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ABSTRACT

State Governments throughout the country have taken steps to strengthen their economic bases by promoting growth of high-technology industries within their respective borders. A byproduct of this effort has been an increasing need for information on the geographic distribution of industrial research and development (R&D) activities in terms of expenditures and employed scientists and engineers. This report contributes to meeting this need by providing information on U.S. industrial expenditures for R&D by geographic region and by selected States. The information in this report permits more detailed analysis of company-financed R&D activities, federally supported industrial R&D programs, and R&D funding growth-rates among states of similar size or within the same geographic region. The principal source of data contained herein is the National Science Foundation's (NSF's) annual Survey of Industrial Research and Development. Detailed statistical tables are provided in the appendices. (CW)

geographic distribution of industrial r&d expenditures

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foreword

In recent years, State Governments throughout the country have taken steps to strengthen their economic bases by promoting growth of high-technology industries within their respective borders. A byproduct of this effort has been an increasing need for information on the geographic distribution of industrial research and development (R&D) activities in terms of expenditures and employed scientists and engineers.

This report contributes to meeting this need by providing information on U.S. industrial expenditures for research and development by geographic region and by selected States. The information in this report—much of which is being presented for the first time—permits more detailed analysis of company-financed R&D activities, federally supported industrial R&D programs, and R&D funding growth rates among States of similar size or within the same geographic region. The principal source of data contained herein is the National Science Foundation's (NSF's) annual Survey of Industrial Research and Development.

NSF staff members wish to express their appreciation for the valuable assistance provided over the years by companies throughout the country. As the leading performer of research and development in the United States, industry's willingness to supply information annually on its R&D activities is vital to national—and now State—science and technology policy formulation.

William L. Stewart, Director
Division of Science
Resources Studies
Directorate for Scientific,
Technological, and
International Affairs

May 1988

acknowledgments

This report was prepared within NSF's Division of Science Resources Studies by Melissa Pollak, Science Resources Analyst, Industry Studies Group. Stephen W.C. Lowe, of the Surveys and Analysis Section, prepared the charts.

Supervision, review, and guidance were provided by Thomas J. Hogan, Study Director, Industry Studies Group; Charles H. Dickens, Head, Surveys and Analysis Section; and William L. Stewart, Director, Division of Science Resources Studies.

Steve Andrews of the Center for Economic Statistics, and Patricia Garner and William Grubb of the Special Projects Branch, U.S. Bureau of the Census, prepared the statistical data.

contents

highlights

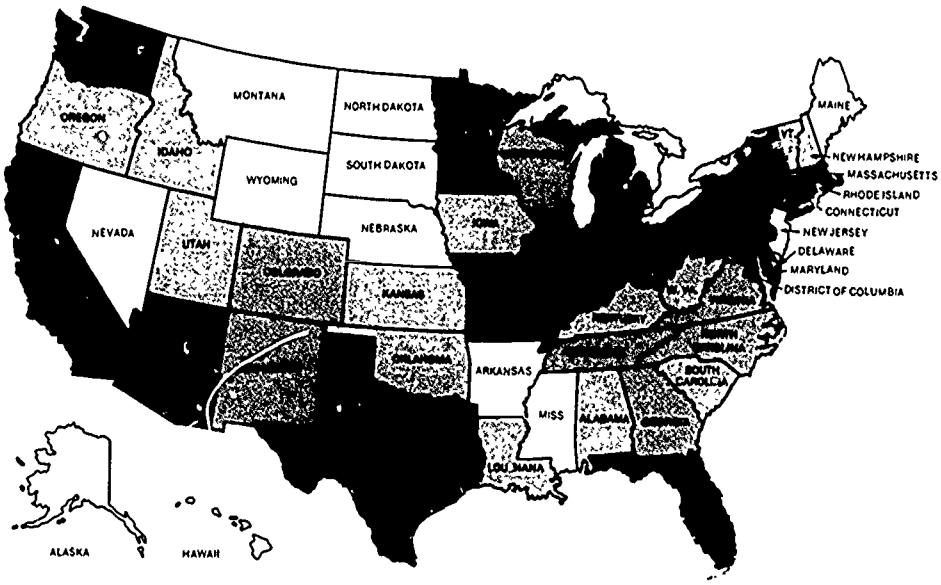
state distribution of industrial r&d expenditures

- Ten States had total[1] industrial R&D outlays exceeding $2 billion in 1985: California, New York, Michigan, New Jersey, Massachusetts, Pennsylvania, Texas, Illinois, Ohio, and Washington. Approximately three-fourths of the total amount spent on R&D by U.S. industry in 1985[2] financed projects undertaken in these 10 States (chart 1); more than one-half was spent in the first 5 of these States.

[1]"Total" industrial R&D expenditures includes both companies' own *and* Federal funds provided to firms for performing R&D.

[2]The most recent data on the geographic distribution of industrial R&D expenditures are for 1985. Updated data for 1987 will be available in September 1989.

Chart 1. Size of industrial R&D expenditures by State: 1985



■ > $2 billion ■ $1-2 billion ⊡ $500 million-1 billion
⊡ $50 - $500 million □ Less than $75 million

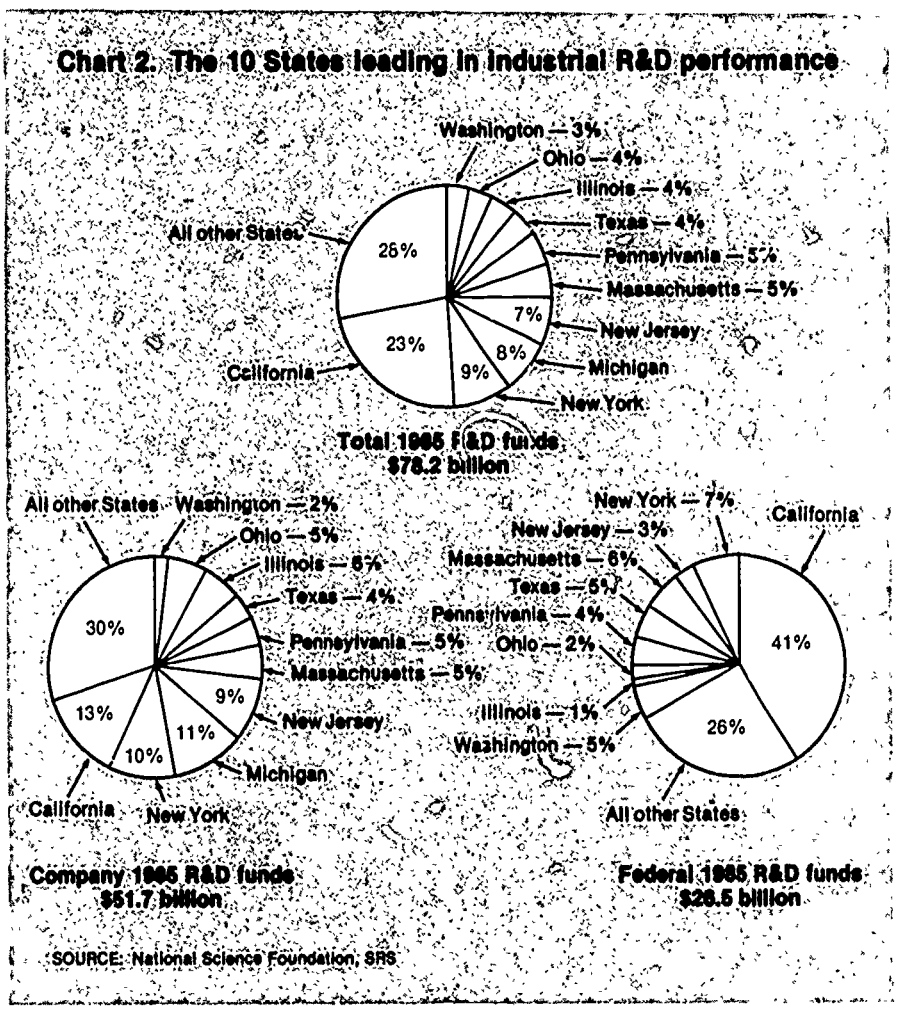
SOURCE: National Science Foundation, SRS

- California had 23 percent of total U.S. industrial R&D spending in 1985 and had the largest amounts of both companies' own and Federal funds, $6.9 billion and $10.8 billion, respectively. Forty-one percent of the total amount of Federal R&D funds received by industry in 1985 was spent in California (chart 2) where the Nation's largest defense contractors are located.

industrial r&d spending growth rates

- In 13 States, total industrial R&D expenditures increased at average annual constant-dollar rates exceeding 10 percent between 1981 and 1985.[3] In contrast, total U.S. industrial R&D spending increased at an average annual rate of 6.2 percent during this period. Four of these States—New York, Massachusetts. Texas, and Ohio—had more than $2 billion in industrial R&D expenditures (charts 3 and 4); two—Minnesota and Maryland—had $1 billion to $2 billion; seven—New Hampshire, Rhode Island, Delaware, South Carolina, Georgia, Alabama, and Colorado—had less than $1

[3]All percentage changes in this report are given in constant 1982 dollars. The gross national product (GNP) implicit price deflator was used to convert current to constant dollars.



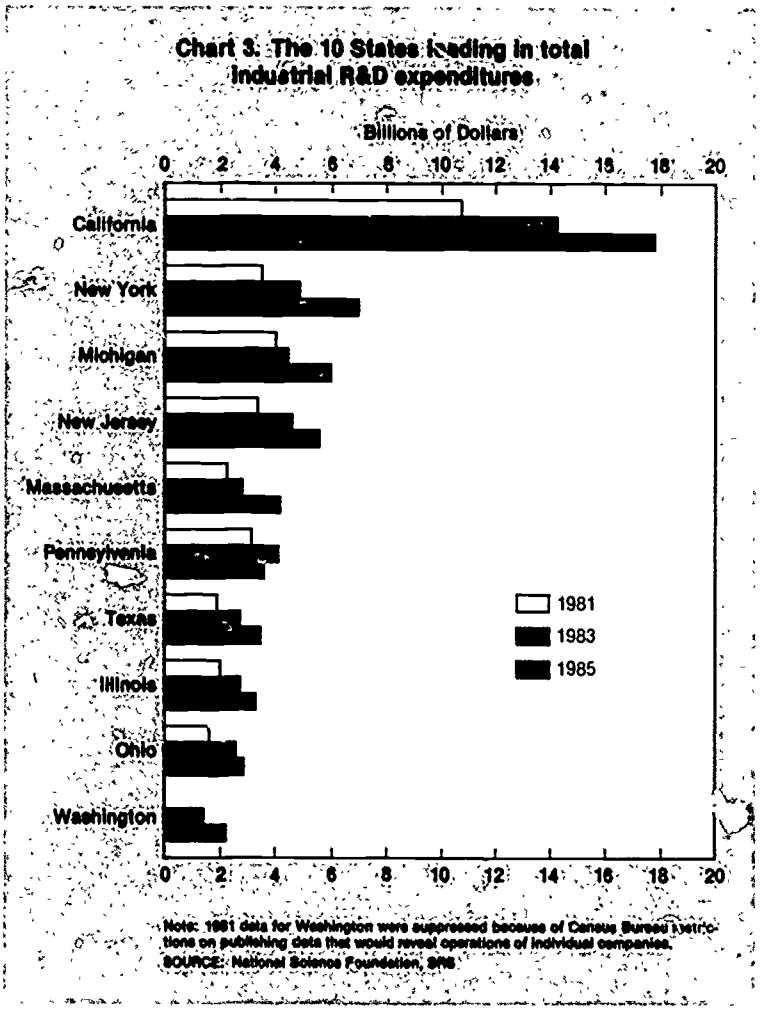


Chart 3. The 10 States leading in total industrial R&D expenditures
Billions of Dollars
0 2 4 6 8 10 12 14 16 18 20
California
New York
Michigan
New Jersey
Massachusetts
Pennsylvania
Texas
Illinois
Ohio
Washington
1981
1983
1985
0 2 4 6 8 10 12 14 16 18 20
Note: 1981 data for Washington were suppressed because of Census Bureau restrictions on publishing data that would reveal operations of individual companies.
SOURCE: National Science Foundation, SRS

