciences	4,534	4,820	4,963	5,018	5,036	5,557	5,467	5,837	6,060	5,647	5,925	5,937	5,970	6,078
Mathematics	3,112	3,247	2,671	2,758	2,916	2,770	2,751	2,620	2,674	2,506	2,840	2,925	3,064	2,995
Medical sciences	30,444	32,119	32,844	32,733	34,306	33,679	34,467	35,391	34,916	35,651	35,613	35,638	35,002	36,094
Physics	10,727	11,511	11,446	12,374	12,357	12,420	13,265	12,814	12,474	12,029	11,922	11,890	11,285	11,492
Psychology	4,984	4,893	5,215	4,891	5,185	4,671	4,811	5,319	5,609	5,539	5,262	5,446	5,222	5,570
Social sciences	6,302	6,754	6,839	6,893	6,778	6,809	6,616	6,558	6,904	6,772	6,793	6,803	6,988	6,988
Whole counts														
All fields	138,876	146,874	151,271	154,021	160,193	159,393	163,304	167,157	168,615	166,881	169,005	170,844	170,475	176,562
Agricultural sciences	3,365	3,424	3,572	3,683	3,204	3,260	3,194	3,005	2,880	3,064	2,998	2,460	3,194	2,748
Astronomy	1,481	1,537	1,655	1,689	1,889	1,870	2,205	2,324	2,514	2,466	1,913	2,785	2,570	2,849
Biological sciences	36,903	39,681	40,966	41,900	43,607	43,360	44,728	45,792	45,741	44,704	45,720	45,588	45,254	47,401
Chemistry	9,439	9,765	10,391	10,871	11,111	11,387	11,069	11,439	11,709	11,437	11,722	11,705	11,983	11,958
Computer sciences	1,116	1,314	1,239	1,353	1,406	1,497	1,696	1,629	1,648	1,667	1,706	1,765	1,800	1,872
Engineering	6,879	7,065	8,010	7,753	9,151	8,310	8,797	9,059	8,623	8,636	8,920	9,455	9,016	10,106
Geosciences	5,548	5,902	6,207	6,270	6,407	7,035	7,018	7,624	7,979	7,567	8,095	8,151	8,284	8,528
Mathematics	3,634	3,797	3,158	3,272	3,527	3,350	3,318	3,197	3,311	3,109	3,562	3,717	3,918	3,903
Medical sciences	37,377	39,404	40,309	40,344	42,450	42,006	43,277	44,432	44,147	45,217	45,616	46,028	45,622	47,445
Physics	13,216	14,168	14,320	15,715	15,999	16,182	17,303	17,004	16,853	16,522	16,457	16,669	16,058	16,467
Psychology	5,684	5,621	5,955	5,618	5,954	5,428	5,578	6,222	6,627	6,539	6,249	6,491	6,202	6,652
Social sciences	7,049	7,502	7,653	7,679	7,657	7,693	7,536	7,520	7,936	7,801	7,775	7,769	8,048	8,117

S&E = science and engineering.

NOTES: For articles with collaborating institutions, fractional counts assign each participating institution fractional credit on basis of proportion of its participation, and whole counts assign the combined group of top 200 research universities one credit for its participation, regardless of the number of participating institutions. "All fields "includes health sciences and professional fields. Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 19. Ratio of fractional to whole counts of S&E articles for top 200 research universities, by institution: 1988–2001

Academic institution	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
AZ State U.	0.77	0.75	0.75	0.72	0.71	0.72	0.70	0.70	0.67	0.66	0.64	0.65	0.63	0.64
Auburn U.	0.79	0.77	0.77	0.76	0.78	0.75	0.76	0.74	0.71	0.73	0.71	0.69	0.68	0.65
Baylor C. of Medicine	0.68	0.67	0.66	0.65	0.64	0.64	0.61	0.61	0.61	0.61	0.58	0.59	0.57	0.57
Boston C.	0.76	0.73	0.68	0.69	0.65	0.70	0.62	0.62	0.67	0.68	0.63	0.59	0.59	0.59
Boston U.	0.64	0.63	0.63	0.65	0.60	0.59	0.60	0.61	0.60	0.57	0.57	0.59	0.55	0.55
Brandeis U.	0.79	0.74	0.73	0.72	0.68	0.67	0.65	0.65	0.67	0.63	0.64	0.65	0.68	0.64
Brigham Young U.	0.78	0.75	0.72	0.70	0.71	0.72	0.69	0.71	0.69	0.69	0.66	0.67	0.67	0.65
Brown U.	0.65	0.65	0.64	0.64	0.62	0.63	0.63	0.61	0.59	0.60	0.56	0.58	0.56	0.53
CA Institute of Technology	0.72	0.72	0.70	0.69	0.69	0.67	0.65	0.67	0.64	0.63	0.63	0.60	0.55	0.55
Carnegie Mellon U.	0.74	0.72	0.74	0.71	0.69	0.67	0.67	0.69	0.67	0.65	0.64	0.64	0.58	0.56
Case Western Reserve U.	0.70	0.70	0.71	0.70	0.68	0.68	0.67	0.63	0.63	0.63	0.62	0.61	0.60	0.57
C. R. Drew U. of Medicine & Science	0.60	0.56	0.51	0.55	0.51	0.51	0.46	0.55	0.41	0.50	0.45	0.46	0.44	0.44
City U. NY	0.72	0.72	0.71	0.73	0.70	0.70	0.70	0.70	0.69	0.70	0.66	0.65	0.67	0.66
Clark Atlanta U.	0.78	0.82	0.73	0.67	0.73	0.60	0.76	0.65	0.66	0.60	0.61	0.64	0.68	0.60
Clemson U.	0.79	0.74	0.75	0.77	0.74	0.74	0.74	0.71	0.69	0.68	0.68	0.69	0.67	0.67
C. of William & Mary	0.68	0.59	0.64	0.64	0.66	0.63	0.62	0.62	0.62	0.58	0.58	0.60	0.60	0.59
CO School of Mines	0.80	0.75	0.64	0.73	0.68	0.73	0.63	0.71	0.60	0.63	0.62	0.57	0.64	0.61
CO State U.	0.78	0.73	0.75	0.74	0.72	0.70	0.70	0.73	0.68	0.68	0.66	0.65	0.65	0.64
Columbia U. in the City of NY	0.70	0.70	0.68	0.67	0.66	0.65	0.63	0.64	0.63	0.60	0.60	0.61	0.59	0.57
Cornell U.	0.75	0.76	0.74	0.72	0.71	0.70	0.70	0.70	0.66	0.66	0.64	0.64	0.63	0.62
Dartmouth C.	0.71	0.75	0.70	0.71	0.67	0.67	0.65	0.63	0.66	0.64	0.63	0.63	0.61	0.61
Desert Research Institute	0.59	0.81	0.53	0.56	0.60	0.67	0.46	0.54	0.48	0.36	0.54	0.49	0.46	0.45
Drexel U.	0.66	0.70	0.67	0.66	0.64	0.67	0.63	0.67	0.58	0.62	0.59	0.57	0.55	0.51
Duke U.	0.74	0.74	0.73	0.71	0.69	0.68	0.66	0.65	0.64	0.67	0.64	0.63	0.62	0.61
Eastern KY U.	0.66	0.76	0.73	0.70	0.66	0.59	0.70	0.74	0.69	0.63	0.77	0.63	0.66	0.69
Eastern VA Medical School	0.73	0.72	0.71	0.65	0.66	0.63	0.60	0.63	0.55	0.54	0.62	0.50	0.56	0.56
Emory U.	0.72	0.72	0.71	0.68	0.68	0.66	0.64	0.63	0.63	0.62	0.61	0.60	0.60	0.59
FL A&M U.	0.89	0.72	0.73	0.66	0.65	0.64	0.67	0.71	0.63	0.61	0.65	0.60	0.57	0.57
FL International U.	0.71	0.70	0.68	0.71	0.72	0.70	0.68	0.69	0.68	0.71	0.64	0.67	0.61	0.57
FL State U.	0.75	0.75	0.71	0.75	0.70	0.67	0.68	0.65	0.62	0.61	0.62	0.62	0.59	0.60
George Mason U.	0.68	0.71	0.65	0.66	0.69	0.62	0.65	0.62	0.59	0.61	0.59	0.54	0.56	0.58
George Washington U.	0.65	0.62	0.61	0.60	0.60	0.58	0.60	0.57	0.56	0.58	0.59	0.53	0.52	0.51
Georgetown U.	0.66	0.66	0.64	0.62	0.64	0.64	0.64	0.61	0.61	0.60	0.62	0.61	0.60	0.58
GA Institute of Technology	0.74	0.75	0.74	0.74	0.72	0.72	0.74	0.71	0.69	0.69	0.69	0.68	0.68	0.66
GA State U.	0.72	0.73	0.71	0.70	0.67	0.67	0.70	0.65	0.66	0.64	0.62	0.65	0.63	0.62
Harvard U.	0.61	0.61	0.60	0.60	0.58	0.58	0.57	0.57	0.55	0.55	0.55	0.54	0.54	0.53
Howard U.	0.75	0.72	0.70	0.70	0.65	0.68	0.68	0.61	0.63	0.61	0.56	0.56	0.54	0.54
IN U.	0.74	0.73	0.72	0.72	0.72	0.68	0.66	0.68	0.65	0.63	0.63	0.64	0.61	0.60
IA State U.	0.78	0.78	0.78	0.76	0.75	0.74	0.73	0.71	0.70	0.64	0.65	0.65	0.62	0.62
Johns Hopkins U.	0.74	0.73	0.72	0.71	0.69	0.68	0.67	0.64	0.66	0.63	0.63	0.62	0.61	0.59
KS State U.	0.80	0.77	0.78	0.78	0.77	0.74	0.74	0.72	0.71	0.68	0.69	0.68	0.69	0.66
Lehigh U.	0.80	0.76	0.79	0.79	0.77	0.76	0.73	0.77	0.79	0.73	0.71	0.73	0.69	0.71
LA State U., all campuses	0.77	0.77	0.74	0.74	0.74	0.72	0.73	0.72	0.70	0.68	0.69	0.64	0.63	0.62

APPENDIX TABLE 19. Ratio of fractional to whole counts of S&E articles for top 200 research universities, by institution: 1988–2001