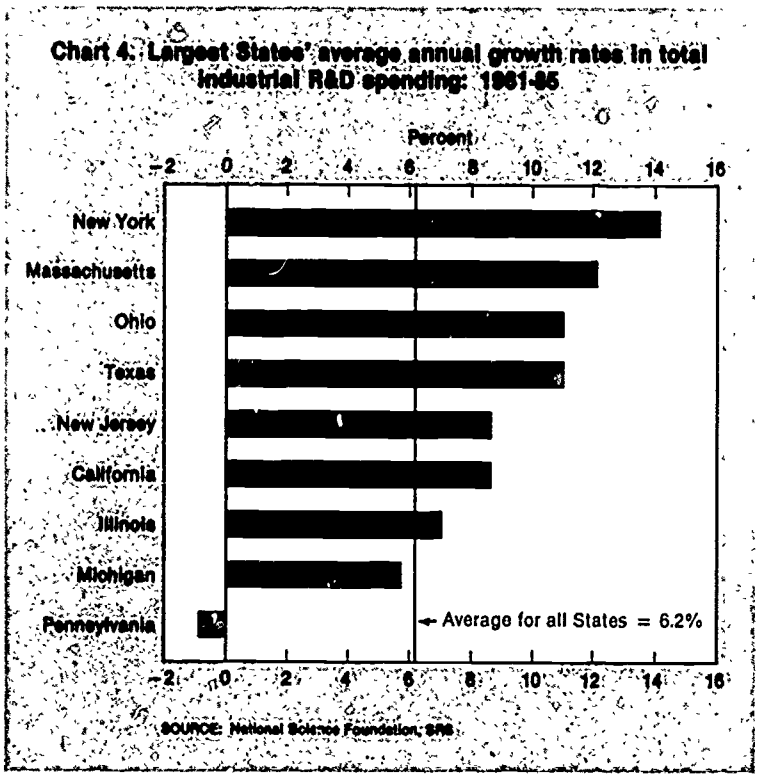


Chart 4. Largest States' average annual growth rates in total industrial R&D spending: 1981-85
Percent
-2 0 2 4 6 8 10 12 14 16
New York
Massachusetts
Ohio
Texas
New Jersey
California
Illinois
Michigan
Pennsylvania
Average for all States = 6.2%
-2 0 2 4 6 8 10 12 14 16
SOURCE: National Science Foundation, SRS

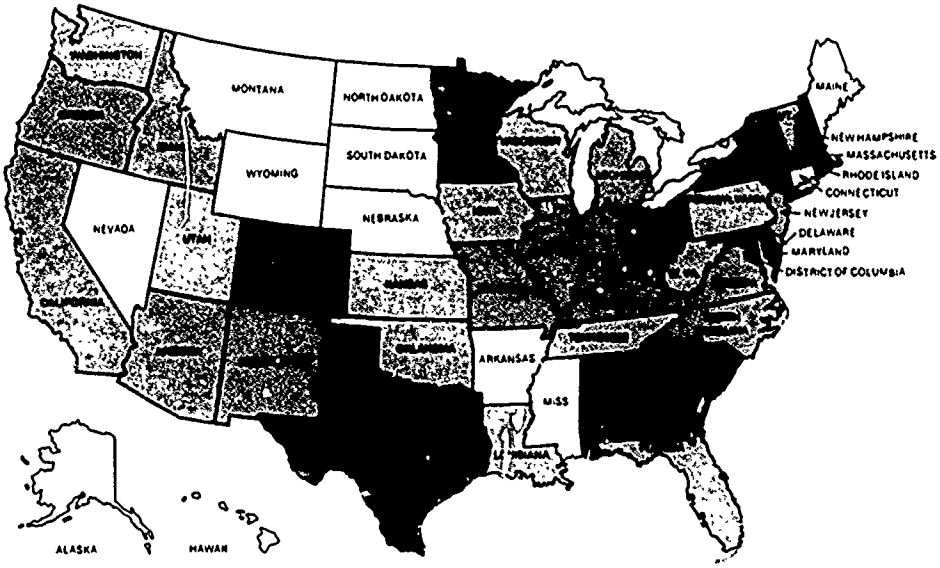
billion. New York, at 14.1 percent, had the highest average annual constant-dollar increase among the first four States. South Carolina, Alabama, and Maryland had average annual growth rates in total industrial R&D expenditures exceeding 20 percent (chart 5).

- Four States—Pennsylvania, Wisconsin, Iowa, and West Virginia—had average annual decreases in industrial R&D spending between 1981 and 1985. Iowa had the largest decrease—5.4 percent per year. Industry undertakes only a relatively small amount of R&D (less than $700 million) in Wisconsin, Iowa, and West Virginia. Pennsylvania, with a 0.8-percent average annual decline, dropped in ranking, from fifth to sixth, in terms of total industrial R&D performance during this period.

companies' own r&d expenditures

- The four States with the highest levels of companies' own R&D funding—California, Michigan, New York, and New Jersey—also had the largest gains in these expenditures between 1981 and 1985. These increases ranged from about $2.8 billion in California to $2.0 billion each in New York, Michigan, and New Jersey. California, New York, and New Jersey had average annual percentage increases of 8.0 percent to 9.0 percent, whereas Michigan's was somewhat lower—about 5.7 percent—between 1981 and 1985. In comparison, the average for all States was 5.3 percent.

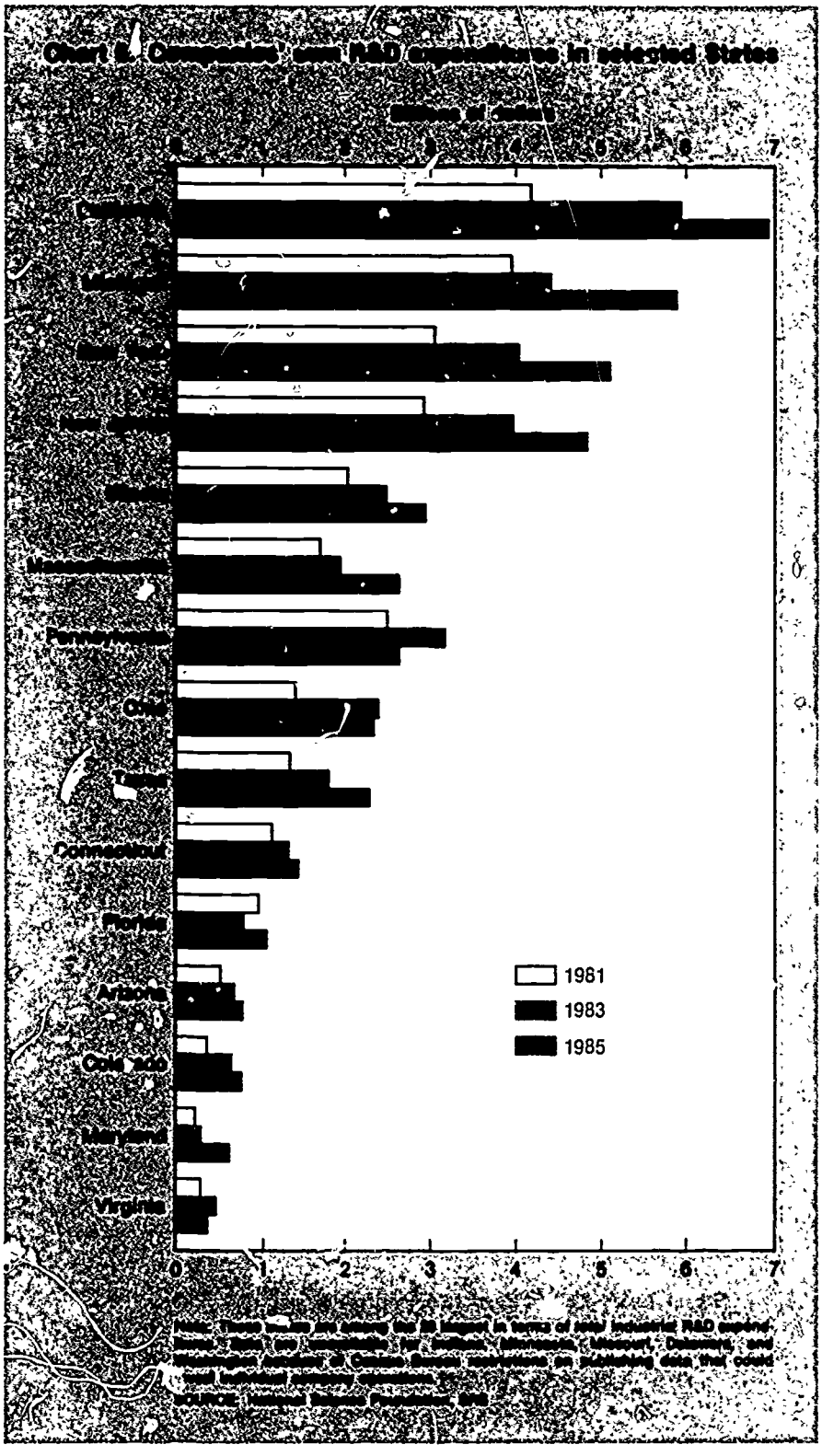
Chart 5. Average annual constant-dollar growth rates in total industrial R&D expenditures by State: 1981-85



■ > 20% ▩ 10 - 20% □ 2 - 10% □ < 2% □ Less than $75 million

SOURCE: National Science Foundation, SRS

- Growth in spending on R&D projects undertaken in California, Michigan, New York, and New Jersey accounted for over one-half of the United States' $16.3-billion increase in companies' own R&D funding between 1981 and 1985.
- Among the 20 States with the largest amounts of total industial R&D expenditures (table 2), Maryland had the highest average annual percentage increase, 24.3 percent, in companies' own R&D spending between 1981 and 1985, followed by Minnesota, Missouri, Delaware, and Colorado with increases ranging from 14 percent to 18 percent. California and Texas both had increases of around 9.0 percent (chart 6).



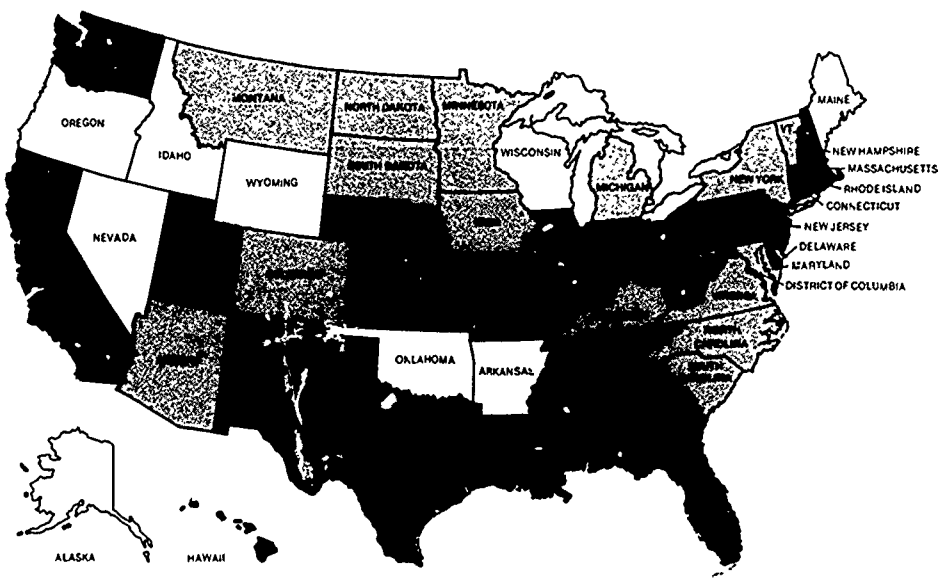
federal funding of industrial R&D

- Companies spent more than $1 billion in Federal R&D funds in each of six States—California, New York, Massachusetts, Washington, Texas, and Pennsylvania—in 1985. Of these States, California had the largest absolute increase ($4.2 billion) in Federal support of industrial R&D activities between 1981 and 1985; New York had the largest percentage increase (38 percent).
- In 11 States—5 in the West, 4 in the South, and 2 in the Northeast—industry spends more Federal than companies' own funds on R&D. These States are New Hampshire, Rhode Island, Maryland, Virginia, Tennessee, Alabama, Idaho, New Mexico, Washington, California, and Hawaii. Federal funding of industry-performed R&D activities, therefore, is the major determinant of these States' industrial R&D spending growth rates.
- In 12 States (Maine, North Dakota, South Dakota, Delaware, West Virginia, North Carolina, Kentucky, Arkansas, Oklahoma, Montana, Wyoming, and Alaska) and the District of Columbia, industry spends less than $2 million in Federal funds on R&D. Survey respondents reported no Federal support of industrial R&D activities in most of these States.

leading r&d-performing industries

- The leading R&D-performing industries, by size of total 1985 R&D expenditures, are: aircraft and missiles (SIC 372 and 376), $17.6 billion; electrical equipment (SIC 36), $17.1 billion; machinery (including computers) (SIC 35), $10.9 billion; chemicals and allied products (SIC 28), $8.7 billion; and motor vehicles (SIC 371), $7.1 billion. Firms in these industries account for approximately three-fourths of all R&D dollars spent in the United States by the industrial sector.
- Companies in two of the five major industries (aircraft and missiles and motor vehicles) spend over one-half of their total R&D expenditures within a single State. In contrast, R&D outlays of firms in the electrical equipment, machinery (including computers), and chemicals industries are spread over many States.
- In 1985, almost 60 percent of aircraft and missiles companies' R&D expenditures were made in California. Over 85 percent of these funds were Federal monies. Although most of its R&D expenditures are made in California, it is interesting to note that the aircraft and missiles industry leads other industries in terms of R&D performance in many other States, especially in the South and West (chart 7).

Chart 7. States' leading R&D-performing industries: 1985



■ Aircraft and missiles ■ Electrical equipment ■ Chemicals
▨ Machinery ▨ Motor vehicles □ Other industries

SOURCE: National Science Foundation, SRS

- Approximately 70 percent of R&D expenditures in the motor vehicles industry supported projects undertaken in Michigan in 1985. These R&D activities were internally financed. As in the aircraft and missiles industry, Federal R&D funds reported by automotive companies supported defense-related projects undertaken primarily in California.
- Firms in the electrical equipment industry have the highest level of R&D expenditures (including both companies' own and Federal funds) in 6 of the 10 States leading in total industrial R&D performance (chart 7). These States are New Jersey, Massachusetts, Texas, Pennsylvania, Illinois, and Ohio. The electrical equipment industry ranks second in California, New York, and Washington, 3 more of the 10 leading States.
- Companies in the electrical equipment industry spent more than $1 billion of both their own and Federal funds on R&D in each of six States: California, New York, New Jersey, Pennsylvania, Massachusetts, and Illinois. More than 60 percent of this industry's total R&D expenditures was spent in these six States. New Jersey is the leading State in terms of R&D spending by the electrical equipment industry; companies in this industry spent $2.9 billion on R&D activities. In New York, electrical equipment companies increased their R&D spending at an average annual rate of 22.4 percent between 1981 and 1985, the highest growth rate among the 10 leading States for this industry. Most of this gain can be attributed to an acceleration in R&D funds from Federal agencies.
- The chemicals industry did not have the highest amount of R&D spending in any of the 10 leading States; it did, however, rank second in 4 States (Michigan, New Jersey, Pennsylvania, and Ohio). Chemicals companies spent more on R&D in New Jersey—$1.3 billion in 1985—than in any other State. Almost all of these funds were companies' own; most were spent by firms in the industry's drugs and medicines segment. New Jersey is the leading State in terms of R&D expenditures by the pharmaceutical industry.

introduction

The purpose of this report is to provide information on industry's R&D expenditures by State and geographic region. The data herein should prove valuable to State policy planners as they weigh various options for new legislation and/or programs, e.g., the establishment of State-supported technology centers, tax incentives, or additional support of science and engineering education.[4]

Policymakers and legislators at both the national and State levels are concerned about the welfare of U.S. industry. There could be a reversal of the recent downward trend in unemployment rates if domestic firms are unable to match or exceed the performance of their foreign rivals. U.S. leadership in science and technology is no longer undisputed. Domestic companies are striving to compete successfully with those in other industrialized nations by developing new and improved products and services based on advances in such fields as robotics, information processing, and laser technologies. As a result of these efforts and the effects of international trade, major changes have been occurring in the composition of the U.S. industrial sector. For example, manufacturing has been steadily losing its dominance in the U.S. economy. Smokestack industries are declining or modernizing. Furthermore, new industries—many of them in the nonmanufacturing sector—are evolving from successful commercial applications of state-of-the-art technologies.

The focus of this report is industry, because, of the three R&D-performing sectors—industry, the Federal Government, and universities and colleges—industry is by far the largest. Approximately three-fourths of the R&D expenditures in the United States are by firms. One-third of those expenditures are from Federal sources.[5]

[4]Several organizations—including the National Governor's Association, the U S Office of Technology Assessment, and SRI International—have prepared compilations of States' programs designed to attract high-technology development.

[5]In addition to financing the R&D activities it undertakes, a sector may also receive R&D support from another sector. For example, companies' own funds account for approximately two-thirds of the total amount industry spends to perform R&D; Federal agencies provide the rest.

NSF's annual Survey of Industrial Research and Development is the only source of data on U.S. industry's R&D expenditures by State.[6] The survey is used to gather overall data on R&D funding, including the total amount spent on R&D; the amount, if any, of those funds received from Federal agencies; and the allocation of R&D expenditures by State. This report contains geographic data for 1981, 1983, and 1985. Detailed data that show R&D expenditures at the individual industry level by State are not available for earlier years.

Industry is both the largest *performer* of R&D and the largest *source* of R&D funding in the United States (chart 8). Industry spent $78.2 billion ($26.5 billion of those funds from Federal agencies) to *perform* R&D in 1985. More than one-half of all Federal funds supporting R&D activities in the United States are spent by industry (chart 9).

[6]Geographic data on R&D performance by the remaining two sectors—universities and colleges and the Federal Government—are available from the Universities and Colleges Studies Group and the Government Studies Group, respectively, of the Division of Science Resources Studies. R&D expenditure data on all sectors are published in National Science Foundation, *National Patterns of Science and Technology Resources. 1987* (NSF 88-305) (Washington, D.C., 1988). In addition, "State profiles" are available from the Economic Analysis Studies Group of the Division of Science Resources Studies. Appendix table 1 presents a ranking of State by each sector's R&D performance, by employed scientists and engineers, and by population.

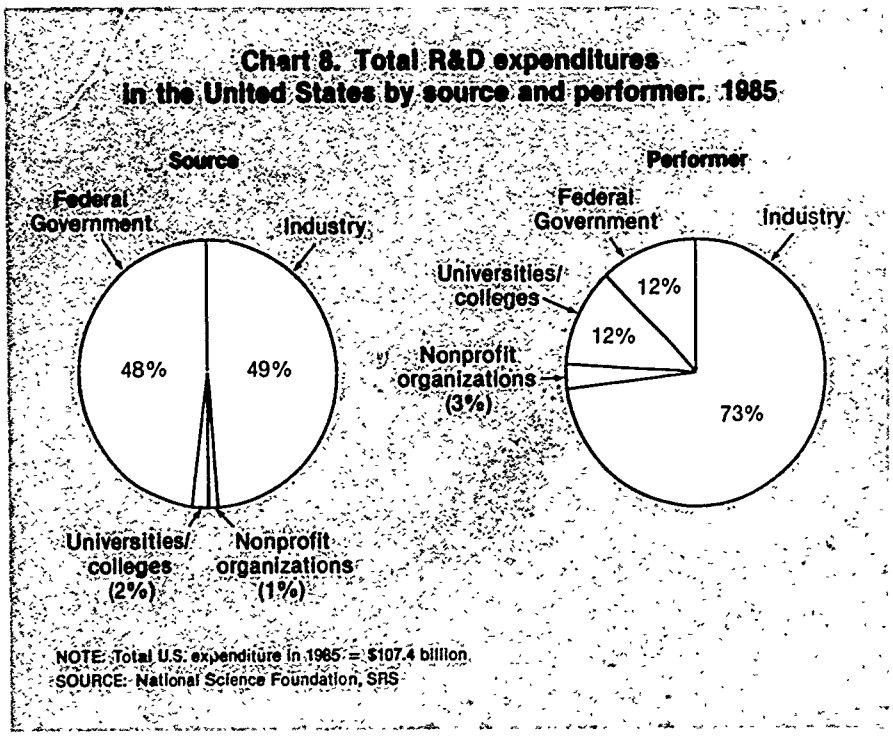


Chart 8. Total R&D expenditures in the United States by source and performer: 1985

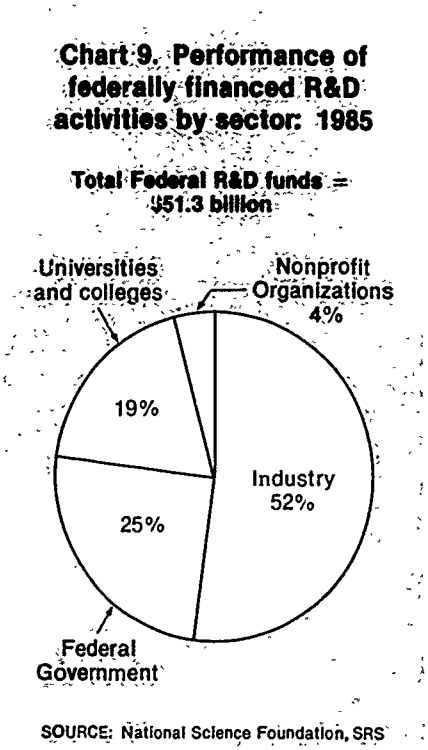


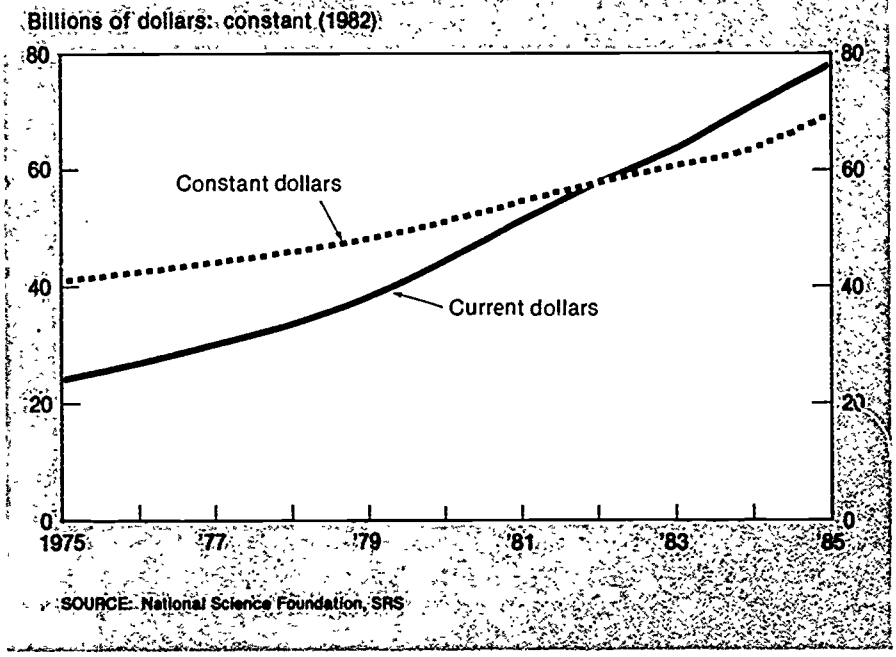
Chart 9. Performance of federally financed R&D activities by sector: 1985

Industrial R&D performance has grown steadily for over a decade (chart 10). Between 1981 and 1985, combined company and Federal funding increased in real terms at an average annual rate of 6.2 percent.