Academic institution	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Loyola U. Chicago	0.63	0.70	0.67	0.68	0.67	0.67	0.66	0.64	0.67	0.67	0.64	0.63	0.61	0.63
MA Institute of Technology	0.73	0.72	0.68	0.69	0.67	0.67	0.65	0.64	0.65	0.63	0.62	0.61	0.60	0.59
Medical C. GA	0.74	0.74	0.76	0.73	0.74	0.71	0.67	0.66	0.64	0.66	0.66	0.72	0.64	0.66
MCP Hahnemann U.	0.66	0.69	0.69	0.69	0.65	0.66	0.65	0.65	0.61	0.60	0.59	0.55	0.51	0.48
Medical C. WI	0.70	0.69	0.68	0.69	0.64	0.67	0.66	0.65	0.66	0.63	0.66	0.63	0.60	0.61
Medical U. SC	0.73	0.73	0.73	0.69	0.70	0.70	0.66	0.69	0.69	0.66	0.64	0.65	0.62	0.62
MI State U.	0.79	0.77	0.78	0.78	0.74	0.74	0.72	0.70	0.69	0.68	0.66	0.67	0.64	0.65
MI Technical U.	0.73	0.73	0.77	0.73	0.71	0.67	0.75	0.67	0.66	0.70	0.67	0.61	0.61	0.63
MS State U.	0.73	0.72	0.75	0.69	0.75	0.68	0.74	0.67	0.70	0.70	0.70	0.65	0.66	0.61
MT State U. Bozeman	0.73	0.76	0.76	0.74	0.71	0.70	0.70	0.64	0.69	0.65	0.63	0.65	0.64	0.62
Mount Sinai School of Medicine	0.68	0.68	0.67	0.68	0.67	0.66	0.64	0.64	0.63	0.62	0.63	0.62	0.59	0.59
Naval Postgraduate School	0.73	0.72	0.77	0.75	0.75	0.76	0.73	0.71	0.67	0.65	0.64	0.61	0.56	0.63
NJ Institute of Technology	0.61	0.64	0.70	0.63	0.68	0.69	0.73	0.69	0.66	0.60	0.62	0.68	0.65	0.63
NM Institute of Mining and Technology	0.66	0.69	0.63	0.62	0.71	0.65	0.71	0.62	0.55	0.55	0.55	0.56	0.59	0.58
NM State U.	0.76	0.72	0.74	0.68	0.70	0.67	0.65	0.65	0.59	0.62	0.60	0.58	0.59	0.58
NY Medical C.	0.71	0.67	0.69	0.68	0.66	0.62	0.63	0.63	0.64	0.61	0.62	0.61	0.61	0.58
NY U.	0.69	0.70	0.70	0.65	0.66	0.67	0.66	0.64	0.64	0.63	0.62	0.60	0.60	0.60
NC State U.	0.78	0.77	0.77	0.75	0.76	0.74	0.73	0.70	0.70	0.69	0.67	0.67	0.66	0.65
ND State U.	0.75	0.77	0.78	0.77	0.80	0.72	0.73	0.73	0.77	0.78	0.75	0.71	0.68	0.68
Northeastern U.	0.69	0.69	0.67	0.71	0.67	0.66	0.65	0.64	0.61	0.59	0.62	0.56	0.57	0.56
Northwestern U.	0.72	0.71	0.70	0.71	0.70	0.68	0.69	0.66	0.64	0.64	0.63	0.63	0.64	0.62
OH State U.	0.78	0.76	0.76	0.75	0.74	0.75	0.72	0.73	0.71	0.69	0.68	0.67	0.64	0.63
OH U.	0.76	0.75	0.71	0.73	0.71	0.71	0.68	0.63	0.68	0.68	0.64	0.65	0.63	0.62
OK State U.	0.73	0.73	0.78	0.73	0.74	0.75	0.74	0.72	0.71	0.67	0.69	0.71	0.70	0.69
Old Dominion U.	0.71	0.70	0.74	0.72	0.71	0.72	0.68	0.60	0.63	0.60	0.59	0.58	0.52	0.58
OR Health & Science U.	0.70	0.70	0.68	0.64	0.65	0.63	0.60	0.59	0.60	0.61	0.61	0.60	0.59	0.56
OR State U.	0.75	0.75	0.73	0.74	0.73	0.73	0.72	0.72	0.70	0.67	0.65	0.66	0.67	0.59
PA State U.	0.78	0.79	0.77	0.76	0.75	0.73	0.74	0.72	0.72	0.69	0.69	0.69	0.67	0.64
Princeton U.	0.72	0.73	0.70	0.69	0.68	0.69	0.67	0.66	0.65	0.66	0.67	0.65	0.61	0.58
Purdue U.	0.78	0.77	0.77	0.75	0.73	0.72	0.72	0.71	0.73	0.70	0.69	0.70	0.65	0.64
Rensselaer Polytechnic Institute	0.77	0.74	0.73	0.74	0.73	0.75	0.71	0.72	0.71	0.70	0.66	0.66	0.64	0.63
Rice U.	0.74	0.75	0.70	0.69	0.72	0.71	0.69	0.67	0.65	0.61	0.66	0.61	0.59	0.61
Rockefeller U.	0.69	0.69	0.68	0.67	0.63	0.62	0.60	0.58	0.61	0.60	0.54	0.57	0.52	0.52
Rush U.	0.68	0.66	0.64	0.65	0.60	0.64	0.62	0.60	0.59	0.56	0.59	0.59	0.58	0.56
Rutgers the State U. NJ	0.75	0.72	0.71	0.72	0.70	0.67	0.69	0.68	0.69	0.67	0.65	0.65	0.62	0.60
Saint Louis U.	0.74	0.67	0.69	0.72	0.69	0.66	0.66	0.63	0.63	0.60	0.59	0.61	0.60	0.58
San Diego State U.	0.71	0.69	0.68	0.66	0.62	0.64	0.61	0.57	0.59	0.59	0.59	0.56	0.53	0.55
San Jose State U.	0.66	0.68	0.61	0.60	0.61	0.65	0.59	0.63	0.56	0.54	0.51	0.56	0.57	0.58
SD State U.	0.78	0.76	0.72	0.77	0.68	0.68	0.73	0.66	0.66	0.69	0.66	0.62	0.63	0.67
Southern IL U. Carbondale	0.77	0.77	0.79	0.73	0.76	0.72	0.73	0.74	0.73	0.72	0.71	0.69	0.67	0.62
Stanford U.	0.73	0.71	0.71	0.69	0.69	0.67	0.67	0.66	0.64	0.63	0.63	0.62	0.62	0.61
SUNY Albany	0.70	0.68	0.67	0.67	0.61	0.59	0.62	0.60	0.58	0.58	0.55	0.57	0.53	0.54
SUNY Binghamton	0.80	0.79	0.78	0.79	0.78	0.81	0.75	0.77	0.75	0.76	0.77	0.70	0.67	0.70

APPENDIX TABLE 19. Ratio of fractional to whole counts of S&E articles for top 200 research universities, by institution: 1988–2001