Company-funded R&D outlays grew more than twice as fast as the Federal portion of total industrial R&D expenditures between 1975 and 1980. Then Federal funding began to outpace that of firms: increases in R&D funding from Federal sources averaged 8.0 percent annually; companies' own spending grew 5.3 percent per year between 1981 and 1985 (chart 11). Since, in the 1980s, there has been a strong emphasis on strengthening national security, Federal defense expenditures have increased significantly to support the development of aircraft, weapons systems, and other types of military hardware and software.

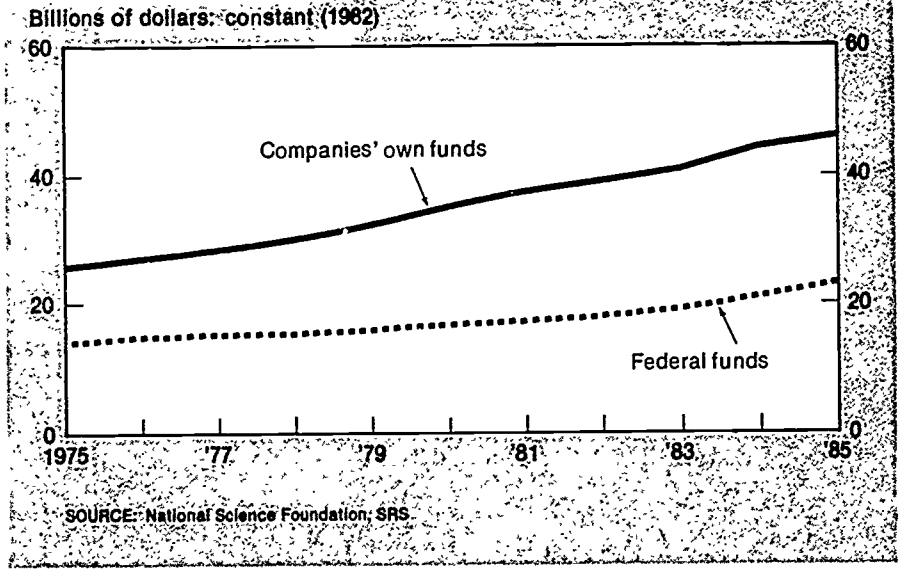
The following report is divided into two sections. Section I is an examination of industrial R&D expenditures at the regional level Comparisons of absolute levels and rates of change in R&D funding are made among regions and among States within regions. These comparisons are made for total R&D outlays and by source of funds (i.e., companies' own or Federal funds). Section II is a review of R&D funding data for selected industries in States with more than $2 billion in industrial R&D expenditures.

Chart 10. Total (company and Federal) funding of industrial activities



SOURCE: National Science Foundation, SRS

Chart 11. Companies' own and Federal funding of industrial R&D performance (constant 1982 dollars)



SOURCE: National Science Foundation, SRS

section i.

industrial r&d expenditures by region

This section is an exploration of trends in industry's R&D expenditures at the regional and State levels (chart 12). Industrial firms' own investment in R&D is largely in the Northeastern and North Central regions of the United States. Together, these two regions accounted for 65 percent of companies' own R&D expenditures in 1985. In contrast, more than one-half of the Federal funds that finance industry-performed R&D activities are spent in Western States; 41 percent of the total amount of Federal R&D funds received by companies in 1985 was spent in California alone. The South has the smallest amount of companies' own R&D spending, but ranks third (ahead of the North Central region) in Federal support of industry-performed R&D. Table 1 shows the distribution of industry's own R&D

Table 1. Total industrial R&D performance

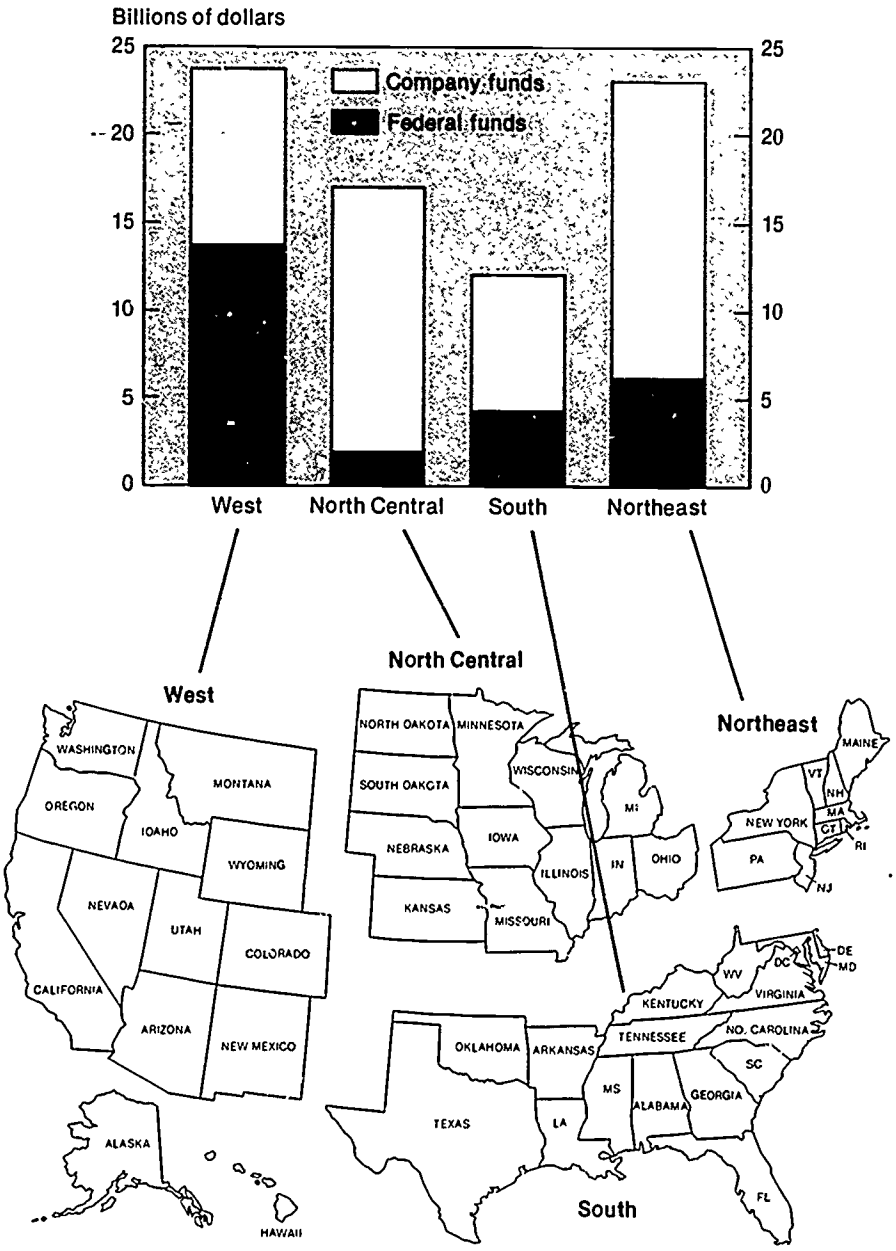
Region	Percent of U.S. industry	Average annual increase, 1981-85[1]
	Total funds	
All regions, total	100	6.2
Northeast	29	8.2
North Central	23	6.5
South	15	8.7
West	30	7.2
	Companies' own funds	
All regions, total	100	5.3
Northeast	33	5.4
North Central	31	7.0
South	15	6.8
West	19	6.4
	Federal funds spent by industry	
All regions, total	100	8.0
Northeast	23	18.7
North Central	7	2.8
South	16	12.9
West	52	7.8

[1]Constant 1982 dollars.

NOTE: Percentages may not add to 100 because not all company respondents allocated all R&D funds by State. In addition, there was a significant decrease in undistributed funds between 1981 and 1985.

SOURCE: National Science Foundation, SRS

Chart 12. Distribution of industrial R&D expenditures across regions: 1985



SOURCE: National Science Foundation, SRS

expenditures by region and by source of funds.

Throughout this report, information on industrial R&D performance for some States has been omitted, because Census Bureau restrictions prohibit publication of data that may reveal information about operations of individual companies. Total R&D expenditure data were suppressed for Maine, Vermont, Delaware, the District of Columbia, West Virginia, Montana, New Mexico, Nevada, Alaska, and Hawaii. (Together, these nine States and the District of Columbia had industrial R&D expenditures of $2.2 billion in 1985, 3 percent of total industrial R&D outlays.) In table 2, the 20 States with the largest amounts of industrial R&D expenditures are ranked. (Data for Delaware have been omitted.)

In addition, data showing industrial R&D expenditures by source of funds (companies' own and Federal) were suppressed for New Hampshire, Rhode Island, Indiana, Wisconsin, Minnesota, Iowa, Missouri,

Table 2. The 20 States with the largest amounts of total industrial R&D expenditures: 1985

State	Amount
1. California	$17,760
2. New York	7,019
3. Michigan	5,975
4. New Jersey	5,547
5. Massachusetts	4,173
6. Pennsylvania	3,570
7. Texas	3,492
8. Illinois	3,231
9. Ohio	2,847
10. Washington	2,183
11. Connecticut	1,976
12. Minnesota	1,971
13. Florida	1,832
14. Maryland	1,437
15. Indiana	1,433
16. Missouri	1,208
17. Arizona	1,002
18. Colorado	917
19. Delaware	[1]
20. Virginia	800

[1]Data withheld by Census Bureau to avoid disclosing company operations.

SOURCE: National Science Foundation, SRS

Throughout this report, both R&D expenditures and percentage changes are identified by referring to either "total," "companies' own," or "Federal" funds. *All percentage changes are given in terms of constant 1982 dollars.*[7]

Companies' own and Federal support of R&D activities in States in each of the four regions are discussed in greater detail in the following sections.

the northeastern states

Companies spent $23.1 billion on R&D in the Northeast region in 1985 (chart 13). Of this, $17.0 billion were companies' own funds and $6.1 billion were Federal funds. Of the 10 States leading in industrial R&D expenditures, 4—New York, New Jersey, Massachusetts, and Pennsylvania—are in this region. Firms in three of the leading R&D-performing industries—electrical equipment, machinery (including computers), and chemicals—spent more on R&D activities in the Northeast than in the other three regions combined. Companies in the electrical equipment industry spent $8.1 billion; those in the machinery and chemicals industries each spent $3.9 billion and $3.6 billion; respectively, on R&D activities undertaken in the Northeast.

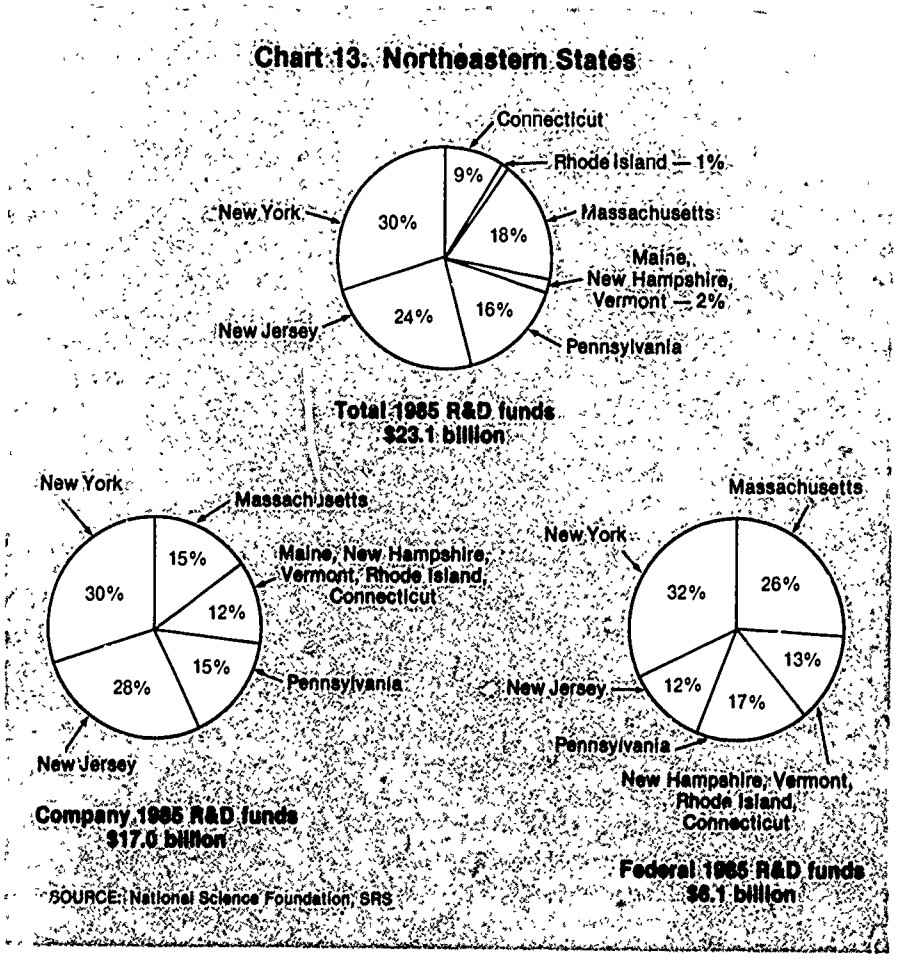
Between 1981 and 1985, four States in the Northeastern region—New Hampshire, Massachusetts, Rhode Island, and New York—had average annual constant-dollar growth rates in total industrial R&D expenditures exceeding 10 percent. New York and Massachusetts have rela-

[7]The GNP implicit price deflator was used to convert current to constant dollars.

Nebraska, Kansas, South Carolina, Georgia, Tennessee, Mississippi, Louisiana, Oklahoma, Idaho, Utah, Oregon, and Washington. In most (if not all) of these 19 States, data were suppressed because of the small number of companies reporting Federal R&D funds in those States.

Industrial R&D data for North Dakota, South Dakota, Nebraska, Mississippi, Arkansas, and Wyoming appear in appendix table 2. Each of these States, however, and Maine, the District of Columbia, Montana, Nevada, Alaska, and Hawaii had relatively small amounts of industrial R&D expenditures (less than $75 million total) in 1985. These 11 States and the District of Columbia were omitted from interstate comparisons of growth rates in this report.

Data for all States (including those with suppressions) with more than $75 million in total, company, or Federal R&D funds were used in making interstate comparisons of growth rates in R&D spending. In some cases, percentage changes were printed, although data used in calculations were not.



tively large amounts of industrial R&D activity, ranking second and fifth among all States with total industrial R&D expenditures of $7.0 billion and $4.2 billion, respectively. Between 1981 and 1985, firms' total R&D spending increased in those States at average annual rates of 14.1 percent and 12.1 percent, respectively. Rhode Island, with $198 million in total industrial R&D expenditures, had an annual growth rate of 14.1 percent.

Pennsylvania was the only State in the Northeastern region with an average annual constant-dollar decline (0.8 percent) in total industrial R&D spending between 1981 and 1985. This State fell in ranking from fifth in 1983 to sixth in 1985. Connecticut, which ranks 11th in total industrial R&D outlays, was the only other State in the Northeast region to have an average annual growth rate below 2 percent during this period.

companies' own funds

Industrial firms spent $17.0 billion of their own funds on R&D in the Northeastern States in 1985. Although companies spent more of their own funds on R&D projects in the Northeast than in any other region, the 1981-85 average annual rate of increase in firms' own R&D spending (5.4 percent) was the lowest of the four regions. While New York and New Jersey had sizable increases in companies' own R&D spending, the overall increase in the Northeast region was tempered by the lack of growth in Pennsylvania.

Nine out of every ten dollars spent on R&D activities in the Northeast financed projects undertaken in New York, New Jersey, Massachusetts, and Pennsylvania. These States ranked third, fourth, sixth, and seventh, respectively, among all States in companies' own R&D funds in 1985. New York and New Jersey each had about $5 billion in industry-financed R&D expenditures in 1985, and both States had increases averaging 8.0 to 9.0 percent per year between 1981 and 1985. In 1985, companies' own R&D expenditures were about $2.0 billion higher than in 1981 in New York and New Jersey. These increases were second only to the absolute increase in California and were equal to that in Michigan, the first- and second-ranking States, respectively, in terms of companies' own R&D spending. New York's increase was largely due to companies in the chemicals and machinery industries; almost one-half of New Jersey's additional R&D investment was attributable to firms in the electrical equipment industry.

In Massachusetts, the average annual rate of increase in companies' own R&D expenditures was 6.7 percent between 1981 and 1985. While there was a substantial increase in R&D spending by the computer segment of the machinery industry, this was somewhat offset by a decline in companies' own R&D investment by firms in the electrical equipment industry. Massachusetts has experienced a dramatic shift in its manufacturing base: during the late seventies and early eighties, many companies in the State's traditional industries—textiles and shoes—either failed or relocated. New employment opportunities were created, however, by the establishment and growth of companies in high-tech industries such as computers and computer software and electronic components. The revitalization of Massachusetts' economy has been attributed to the large pool of technically trained graduates of leading educational institutions (e.g., the Massachusetts Institute of Technology) in the area. Many of the scientists and engineers produced by these universities have established highly successful, small high-tech companies along Massachusetts' Route 128 corridor.

Industry's R&D investment in Pennsylvania increased approximately $700 million between 1981 and 1983, but then fell by the same amount between 1983 and 1985. Firms in the electrical equipment industry were directly responsible for these changes: the curtailment of these companies' R&D budgets is related to poor sales performance in some product areas, especially the sale of electric transmission equipment to utility companies. These customers limited their purchases because of overcapacity and public consternation about the building of new nuclear facilities.

federal funds

Companies spent $6.1 billion in Federal funds on R&D in the Northeastern States in 1985. Although it ranks a distant second to the West in the amount of Federal R&D funds spent by industry, the Northeast had the highest average annual constant-dollar growth rate (18.7 percent) in Federal R&D support of any region between 1981 and 1985.

New York is second only to California in terms of Federal R&D funds spent by industry. Between 1981 and 1985, New York had the largest percentage increase—37.9 percent—and the second highest (after California) absolute increase—$1.5 billion—in industry's expenditures of Federal R&D funds among all States. Companies in the two industries with the largest amounts of Federal R&D support in New York (machinery and electrical equipment) were responsible for this increase. Firms in these industries are developing computer and communications systems for the military.

Massachusetts, which ranked third in 1985 among all States in Federal R&D funds spent by companies ($1.6 billion), had the fourth highest percentage increase (25.8 percent) and the third highest absolute increase ($1 billion) in industrial R&D funding from Government sources between 1981 and 1985. Four out of every five of these Federal R&D dollars were spent by companies in the electrical equipment industry. These firms (many of them among the small high-tech companies mentioned above) reported more than a three-

fold increase in Federal R&D support between 1981 and 1985.

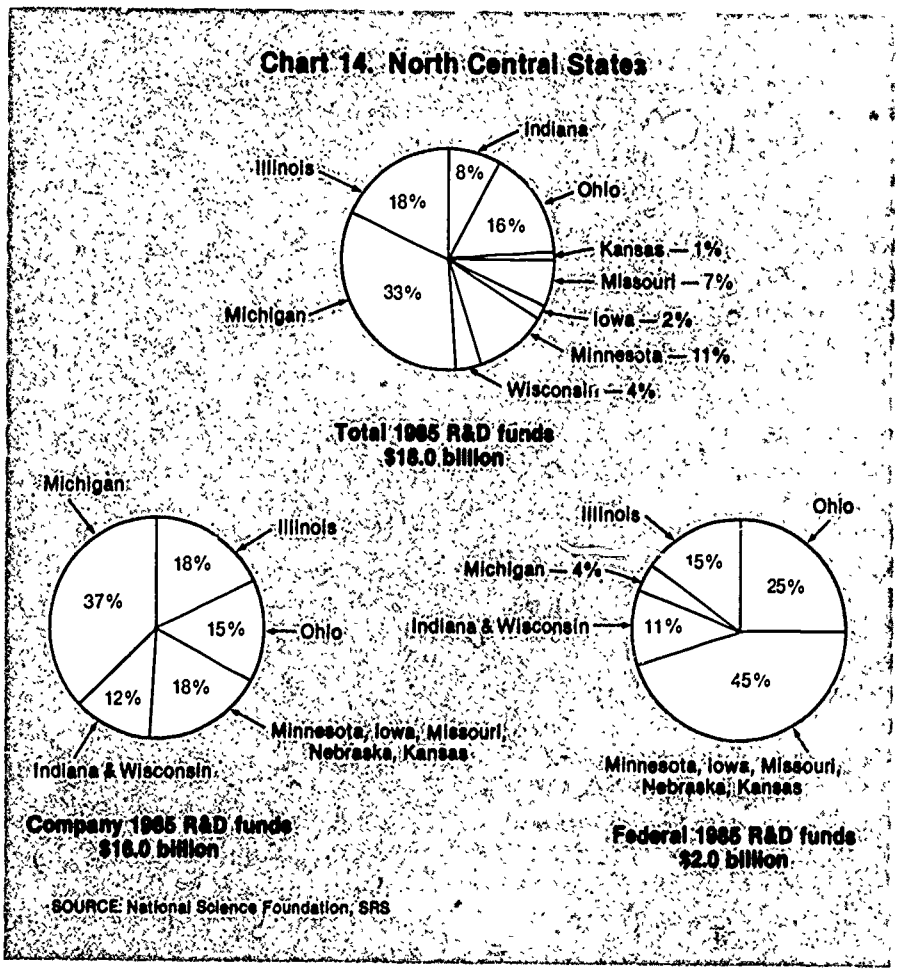
Pennsylvania and New Jersey had average annual increases of 9.0 percent and 9.4 percent, respectively, in Federal R&D support to industry between 1981 and 1985. Pennsylvania is the sixth largest State in terms of Federal R&D funds spent by industry. As in Massachusetts, companies in the electrical equipment industry perform almost all of the federally financed R&D undertaken in these two States.

the north central states

Industrial R&D expenditures in the North Central region amounted to $18.0 billion in 1985 (chart 14). Only 11 percent of these monies were Federal funds. Of the 10 States with the highest levels of industrial R&D spending, 3—Michigan, Illinois, and Ohio—are in this region. The leading R&D-performing industry in this region by far is motor vehicles, which had R&D expenditures totaling $5.6 billion in 1985. The second largest is the chemicals industry, with $2.6 billion in 1985 R&D outlays, followed by the electrical equipment industry with $2.5 billion, and the machinery industry with $2.4 billion. Although most of the motor vehicles industry's R&D activities are in Michigan, those of the other industries are more evenly distributed among the region's six largest States.