Academic institution	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
SUNY Buffalo	0.73	0.73	0.73	0.74	0.71	0.73	0.69	0.72	0.70	0.67	0.68	0.68	0.67	0.67
SUNY C. of Environmental Science and Forestry	0.76	0.71	0.74	0.77	0.79	0.77	0.68	0.77	0.67	0.75	0.62	0.65	0.62	0.58
SUNY Health Sciences Center Brooklyn	0.66	0.68	0.70	0.70	0.72	0.72	0.64	0.63	0.62	0.65	0.66	0.62	0.58	0.59
SUNY Stony Brook	0.69	0.70	0.70	0.69	0.67	0.65	0.67	0.65	0.65	0.62	0.64	0.62	0.61	0.60
SUNY Upstate Medical U.	0.72	0.65	0.69	0.67	0.62	0.63	0.65	0.62	0.66	0.63	0.63	0.62	0.67	0.60
Syracuse U.	0.77	0.76	0.69	0.69	0.68	0.69	0.65	0.64	0.61	0.61	0.60	0.64	0.59	0.59
Temple U.	0.71	0.71	0.70	0.67	0.67	0.66	0.66	0.64	0.65	0.65	0.64	0.65	0.64	0.62
TX A&M U.	0.80	0.77	0.76	0.76	0.74	0.74	0.73	0.73	0.71	0.71	0.68	0.66	0.65	0.65
TX Tech U.	0.76	0.78	0.80	0.74	0.74	0.74	0.72	0.71	0.70	0.68	0.67	0.65	0.64	0.62
Thomas Jefferson U.	0.74	0.74	0.73	0.70	0.67	0.70	0.66	0.64	0.65	0.62	0.61	0.60	0.59	0.59
Tufts U.	0.63	0.63	0.61	0.61	0.60	0.65	0.65	0.65	0.63	0.63	0.61	0.61	0.58	0.58
Tulane U.	0.70	0.67	0.66	0.70	0.67	0.65	0.65	0.65	0.66	0.64	0.61	0.62	0.61	0.59
Uniformed Services U. of the Health Sciences	0.57	0.55	0.53	0.55	0.55	0.50	0.51	0.48	0.48	0.46	0.44	0.48	0.45	0.43
U. Akron	0.79	0.78	0.78	0.79	0.77	0.75	0.76	0.74	0.74	0.74	0.74	0.75	0.73	0.72
U. AL	0.71	0.70	0.73	0.67	0.72	0.72	0.72	0.67	0.70	0.69	0.71	0.65	0.57	0.64
U. AL Birmingham	0.73	0.71	0.71	0.69	0.70	0.68	0.66	0.65	0.62	0.62	0.62	0.62	0.62	0.61
U. AL Huntsville	0.67	0.66	0.69	0.64	0.70	0.64	0.65	0.61	0.53	0.51	0.49	0.45	0.50	0.50
U. AK Fairbanks	0.75	0.72	0.73	0.65	0.69	0.69	0.66	0.66	0.64	0.62	0.59	0.61	0.56	0.57
U. AZ	0.73	0.74	0.72	0.71	0.71	0.69	0.68	0.67	0.66	0.66	0.63	0.62	0.61	0.60
U. AR for Medical Sciences	0.65	0.64	0.62	0.61	0.60	0.63	0.58	0.56	0.60	0.61	0.60	0.61	0.57	0.55
U. AR, main campus	0.78	0.75	0.74	0.73	0.75	0.74	0.75	0.75	0.67	0.69	0.70	0.71	0.68	0.71
U. CA Berkeley	0.72	0.71	0.69	0.68	0.67	0.66	0.66	0.64	0.63	0.61	0.62	0.61	0.58	0.57
U. CA Davis	0.77	0.75	0.76	0.73	0.71	0.72	0.71	0.69	0.69	0.67	0.66	0.64	0.65	0.62
U. CA Irvine	0.74	0.73	0.71	0.68	0.68	0.67	0.67	0.66	0.66	0.65	0.64	0.61	0.63	0.61
U. CA Los Angeles	0.73	0.72	0.72	0.70	0.69	0.68	0.67	0.67	0.65	0.64	0.63	0.62	0.61	0.61
U. CA Riverside	0.78	0.78	0.76	0.75	0.74	0.72	0.75	0.68	0.67	0.66	0.65	0.65	0.64	0.61
U. CA San Diego	0.70	0.68	0.68	0.67	0.66	0.65	0.65	0.65	0.63	0.62	0.62	0.60	0.59	0.57
U. CA San Francisco	0.72	0.71	0.70	0.71	0.69	0.69	0.68	0.67	0.65	0.65	0.63	0.63	0.60	0.58
U. CA Santa Barbara	0.74	0.75	0.73	0.72	0.71	0.70	0.68	0.66	0.65	0.66	0.64	0.65	0.61	0.60
U. CA Santa Cruz	0.67	0.69	0.65	0.62	0.65	0.65	0.64	0.63	0.59	0.60	0.60	0.58	0.54	0.51
U. Central FL	0.75	0.75	0.77	0.73	0.70	0.68	0.66	0.66	0.65	0.65	0.64	0.65	0.65	0.61
U. Chicago	0.74	0.72	0.72	0.73	0.71	0.69	0.68	0.67	0.67	0.65	0.66	0.66	0.62	0.61
U. Cincinnati	0.74	0.73	0.73	0.71	0.70	0.70	0.68	0.66	0.63	0.65	0.63	0.63	0.62	0.58
U. CO	0.71	0.69	0.68	0.67	0.66	0.64	0.64	0.63	0.62	0.62	0.61	0.59	0.58	0.58
U. CT	0.73	0.71	0.72	0.71	0.72	0.70	0.69	0.68	0.68	0.66	0.66	0.67	0.63	0.64
U. Dayton	0.69	0.68	0.76	0.67	0.65	0.63	0.64	0.65	0.62	0.62	0.59	0.58	0.57	0.50
U. DE	0.74	0.77	0.73	0.73	0.70	0.71	0.69	0.69	0.67	0.65	0.65	0.65	0.62	0.63
U. FL	0.79	0.77	0.76	0.76	0.74	0.75	0.72	0.71	0.70	0.69	0.69	0.67	0.66	0.65
U. GA	0.77	0.75	0.76	0.74	0.74	0.73	0.74	0.73	0.70	0.71	0.71	0.68	0.66	0.65
U. HI Manoa	0.71	0.70	0.69	0.69	0.68	0.66	0.64	0.63	0.59	0.61	0.57	0.54	0.55	0.53
U. Houston	0.75	0.72	0.74	0.73	0.74	0.70	0.70	0.70	0.69	0.67	0.64	0.64	0.63	0.63
U. ID	0.75	0.76	0.74	0.71	0.78	0.71	0.71	0.69	0.68	0.67	0.67	0.66	0.66	0.61
U. IL Chicago	0.72	0.71	0.69	0.67	0.68	0.68	0.66	0.65	0.63	0.63	0.60	0.63	0.61	0.60