Two States in this region—Ohio and Minnesota—had average annual constant-dollar rates of increase in total industrial R&D outlays exceeding 10 percent between 1981 and 1985. These two States ranked 9th and 12th, respectively, in terms of total industrial R&D expenditures. Three States—Wisconsin, Iowa, and Kansas—had growth rates below 2 percent. (None of these latter States had more than $700 million in total industrial R&D outlays.)

Firms spent $317 million on R&D activities in Iowa in 1985. Iowa recorded an average annual decline of 5.4 percent; this State and West Virginia are the only States in the country to have actual reductions in industrial R&D spending between 1981 and 1985.



companies' own funds

Firms spent $16.0 billion of their own funds on R&D projects conducted in the North Central region in 1985. This region thus had the second highest level of companies' own R&D spending after the Northeast. Between 1981 and 1985, firms increased their funding of R&D activities at an average annual rate of 7.0 percent per year—the highest percentage increase of any of the four regions. Most of the gain in industrial R&D activity occurred in Ohio, Minnesota, and Missouri.

Michigan, which is second only to California in terms of companies' own R&D expenditures, is the region's leading State. Motor vehicles companies spend approximately 80 percent of the funds financing R&D activities undertaken in Michigan. In 1985, companies spent $5.9 billion in this State on R&D activities. This was more than twice the level spent in Illinois, which was the fifth largest State nationally—and the second largest in the North Central region—in terms of companies' own R&D funds. Ohio ranks eighth nationally and third regionally with $2.4 billion in companies' own R&D spending in 1985. Companies also spent more than $1 billion of their own funds on R&D projects undertaken in Minnesota and in Indiana.

Missouri (15.2 percent), Minnesota (14.4 percent), and Ohio (9.1

percent) had the highest average annual rates of growth in companies' own funding between 1981 and 1985. In comparison, Michigan and Illinois had average annual increases of approximately 5 percent in companies' own R&D spending between 1981 and 1985.

federal funds

Only 7 percent ($2.0 billion) of the total amount of Federal R&D funds spent by industrial firms in 1985 financed projects undertaken in the North Central region. This region also had the lowest percentage growth rate—2.8 percent—in Federal funding between 1981 and 1985.

Four out of every five Federal dollars spent on R&D activities undertaken by companies in the North Central region were spent in four States—Ohio, Illinois, Minnesota, and Missouri. In terms of Federal R&D support, Ohio is the region's leading State with expenditures of $484 million. Both Ohio and Illinois had substantial increases—$309 million and $238 million, respectively—in Federal R&D support between 1981 and 1985, largely in the electrical equipment and aircraft and missiles industries. These sizable increases in Federal R&D funding were offset by a large decrease in Missouri.

the southern states

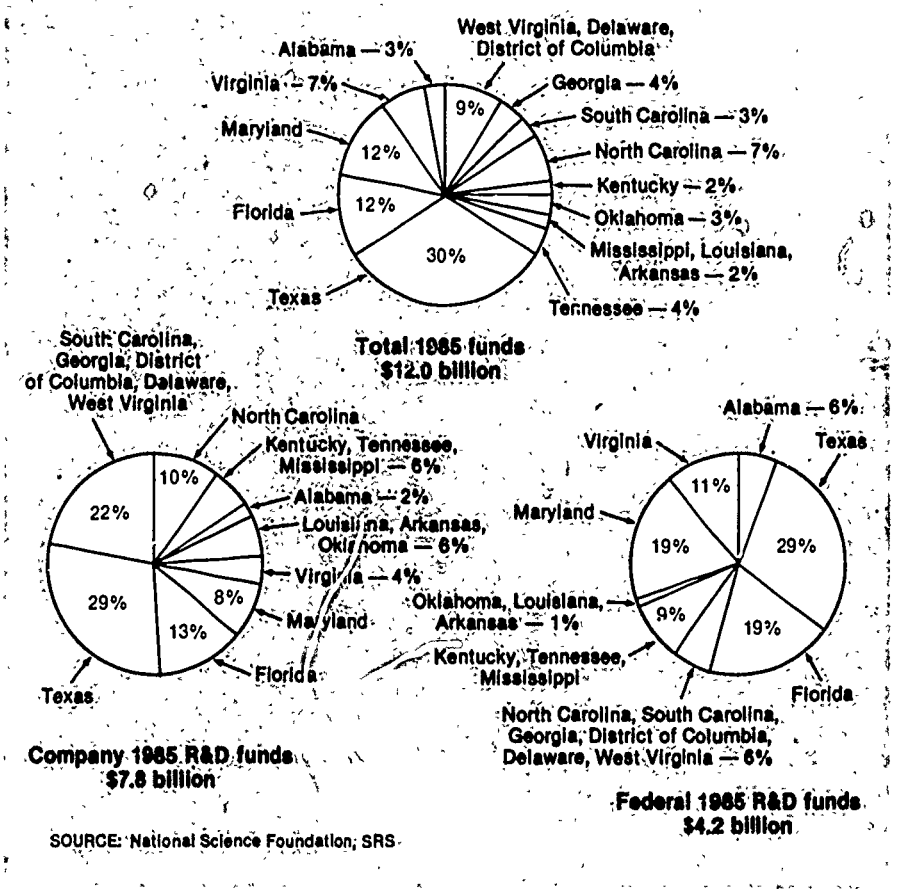
With $12.0 billion in 1985, the South has the lowest regional level of industrial R&D expenditures (chart 15). More than one-half of these funds were companies' own funds. The leading R&D-performing industry in the South is the machinery industry: it had expenditures of $2.5 billion in 1985. The next largest industry is electrical equipment, with expenditures of $2.3 billion. Third largest is the aircraft and missiles industry; firms in this industry spent $2.1 billion in 1985. The South is second only to the West in terms of R&D expenditures by aircraft and missiles companies.

The three States with the highest average annual constant-dollar growth rates (all above 20 percent) in total industrial R&D funding between 1981 and 1985 were in the South. They were South Carolina (24.6 percent), Maryland (23.2 percent), and Alabama (22.7 percent). Three other Southern States—Delaware, Georgia, and Texas—had average annual growth rates exceeding 10 percent during this period. Texas, Maryland, and Delaware, which ranked 7th, 14th, and 19th, respectively, have relatively large amounts of industrial R&D activity. The other Southern States with high 1981-85 average annual growth rates had less than $600 million in total industrial R&D expenditures in 1985.

Florida is the only other State in the South with a substantial amount of industrial R&D spending. It ranked 13th in 1985. Total R&D spending in Florida rose 2.4 percent per year in real terms between 1981 and 1985.

Four Southern States—West Virginia, Tennessee, Louisiana, and Oklahoma—had rates of increase in total industrial R&D spending below 2 percent. Tennessee, Louisiana, and Oklahoma recorded almost no growth in R&D spending during the 1981–85 period. West Virginia was one of only two States (Iowa was the other one) to have a reduction in industrial R&D spending between 1981 and 1985.

Chart 15. Southern States



SOURCE: National Science Foundation, SRS

companies' own funds

Of the four major regions, the South has the smallest amount—$7.8 billion in 1985—of company-financed R&D expenditures. Although the South lags behind the other regions in companies' own R&D investment, it did have the second highest growth rate (after the North Central region)—6.8 percent per year in constant dollars—between 1981 and 1985.

Texas is the leading Southern State in terms of industry's own R&D investment. Over $2 billion was spent on R&D in Texas in 1985, more than twice the level spent in Florida, which has the region's second highest level. Between 1981 and 1985, companies' own R&D spending rose 9.1 percent per year in Texas, but fell at an average annual rate of 3.1 percent in Florida.

Although the petroleum industry is one of the largest R&D-performing industries in Texas and more of its R&D activities are undertaken in this State than in any other, the State's economy (unlike those of Louisiana and Oklahoma) does not depend entirely on this industry.[8] For example, in Texas, companies in the electrical equipment industry spend more on R&D ($599 million in 1985) than do firms in any other industry—including petroleum. Further, in a well-publicized competition, Austin was chosen over 56 other cities in 27 States as the site of the Microelectronics and Computer Technology Corporation, a consortium of electronics companies striving to develop future generations of computers ahead of Japanese firms.

Among all States, Maryland and South Carolina had the highest average annual increases in companies' own R&D investment between 1981 and 1985; Maryland's increase was 24.3 percent. Even within the South, however, Maryland (with $624 million) only ranks fourth after Texas, Florida, and North Carolina in terms of companies' own R&D spending. Part of Maryland's large increase may be due to the growth in R&D spending by biotechnology firms that have been established in those Maryland suburbs of Washington, D.C., in which the National Institutes of Health and the U.S. Food and Drug Administration are located.

In North Carolina, industrial R&D spending increased at an average annual rate of 7 2 percent between 1981 and 1985. Most companies performing R&D in this State are located in Research Triangle Park. Unlike a number of other such areas of high-technology development (e.g., Massachusetts' Route 128 corridor), companies reported spending only $1 million in Federal R&D funds in North Carolina.

federal funds

Overall, companies spent $4.2 billion in Federal funds on R&D in Southern States in 1985. This region ranks third (behind the West and the Northeast, but ahead of the North Central region) in Federal funding of industrial R&D projects. After the Northeast, the South registered the second highest average annual constant-dollar increase (12.9 percent) in Federal R&D support between 1981 and 1985. In four Southern States—Maryland, Virginia, Tennessee, and Alabama—industry spends more Federal than companies' own funds on R&D.

Several Southern States have significant concentrations of Federal R&D funding and have recorded substantial increases in such funding between 1981 and 1985. Texas is the leading Southern State (and the fifth largest overall) in terms of federally funded industrial R&D activities: its 1985 expenditures amounted to $1.2 billion. Between 1981 and 1985, Federal support of R&D projects undertaken by companies in Texas grew 15.1 percent per year. Several large defense contractors in the aircraft and missiles and primary metals industries have operations in Texas; these received substantial increases in R&D funds from the Department of Defense (DOD) during the 1980s. According to a Census Bureau report,[9] Texas ranked second to California in total Federal procurement funds in 1985.

Other Southern States also had average annual gains in Federal R&D support exceeding 10 percent. These increases were 34.1 percent in Alabama, 22.4 percent in Maryland, 12.3 percent in Florida, and 12.3 percent in Virginia. Absolute increases in Federal R&D support in States in the South ranged from approximately $630 million in Texas to $190 million in Alabama. Florida is the seventh largest State in terms of Federal R&D support to industry; Maryland is the eighth largest.

The National Aeronautics and Space Administration (NASA) supports many of the R&D activities undertaken by companies along the "space coast" in Florida, in Alabama, and in Maryland. In Alabama, firms also have been performing R&D related to the Strategic Defense Initiative (SDI), making the State, according to a recent study,[10] fourth—after California, New Mexico, and Massachusetts—in funds received from SDI contracts. Maryland and Virginia have a large number of telecommunications, computer software, and electronics firms performing R&D for the Government. Proximity to Federal agencies—e.g., DOD, the National Security Agency, and the Goddard Space Flight Center—is the major reason these firms are located in the

[8] R&D spending by the petroleum industry was affected by the industry's financial problems, i.e., falling prices; companies' own R&D funding in Texas declined at an average annual rate of 1.6 percent between 1981 and 1985.

[9] Department of Commerce, Bureau of the Census, *Federal Expenditures by State for Fiscal Year 1987* (Washington, D.C., Supt. of Documents, U.S. Government Printing Office, 1988.)

[10] Pike, John and David G. Bourns, *SDI Contracts After Five Years*, Federation of American Scientists (Washington, D.C., 1988).

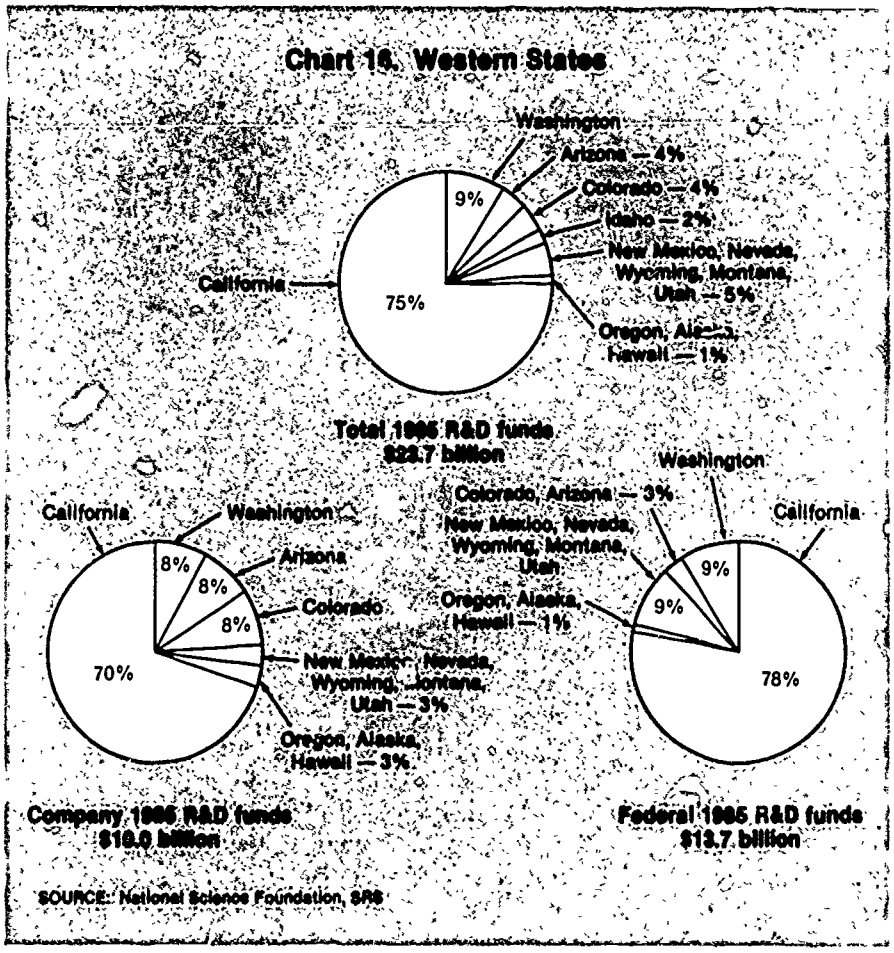
Washington, D.C. metropolitan area. Virginia ranks sixth and Maryland eighth in total Federal procurement dollars.

the western states

Companies spent $23.7 billion on R&D activities undertaken in the West in 1985 (chart 16). Federal funds accounted for 58 percent of this amount. The leading R&D-performing industries in the West are aircraft and missiles and electrical equipment, with expenditures of $12.1 billion and $3.3 billion, respectively.

Colorado was the only State in the West to register an average annual constant-dollar increase in industrial R&D expenditures above 10 percent between 1981 and 1985. California, the State with the highest level of total industrial R&D spending, accounting for 23 percent of total U.S. industrial P&D expenditures in 1985, had the largest absolute increase—$7.0 billion—between 1981 and 1985.

Industrial R&D spending in two Western States—Utah and Washington—grew at an average annual rate less than 2 percent between 1981 and 1985. Washington had the second highest amount of R&D funds spent by industry in the West; it ranks 10th overall in total industrial R&D funding. Because of Census Bureau restrictions on disclosing data that might reveal information about individual companies, 1981 data for Washington are not available. Industry increased its total R&D funding in the State, however, 20 percent between 1983 and 1985, so there must have been a substantial decrease between 1981 and 1983.



companies' own funds

Companies spent $10.0 billion of their own funds on R&D in Western States in 1985. Between 1981 and 1985, companies' own funding in the West grew at an average annual constant-dollar rate of 6.4 percent.

California is the leading State in terms of companies' own R&D investment; it dominates the entire West by accounting for 70 percent of the total amount of companies' own funds. Firms spent $6.9 billion of their own funds in California in 1985. Their funding of R&D activities rose at an average annual constant-dollar rate of 8.8 percent between 1981 and 1985. Between 1981 and 1985, firms' investment in R&D increased $2.8 billion in California. Companies in the aircraft and missiles industry and firms in the electrical equipment industry, many of which are located in the area south of San Francisco known as "Silicon Valley," were responsible for about one-half of this increase.

Companies spent $900 million in Washington and almost $800 million each in Arizona and Colorado. These three States accounted for one-fourth of the industry-financed R&D expenditures made in the West. Colorado (which ranked 19th among all States in terms of total industrial R&D funding in 1985) recorded the highest average annual 1981–85 growth rate—14.8 percent—among Western States with substantial amounts of industrial R&D investment.

federal funds

Industry spent $13.7 billion in Federal funds on R&D performed in Western States: this was more than twice the amount spent in any other region. More than three-fourths of the Federal R&D funds financing R&D projects conducted by companies in the West ($10.8 billion) were spent in California, which accounts for 41 percent of all Federal funds supporting industry-performed R&D.

Because of the large number of defense contractors performing R&D in California, the West is the only region in which the level of Federal funding exceeds that of industry's own funds. Five States in the West—Idaho, New Mexico, Washington, California, and Hawaii—have more Federal than companies' own R&D expenditures. The first four of these States had average annual increases in Federal R&D support ranging from 7 percent to 9 percent. In Washington, firms spent $1.3 billion in Federal R&D funds, making this State the fourth highest (after California, New York, and Massachusetts) in terms of Federal R&D support to industry.

Although California's 1981-85 average annual increase in Federal R&D funding of industry-performed R&D activities, 8.5 percent, was not the highest within the United States, it did have the largest absolute increase, $4.2 billion, during this period. About 70 percent of this increase is attributable to aerospace companies. Besides spending Federal R&D funds on the development of military hardware and software, California establishments also have been performing SDI-related R&D activities. A recent study[11] found that close to one-half of all SDI funds provided since 1983 have been spent in California.

[11] Ibid.

section ii.

industrial R&D spending in individual States

In this section, trends in R&D funding in the largest R&D-performing industries within the nine[12] leading States are examined. Data from NSF's annual Survey of Industrial Research and Development are collected on a "company"—as opposed to an "establishment"—basis.[13] Each company's R&D data are placed within one industry, as defined by the Standard Industrial Classification (SIC) system. The geographic R&D data provided by companies in the survey are placed into industries according to the SIC codes of the reporting companies. R&D data from diversified companies are placed within only *one* SIC code. Again, R&D data for some industries in some States have been withheld to avoid disclosing operations of individual companies.

The motor vehicles and aircraft and missiles industries' R&D expenditures are the most concentrated geographically with 69 percent and 60 percent of their total R&D expenditures made in Michigan and California, respectively.

As indicated in table 3 (which contains information for the 20 largest States) and table 4 (which contains information for the 9 largest States), the R&D programs of companies in the electrical equipment and chemicals industries are spread more evenly across the country. In 6 of the 10 States leading in industrial R&D performance, companies in the electrical equipment industry spend more on R&D than do firms in any other industry. In three of the other States (California, New York, and Washington), the electrical equipment industry ranks second in total R&D expenditures. Although the chemicals industry is not the largest R&D-performing industry in any of the 10 leading States, it had the second highest amount of R&D expenditures in 4 of these States.

[12]Individual industry data for Washington, the 10th largest State, were withheld by the Census Bureau to avoid disclosing operations of specific companies.

[13]The sampling unit for the survey is the company, defined as a business organization consisting of one or more establishments under common ownership or control.

Table 3. Largest R&D-performing industries by State: 1985
[Dollars in millions]

State	Total R&D expenditures	Largest industry	Second largest industry	Third largest industry	Percent of the 3 industries' total
California	$17,760	Aircraft and missiles	Electrical equipment[1]	Machinery[2]	74
New York	7,019	Machinery[2]	Electrical equipment[3]	Instruments[4]	66
Michigan	5,975	Motor vehicles	Chemicals[5]	Machinery[6]	93
New Jersey	5,547	Electrical equipment[3]	Chemicals[5]	Petroleum refining	NA
Massachusetts ...	4,173	Electrical equipment[3]	Machinery[2]	Instruments[7]	83
Pennsylvania	3,570	Electrical equipment[8]	Chemicals[5]	Aircraft and missiles	66
Texas	3,492	Electrical equipment[1]	Primary metals	Petroleum refining	NA
Illinois	3,231	Electrical equipment[3]	Machinery[6]	Chemicals[5]	69
Ohio	2,847	Electrical equipment[8]	Chemicals[9]	Rubber products	63
Washington	2,183	Aircraft and missiles	Electrical equipment[8]	Instruments[7]	91
Connecticut	1,976	Aircraft and missiles	Chemicals[5]	Instruments[4]	70
Minnesota	1,971	Machinery[2]	Paper	Instruments[7]	84
Florida	1,832	Aircraft and missiles	Electrical equipment[3]	Machinery[2]	83
Maryland	1,437	Machinery[2]	Electrical equipment[8]	Nonmanufacturing	80
Indiana	1,433	Chemicals[5]	Motor vehicles	Electrical equipment[1]	82
Missouri	1,208	Aircraft and missiles	Chemicals[10]	Food and tobacco	88
Arizona	1,002	Machinery[2]	Aircraft and missiles	Electrical equipment[1]	76
Colorado	917	Machinery[2]	Instruments[7]	Electrical equipment[3]	68
Delaware	NA	Chemicals[10]	Primary metals	Electrical equipment[8]	99
Virginia	850	Machinery[2]	Nonmanufacturing	Electrical equipment[8]	69

[1]Companies in the electronic components segment (SIC 367) of the electrical equipment industry have the highest amount of R&D expenditures in this State.
[2]Companies in the computer segment (SIC 357) of the machinery industry have the highest amount of R&D expenditures in this State.
[3]Companies in the communication equipment segment (SIC 366) of the electrical equipment industry have the highest amount of R&D expenditures in this State.
[4]Companies in the optical, surgical, photographic, and other instruments segment (SIC 383-87) of the instruments industry have the highest amount of R&D expenditures in this State.
[5]Companies in the drugs and medicines segment (SIC 283) of the chemicals industry have the highest amount of R&D expenditures in this State.
[6]Companies in the "Other machinery" segment (SIC 351-56, 358-59) of the machinery industry have the highest amount of R&D expenditures in this State.
[7]Companies in the scientific and mechanical measuring instruments segment (SIC 381-82) of the instruments industry have the highest amount of R&D expenditures in this State.
[8]Companies in the "other electrical equipment" segment (SIC 361-64, 369) of the electrical equipment industry have the highest amount of R&D expenditures in this State.
[9]Companies in the "other chemicals" segment (SIC 284-85, 287-89) of the chemicals industry have the highest amount of R&D expenditures in this State.
[10]Companies in the industrial chemicals segment (SIC 281-82, 286) of the chemicals industry have the highest amount of R&D expenditures in this State.