APPENDIX TABLE 19. Ratio of fractional to whole counts of S&E articles for top 200 research universities, by institution: 1988–2001

Academic institution	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
U. IL Urbana-Champaign	0.77	0.74	0.74	0.74	0.71	0.69	0.68	0.67	0.67	0.65	0.67	0.66	0.65	0.64
U. IA	0.76	0.77	0.76	0.75	0.72	0.73	0.70	0.69	0.70	0.70	0.68	0.68	0.65	0.64
U. KS	0.71	0.72	0.74	0.72	0.69	0.69	0.69	0.68	0.68	0.66	0.66	0.66	0.62	0.63
U. KY	0.77	0.75	0.76	0.76	0.72	0.73	0.73	0.74	0.71	0.72	0.69	0.70	0.67	0.66
U. LA at Lafayette	0.75	0.75	0.73	0.78	0.75	0.77	0.78	0.74	0.73	0.65	0.75	0.76	0.70	0.66
U. Louisville	0.78	0.76	0.75	0.75	0.74	0.70	0.69	0.70	0.70	0.67	0.69	0.66	0.64	0.62
U. ME	0.73	0.76	0.74	0.74	0.70	0.73	0.70	0.71	0.72	0.69	0.66	0.62	0.66	0.62
U. MD Baltimore	0.70	0.71	0.66	0.66	0.62	0.65	0.65	0.62	0.61	0.60	0.61	0.61	0.55	0.56
U. MD Baltimore County	0.72	0.72	0.68	0.67	0.65	0.67	0.70	0.66	0.66	0.63	0.60	0.60	0.60	0.54
U. MD Biotechnology Institute	na	na	na	na	na	na	0.47	0.49	0.44	0.41	0.44	0.45	0.43	0.45
U. MD Center for Environmental Science	0.60	0.64	0.63	0.64	0.62	0.66	0.60	0.59	0.58	0.53	0.61	0.60	0.62	0.57
U. MD College Park	0.70	0.69	0.69	0.68	0.65	0.64	0.61	0.60	0.60	0.58	0.59	0.58	0.56	0.56
U. MA	0.75	0.76	0.73	0.73	0.74	0.72	0.70	0.67	0.67	0.63	0.64	0.64	0.64	0.63
U. of Medicine and Dentistry NJ	0.69	0.69	0.69	0.70	0.71	0.69	0.67	0.67	0.67	0.66	0.63	0.63	0.62	0.60
U. Memphis	0.74	0.72	0.70	0.68	0.67	0.68	0.66	0.64	0.67	0.65	0.66	0.63	0.59	0.58
U. Miami	0.71	0.72	0.71	0.71	0.68	0.67	0.65	0.62	0.65	0.61	0.63	0.61	0.62	0.60
U. MI	0.76	0.75	0.75	0.74	0.73	0.72	0.71	0.68	0.68	0.67	0.66	0.66	0.63	0.63
U. MN	0.74	0.73	0.73	0.73	0.71	0.70	0.70	0.69	0.67	0.66	0.65	0.64	0.63	0.62
U. MS, all campuses	0.72	0.71	0.72	0.71	0.69	0.69	0.68	0.67	0.67	0.65	0.68	0.67	0.66	0.65
U. MO Columbia	0.74	0.73	0.76	0.73	0.74	0.73	0.74	0.73	0.70	0.71	0.70	0.69	0.68	0.67
U. MO Rolla	0.75	0.74	0.79	0.75	0.76	0.77	0.74	0.65	0.68	0.68	0.67	0.68	0.63	0.64
U. MT	0.79	0.73	0.76	0.67	0.66	0.65	0.75	0.62	0.65	0.64	0.68	0.62	0.64	0.68
U. NE Lincoln	0.77	0.75	0.74	0.73	0.72	0.74	0.75	0.71	0.72	0.69	0.70	0.70	0.66	0.65
U. NE Medical Center	0.75	0.74	0.73	0.73	0.71	0.68	0.68	0.68	0.68	0.65	0.63	0.62	0.60	0.59
U. NV Las Vegas	0.73	0.71	0.82	0.69	0.65	0.69	0.70	0.64	0.69	0.63	0.61	0.60	0.61	0.64
U. NV Reno	0.72	0.73	0.76	0.72	0.72	0.70	0.71	0.69	0.68	0.65	0.65	0.67	0.68	0.63
U. NH	0.70	0.72	0.70	0.69	0.65	0.64	0.59	0.64	0.60	0.57	0.54	0.58	0.56	0.52
U. NM	0.70	0.70	0.66	0.67	0.64	0.66	0.63	0.62	0.62	0.61	0.59	0.59	0.58	0.58
U. NC Chapel Hill	0.74	0.74	0.74	0.73	0.70	0.70	0.68	0.68	0.68	0.66	0.64	0.65	0.62	0.60
U. ND	0.69	0.73	0.69	0.69	0.70	0.76	0.74	0.70	0.67	0.64	0.66	0.60	0.59	0.63
U. North TX	0.78	0.72	0.70	0.71	0.71	0.72	0.73	0.72	0.67	0.67	0.68	0.69	0.67	0.65
U. Notre Dame	0.76	0.74	0.75	0.72	0.73	0.72	0.68	0.68	0.69	0.67	0.67	0.67	0.63	0.59
U. OK	0.72	0.72	0.71	0.68	0.68	0.66	0.64	0.66	0.63	0.63	0.63	0.62	0.60	0.58
U. OR	0.78	0.76	0.73	0.73	0.71	0.71	0.69	0.66	0.64	0.63	0.64	0.63	0.59	0.59
U. PA	0.70	0.70	0.68	0.68	0.67	0.67	0.67	0.65	0.64	0.64	0.64	0.64	0.62	0.61
U. Pittsburgh	0.73	0.74	0.72	0.72	0.71	0.70	0.68	0.68	0.69	0.69	0.66	0.66	0.63	0.59
U. PR Mayaguez	0.65	0.69	0.68	0.56	0.65	0.42	0.48	0.58	0.63	0.68	0.58	0.59	0.49	0.57
U. PR Medical Sciences Campus	0.69	0.68	0.69	0.64	0.67	0.59	0.58	0.61	0.58	0.50	0.52	0.50	0.56	0.50
U. RI	0.72	0.69	0.68	0.72	0.70	0.67	0.68	0.63	0.62	0.63	0.64	0.63	0.60	0.62
U. Rochester	0.77	0.73	0.76	0.74	0.71	0.68	0.70	0.70	0.67	0.69	0.68	0.68	0.62	0.60
U. SC	0.70	0.70	0.71	0.72	0.71	0.73	0.68	0.66	0.67	0.68	0.64	0.65	0.63	0.60
U. Southern CA	0.72	0.74	0.73	0.72	0.70	0.70	0.68	0.68	0.66	0.65	0.63	0.63	0.62	0.60

APPENDIX TABLE 19. Ratio of fractional to whole counts of S&E articles for top 200 research universities, by institution: 1988–2001

Academic institution	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
U. South FL	0.71	0.68	0.69	0.70	0.71	0.67	0.68	0.68	0.64	0.65	0.64	0.64	0.63	0.62
U. TN System	0.65	0.67	0.66	0.65	0.64	0.62	0.61	0.62	0.60	0.60	0.60	0.58	0.57	0.55
U. TX Arlington	0.78	0.78	0.74	0.71	0.73	0.71	0.70	0.73	0.72	0.71	0.69	0.71	0.59	0.57
U. TX Austin	0.77	0.77	0.76	0.74	0.75	0.73	0.72	0.71	0.69	0.69	0.69	0.68	0.65	0.63
U. TX Dallas	0.72	0.73	0.67	0.70	0.68	0.68	0.62	0.67	0.59	0.60	0.60	0.61	0.57	0.50
U. TX El Paso	0.71	0.70	0.72	0.72	0.72	0.74	0.67	0.71	0.67	0.69	0.67	0.64	0.64	0.57
U. TX Health Science Center Houston	0.75	0.76	0.73	0.73	0.70	0.71	0.71	0.69	0.67	0.66	0.66	0.64	0.63	0.62
U. TX Health Science Center San Antonio	0.68	0.69	0.67	0.68	0.65	0.65	0.61	0.63	0.63	0.63	0.56	0.60	0.58	0.56
U. TX Medical Branch Galveston	0.75	0.78	0.76	0.75	0.73	0.72	0.72	0.73	0.71	0.70	0.70	0.68	0.67	0.64
U. TX Southwestern Medical Center Dallas	0.75	0.72	0.74	0.75	0.68	0.69	0.71	0.69	0.66	0.65	0.65	0.65	0.62	0.61
U. UT	0.77	0.73	0.73	0.72	0.71	0.70	0.67	0.67	0.64	0.65	0.64	0.63	0.64	0.63
U. VA	0.79	0.77	0.77	0.76	0.74	0.72	0.71	0.69	0.70	0.68	0.68	0.66	0.66	0.63
U. VT	0.74	0.75	0.77	0.75	0.73	0.71	0.71	0.69	0.67	0.66	0.65	0.67	0.66	0.65
U. WA	0.72	0.72	0.70	0.69	0.69	0.67	0.66	0.65	0.64	0.64	0.63	0.63	0.60	0.60
U. WI Madison	0.78	0.77	0.77	0.74	0.74	0.74	0.73	0.71	0.70	0.70	0.68	0.67	0.65	0.63
U. WI Milwaukee	0.74	0.75	0.75	0.77	0.71	0.72	0.74	0.71	0.72	0.71	0.70	0.67	0.68	0.66
U. WY	0.71	0.71	0.68	0.71	0.71	0.71	0.72	0.70	0.68	0.66	0.64	0.64	0.65	0.60
Utah State U.	0.72	0.74	0.71	0.70	0.71	0.70	0.69	0.69	0.71	0.72	0.65	0.67	0.63	0.66
Vanderbilt U.	0.74	0.73	0.73	0.71	0.69	0.66	0.65	0.65	0.67	0.64	0.62	0.62	0.60	0.59
VA Commonwealth U.	0.76	0.76	0.73	0.73	0.75	0.71	0.70	0.71	0.68	0.68	0.67	0.65	0.66	0.64
VA Polytech Institute and State U.	0.78	0.78	0.78	0.77	0.76	0.79	0.73	0.71	0.70	0.70	0.69	0.66	0.63	0.60
Wake Forest U.	0.77	0.83	0.77	0.76	0.71	0.71	0.70	0.69	0.66	0.67	0.64	0.66	0.63	0.60
WA State U.	0.79	0.76	0.76	0.74	0.73	0.73	0.72	0.71	0.71	0.68	0.67	0.66	0.65	0.66
Washington U. St Louis	0.77	0.76	0.74	0.73	0.72	0.70	0.69	0.70	0.70	0.69	0.66	0.66	0.62	0.63
Wayne State U.	0.70	0.70	0.71	0.70	0.70	0.68	0.68	0.66	0.66	0.62	0.64	0.64	0.62	0.60
WV U.	0.74	0.74	0.72	0.73	0.71	0.76	0.72	0.71	0.70	0.73	0.70	0.69	0.68	0.66
Wright State U.	0.69	0.70	0.72	0.66	0.68	0.72	0.69	0.64	0.64	0.64	0.66	0.59	0.65	0.62
Yale U.	0.74	0.74	0.71	0.73	0.71	0.71	0.68	0.68	0.66	0.67	0.67	0.64	0.63	0.61
Yeshiva U.	0.68	0.66	0.67	0.66	0.67	0.65	0.65	0.64	0.64	0.61	0.63	0.60	0.57	0.59

S&E = science and engineering.

NOTES: For articles with collaborating institutions, fractional counts assign each participating institution fractional credit on basis of proportion of its participation, and whole counts assign each participating institution one credit for its participation. Ratio measures collaboration trends, where a lower ratio signifies more collaboration. Top 200 research universities based on total R&D expenditures during the 1988 –2001 period.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

APPENDIX TABLE 20. S&E article output (whole counts) of top 200 research universities, by field and institutional author type: 1988–2001

Institutional author type and field	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Single author														
All fields	21,622	22,096	21,905	21,242	21,336	20,705	20,055	19,540	19,412	18,353	18,112	18,267	18,132	17,519
Agricultural sciences	280	286	254	275	239	234	218	190	203	172	181	150	170	168
Astronomy	236	223	215	217	260	192	240	239	261	234	185	216	215	169
Biological sciences	3,482	3,436	3,472	3,204	3,279	3,171	3,052	3,031	2,838	2,618	2,563	2,480	2,486	2,444
Chemistry	630	661	689	682	648	639	606	543	575	534	472	475	487	510
Computer science	284	297	306	307	277	322	280	260	296	226	182	217	233	222
Engineering	1,013	985	994	907	1,111	899	926	903	740	695	678	749	682	676
Geosciences	1,005	993	952	974	895	937	812	891	869	770	683	639	651	632
Mathematics	1,619	1,611	1,285	1,295	1,326	1,235	1,208	1,133	1,132	1,064	1,135	1,151	1,146	1,192
Medical sciences	3,182	3,217	3,305	3,212	3,376	3,337	3,304	3,093	2,971	3,044	3,068	3,055	3,067	2,765
Physics	1,671	1,686	1,690	1,700	1,615	1,513	1,768	1,580	1,464	1,486	1,535	1,456	1,385	1,367
Psychology	1,536	1,411	1,526	1,369	1,428	1,189	1,188	1,246	1,316	1,146	1,006	1,034	1,038	1,048
Social sciences	3,651	3,903	3,801	3,793	3,583	3,719	3,546	3,454	3,517	3,520	3,486	3,617	3,567	3,488
Single institution-multiple authors														
Single department-multiple authors														
All fields	42,710	45,092	45,865	45,337	46,311	45,734	46,215	46,274	45,374	43,812	43,845	42,759	41,232	41,630
Agricultural sciences	1,419	1,390	1,539	1,525	1,285	1,293	1,224	1,118	1,037	1,070	1,073	798	1,045	851
Astronomy	266	270	273	229	268	264	322	346	342	313	232	366	261	320
Biological sciences	12,712	13,450	13,456	13,369	13,294	12,954	13,114	12,915	12,627	12,036	12,154	11,563	11,284	11,441
Chemistry	5,366	5,397	5,612	5,619	5,758	5,885	5,574	5,647	5,626	5,491	5,592	5,528	5,503	5,307
Computer science	282	337	334	313	362	372	431	393	386	380	373	376	397	404
Engineering	2,787	2,916	3,284	3,077	3,581	3,323	3,438	3,527	3,459	3,205	3,263	3,334	2,966	3,254
Geosciences	1,662	1,824	1,838	1,796	1,777	2,046	2,045	2,142	2,172	1,984	2,088	1,997	1,946	2,024
Mathematics	451	505	397	419	449	443	441	424	392	371	460	450	505	441
Medical sciences	9,630	10,233	10,424	10,256	10,718	10,313	10,473	10,697	10,191	10,326	9,967	9,892	9,526	9,564
Physics	4,401	4,860	4,643	4,762	4,783	4,784	4,992	4,826	4,614	4,198	4,164	4,053	3,615	3,686
Psychology	1,694	1,751	1,821	1,688	1,725	1,702	1,758	1,864	1,943	2,029	1,914	1,888	1,769	1,850
Social sciences	805	883	948	963	979	1,003	994	946	1,051	963	1,105	1,036	1,041	1,044
Single institution-multiple departments														
All fields	19,325	20,359	21,005	21,696	22,231	21,790	22,081	22,611	22,538	22,283	21,949	21,708	21,268	21,859
Agricultural sciences	484	512	539	573	461	470	477	457	439	468	401	338	415	377
Astronomy	86	87	87	82	108	93	95	77	99	101	62	95	81	81
Biological sciences	6,395	6,901	7,119	7,439	7,625	7,690	7,768	7,870	7,993	7,857	7,741	7,608	7,353	7,652
Chemistry	865	920	980	1,124	1,144	1,142	1,084	1,177	1,182	1,088	1,128	1,143	1,164	1,231
Computer science	66	83	95	92	98	84	117	103	82	68	74	96	101	85
Engineering	503	483	589	585	704	668	705	689	668	648	666	694	722	769
Geosciences	471	465	483	476	525	561	566	528	598	515	566	579	610	555
Mathematics	78	101	93	94	104	99	79	77	97	81	75	100	103	75
Medical sciences	7,795	8,186	8,399	8,283	8,547	8,317	8,340	8,841	8,740	8,863	8,651	8,493	8,160	8,410
Physics	1,430	1,531	1,491	1,752	1,680	1,701	1,788	1,633	1,531	1,413	1,422	1,473	1,370	1,375
Psychology	364	311	328	347	376	289	336	394	377	400	384	402	389	439
Social sciences	355	371	361	387	407	309	325	340	320	336	315	318	361	367

APPENDIX TABLE 20. S&E article output (whole counts) of top 200 research universities, by field and institutional author type: 1988–2001

Institutional author type and field	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Multiple institutions														
More than one top 200 institution														
All fields	11,122	12,086	12,486	13,033	13,474	13,397	13,892	14,230	14,840	14,592	14,840	15,038	15,527	16,413
Agricultural sciences	299	302	264	292	265	281	269	242	239	257	238	191	279	220
Astronomy	133	145	154	164	160	169	172	198	173	196	114	202	164	192
Biological sciences	2,923	3,170	3,360	3,486	3,698	3,687	3,886	3,912	4,161	4,079	4,191	4,173	4,371	4,684
Chemistry	450	523	556	549	531	583	548	602	677	632	713	659	757	728
Computer science	139	193	166	169	175	181	204	200	174	168	185	174	184	190
Engineering	447	460	514	513	623	541	602	569	552	510	515	613	616	739
Geosciences	439	513	525	569	568	613	617	650	715	632	678	733	717	695
Mathematics	454	489	409	430	459	419	463	426	428	403	477	478	499	439
Medical sciences	2,680	2,901	3,013	3,090	3,233	3,186	3,414	3,506	3,582	3,687	3,790	3,873	3,804	4,183
Physics	865	912	911	1,039	998	1,037	1,101	1,123	1,132	1,101	1,067	989	1,022	1,031
Psychology	672	669	763	722	838	701	723	862	897	893	897	1,019	957	1,079
Social sciences	723	831	878	941	906	880	833	861	994	926	895	862	969	966
Top 200 institution(s) and other U.S. institution(s)														
All fields	29,753	31,160	32,483	33,067	34,666	34,423	35,595	37,048	37,276	37,224	37,515	38,098	37,814	39,218
Agricultural sciences	619	610	644	653	627	596	609	628	564	675	627	548	689	599
Astronomy	370	383	427	424	438	467	510	541	550	538	367	540	520	559
Biological sciences	7,319	8,204	8,452	8,806	9,392	9,130	9,708	10,163	9,916	9,773	9,883	9,923	9,731	10,225
Chemistry	1,101	1,141	1,272	1,472	1,446	1,486	1,533	1,635	1,689	1,635	1,636	1,634	1,731	1,621
Computer science	181	230	197	275	262	296	327	317	337	419	420	448	424	446
Engineering	1,380	1,355	1,656	1,618	1,941	1,679	1,851	1,932	1,798	2,031	2,095	2,154	2,039	2,265
Geosciences	1,201	1,213	1,433	1,372	1,462	1,621	1,647	1,887	1,871	1,926	2,108	2,187	2,142	2,232
Mathematics	285	308	281	289	284	319	294	306	303	270	325	304	356	354
Medical sciences	11,356	11,713	11,810	11,711	12,146	12,206	12,539	12,715	12,775	12,747	13,053	13,188	13,081	13,715
Physics	2,536	2,587	2,755	2,971	3,072	2,986	3,000	2,977	3,022	2,937	2,728	2,922	2,706	2,728
Psychology	1,113	1,131	1,165	1,137	1,182	1,145	1,153	1,329	1,519	1,450	1,400	1,450	1,399	1,444
Social sciences	990	957	1,024	982	1,066	1,037	1,057	1,124	1,165	1,169	1,141	1,053	1,208	1,219
Top 200 institution(s) and foreign institution(s)														
All fields	11,832	13,242	14,283	15,946	17,762	18,392	20,021	21,495	22,703	23,786	25,391	27,020	28,126	30,545
Agricultural sciences	234	286	293	328	294	341	333	320	347	374	402	369	517	451
Astronomy	274	291	323	370	440	447	531	560	652	637	601	800	797	923
Biological sciences	3,335	3,702	4,132	4,498	4,994	5,238	5,622	6,098	6,342	6,455	7,053	7,502	7,595	8,307
Chemistry	925	1,019	1,143	1,280	1,415	1,471	1,513	1,584	1,692	1,799	1,907	1,957	2,061	2,182
Computer science	143	144	116	169	183	196	287	300	321	345	379	371	386	430
Engineering	665	757	874	918	1,012	1,021	1,098	1,218	1,208	1,309	1,453	1,615	1,674	2,026
Geosciences	627	721	770	869	949	966	1,038	1,179	1,299	1,304	1,419	1,520	1,665	1,778
Mathematics	715	752	657	701	852	776	783	784	915	864	1,033	1,151	1,232	1,297
Medical sciences	2,051	2,404	2,546	2,850	3,299	3,406	3,758	4,085	4,254	4,663	5,123	5,465	5,653	6,239
Physics	1,862	2,085	2,244	2,798	3,008	3,160	3,632	3,774	3,910	4,152	4,231	4,407	4,578	4,742
Psychology	258	306	309	311	346	339	360	462	481	541	540	601	554	664

APPENDIX TABLE 20. S&E article output (whole counts) of top 200 research universities, by field and institutional author type: 1988–2001

Institutional author type and field	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Social sciences	488	498	570	544	634	668	681	697	777	776	728	777	775	899
Top 200 institution(s), other U.S. institution(s), and foreign institution(s)														
All fields	2,512	2,839	3,244	3,700	4,413	4,952	5,445	5,959	6,472	6,831	7,353	7,954	8,376	9,378
Agricultural sciences	30	38	39	37	33	45	64	50	51	48	76	66	79	82
Astronomy	116	138	176	203	215	238	335	363	437	447	352	566	532	605
Biological sciences	737	818	975	1,098	1,325	1,490	1,578	1,803	1,864	1,886	2,135	2,339	2,434	2,648
Chemistry	102	104	139	145	169	181	211	251	268	258	274	309	280	379
Computer science	21	30	25	28	49	46	50	56	52	61	93	83	75	95
Engineering	84	109	99	135	179	179	177	221	198	238	250	296	317	377
Geosciences	143	173	206	214	231	291	293	347	455	436	553	496	553	612
Mathematics	32	31	36	44	53	59	50	47	44	56	57	83	77	105
Medical sciences	683	750	812	942	1,131	1,241	1,449	1,495	1,634	1,887	1,964	2,062	2,331	2,569
Physics	451	507	586	693	843	1,001	1,022	1,091	1,180	1,235	1,310	1,369	1,382	1,538
Psychology	47	42	43	44	59	63	60	65	94	80	108	97	96	128
Social sciences	37	59		69	82	77	100	98	112	111	105	106	127	134

S&E = science and engineering.

NOTES: Articles on whole-count basis, i.e., for articles with collaborating institutions, the combined group of top 200 research universities receives one credit for participation, regardless of the number of participating institutions. "All fields" includes health sciences and professional fields. Top 200 research universities based on total R&D expenditures during the 1988–2001 period.

SOURCES: Thomson ISI, *Science Citation Index* and *Social Sciences Citation Index,* http://www.isinet.com/products/citation/; ipIQ, Inc.; and National Science Foundation, Division of Science Resources Statistics, special tabulations.