NOTE: NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

SOURCE: National Science Foundation, SRS

Table 4. R&D expenditures by State by industry; 1985
[Dollars in millions]

Industry	SIC code	Total, all States	California	New York	Michigan	New Jersey	Massachusetts	Pennsylvania	Texas	Illinois	Ohio	All other States
All industries, total	—	$78,208	$17,760	$7,019	$5,975	$5,547	$4,173	$3,570	$3,492	$3,231	$2,847	$24,594
Aircraft and missiles	372,376	17,619	9,953	413	114	58	274	300	531	328	60	5,588
Electrical equipment	36	17,080	1,920	1,503	60	2,878	1,940	1,325	869	1,072	692	4,821
Machinery	35	10,870	1,237	NA	127	244	954	255	413	632	190	NA
Chemicals and allied products	28	8,667	383	1,154	607	1,322	125	716	250	514	571	3,025
Motor vehicles	371	7,058	NA	232	4,796	NA	NA	NA	NA	NA	NA	671
Instruments	38	5,430	1,061	NA	NA	333	559	252	169	92	52	NA
Petroleum refining	29	NA	442	8[illegible]	NA	NA	NA	119	535	NA	NA	276
Food and tobacco products	20,21	NA	65	114	36	109	NA	NA	12	140	19	503
Rubber products	30	1,147	257	NA	NA	NA	NA	[illegible]	10	NA	533	259
Primary metals	33	NA	59	41	70	NA	NA	190	NA	NA	74	169
Non-manufacturing	10-17,41-67, 737 739,807, 891	2,851	1,079	147	[illegible]58	29	103	40	82	32	75	1,206
All other industries	—	3,018	NA	166	68	63	110	252	43	175	252	1,525

NOTE: NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

Total R&D funds data are unavailable for the petroleum refining, food & tobacco products, and primary metals industries because of restrictions on publishing data showing Federal R&D support to these industries. The amount of companies' own funds spent by each of these industries in 1985 was: petroleum refining, $2,106 million; food and tobacco products, $1,042 million; and primary metals, $758 million.

SOURCE: National Science Foundation, SRS

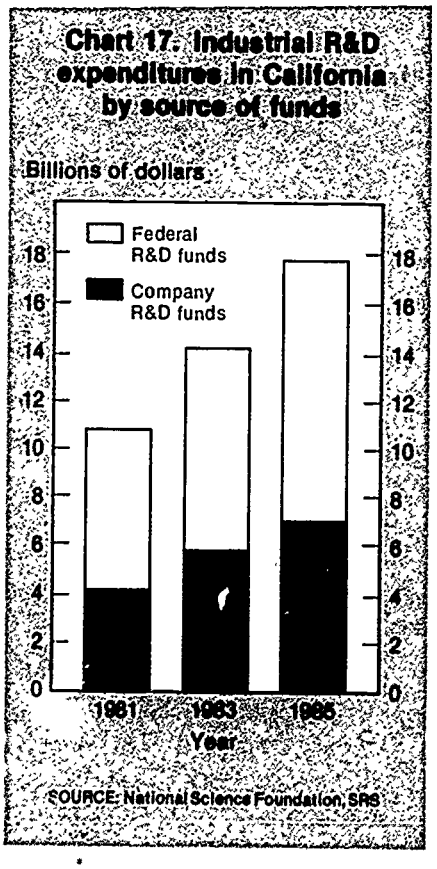
california

Total 1985 R&D expenditures:	$17.760 billion
Aircraft and missiles	56%
Electrical equipment	11
Machinery	7
Nonmanufacturing	6
Instruments	6
Motor vehicles	NA[1]
Petroleum	2
Chemicals	2
All other industries	NA[1]

[1]NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

California leads all other States in industrial R&D performance; it accounted for 23 percent of all such expenditures made within the United States in 1985. Industrial R&D expenditures totaled $17.8 billion in 1985 (appendix table 5) Almost two-thirds of this amount were Federal funds (chart 17), most of which were spent by companies in the aircraft and missiles industry.

- The aircraft and missiles industry's R&D efforts are highly concentrated in California. Companies classified in this industry reported that approximately one-third of their own R&D funds ($1.4 billion) and almost two-thirds of their Federal R&D funds ($8.6 billion) were spent in California in 1985.
- The aircraft and missiles industry is by far the leading R&D-performing industry in California. In 1985, 80 percent of the Federal R&D funds supporting industrial R&D activities undertaken in California were spent by aerospace companies. In addition, aerospace firms accounted for one-fifth of companies' own R&D funds in 1985. Between 1981 and 1985, aerospace companies' own R&D expenditures increased at an average annual constant-dollar rate



of 7.6 percent; R&D funding from Federal sources increased 6.1 percent per year.

- Electrical equipment companies spent $1.3 billion of their own and $575 million in Federal funds on R&D in California in 1985. Two-thirds of the Federal monies were spent by companies in the industry's communications equipment segment, while over one-half of companies' own outlays were expended by firms in the electronic components segment. Between 1981 and 1985, both companies' own and Federal support more than doubled in constant dollars. Much of this increase was reported by companies located in California's Silicon Valley. The 1981-85 average annual constant-dollar growth rate in electrical equipment R&D expenditures was 20.1 percent. This was second only to growth in the petroleum industry.
- California ranks second (after New York) in terms of R&D expenditures by both the machinery and the instruments industries. The machinery industry had the third highest level of R&D expenditures in California. Companies in the computer segment of the machinery industry spent $1.1 billion in company and Federal funds in California in 1985. Between 1981 and 1985, R&D spending by computer companies increased at an average annual rate of 6.9 percent. Many firms classified in this segment of the machinery industry, like those in the electrical equipment industry, are located in Silicon Valley.
- Companies in the instruments industry spent $1.1 billion on R&D activities undertaken in California. The scientific and mechanical measuring instruments segment accounted for about 60 percent of this industry's total R&D outlays.
- Firms in nonmanufacturing industries spent approximately $1.1 billion on R&D projects performed in California in 1985, an average annual increase of 6.1 percent over the level spent in 1981; about 40 percent of these funds were Federal monies.
- Companies in the motor vehicles industry had the sixth highest level of R&D spending in California in 1985. Most of this funding (four out of every five dollars) was provided by the Federal Government to sponsor defense-oriented research. Firms in the motor vehicles industry are among the Nation's largest defense contractors; their federally funded R&D activities are largely conducted in California, while their internally financed R&D programs are undertaken in Michigan.
- Among smaller R&D-performing industries in California, the petroleum industry with 1985 total R&D expenditures amounting to $442 million, had an average annual growth rate of 25.5 percent between 1981 and 1985, the highest rate of increase in R&D spending of any industry in California. In contrast, companies in the chemicals industry—which spent a total of $383 million in 1985—increased their R&D outlays only 1.2 percent per year during this period.

new york

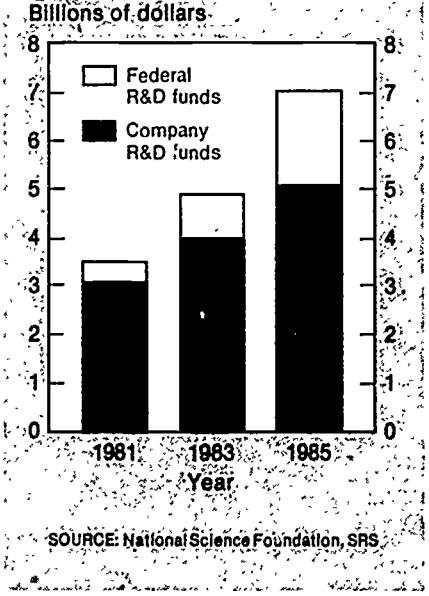
Total 1985 R&D expenditures:	$7.019 billion
Machinery	NA[1]
Electrical equipment	21%
Instruments	NA[1]
Chemicals	16
Aircraft and missiles	6
Motor vehicles	3
Nonmanufacturing	2
All other industries	7

[1]NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies

Industry spent $7.0 billion on R&D activities in New York in 1985 (appendix table 6). While this State has the second highest level of Federal R&D support to industry, unlike California, 7 out of every 10 dollars were companies' own funds (chart 18). Also unlike California, no industry dominates New York; four industries—machinery (including computers), electrical equipment, professional and scientific instruments, and chemicals—each had more than $1 billion in industrial R&D expenditures in 1985.

- Electrical equipment firms reported the second highest level (after the machinery industry)—$1.5 billion—of R&D funding in New York in 1985. Almost one-half of this amount was Federal funds. The communications equipment segment accounts for more than one-half of the electrical equipment industry's R&D expenditures of both companies' own and Federal funds in New York.
- Firms in the machinery and electrical equipment industries exhibited similar R&D spending trends between 1981 and 1985: companies' own R&D funding rose at an

Chart 18. Industrial R&D expenditures in New York by source of funds



SOURCE: National Science Foundation, SRS

average annual rate of 6.8 percent in both industries. During the same period, Federal funds rose at much higher rates—firms in the machinery industry reported a threefold increase (in constant dollars), while those in the electrical equipment industry had a tenfold increase. These companies are undertaking the development of computer and communication systems under DOD contracts. As mentioned earlier, New York had the highest percentage increase among all States in Federal funds spent on R&D by industrial firms between 1981 and 1985.

- Companies in the professional and scientific instruments industry spend more on R&D activities undertaken in New York than in any other State; over one-fifth of all R&D funds spent by firms in this industry were spent in New York. Most of these funds are spent by companies in the optical, surgical, photographic, and other instruments segment.
- New York ranks second (after New Jersey) in R&D spending by chemicals companies. These companies spent a total of $1.2 billion on R&D activities in New York in 1985. All but $118 million of these funds were companies' own financial resources, which increased at an average annual rate of 25.6 percent between 1981 and 1985. Over one-half of the R&D funds reported in 1985 by companies in the chemicals industry were spent by firms in the industrial chemicals segment.
- Among smaller R&D-performing industries in New York, companies in the aircraft and missiles and motor vehicles industries spent $413 million and $232 million, respectively, in 1985. About 60 percent of the funds spent by aerospace companies and almost one- half of those spent by automotive companies were Federal funds.

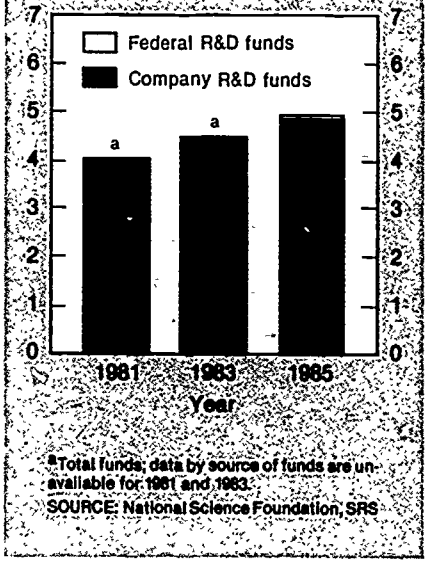
michigan

Total 1985 R&D expenditures:	$5.975 billion
Motor vehicles	80%
Chemicals	10
Machinery	2
Aircraft and missiles	2
Primary metals	1
Electrical equipment	1
Nonmanufacturing	1
All other industries	3

Industry spent $6.0 billion on R&D activities in Michigan in 1985 (appendix table 7). All but $85 million of these outlays were companies' own funds (chart 19). The motor vehicles industry, which dominates the State, was responsible for 80 percent of total[14] industrial R&D expenditures in Michigan in 1985.

- Expenditures of both companies' own and Federal funds on R&D projects undertaken by motor vehicles companies increased at an average annual constant-dollar rate of 5.0 percent between 1981 and 1985.
- Companies in the chemicals industry spent a total of $607 million on R&D activities in Michigan in 1985. R&D funding by the chemicals industry grew at an average annual rate of 15.1 percent between 1981 and 1985. More than one-half of the chemicals industry's total R&D funds were spent by firms in the drugs and medicines segment of the industry.
- Each of the smaller R&D-performing industries in Michigan had less than $150 million in total R&D expenditures in 1985. Firms in four of these industries—machinery, aircraft and missiles, primary metals, and electrical equipment—together spent a total of $370 million in Michigan. Of this amount, $64 million were Federal R&D funds; all but $5 million of these Federal monies were spent by companies in the aircraft and missiles and primary metals industries.

Chart 19. Industrial R&D expenditures in Michigan by source of funds



[a]Total funds; data by source of funds are unavailable for 1981 and 1983.
SOURCE: National Science Foundation, SRS

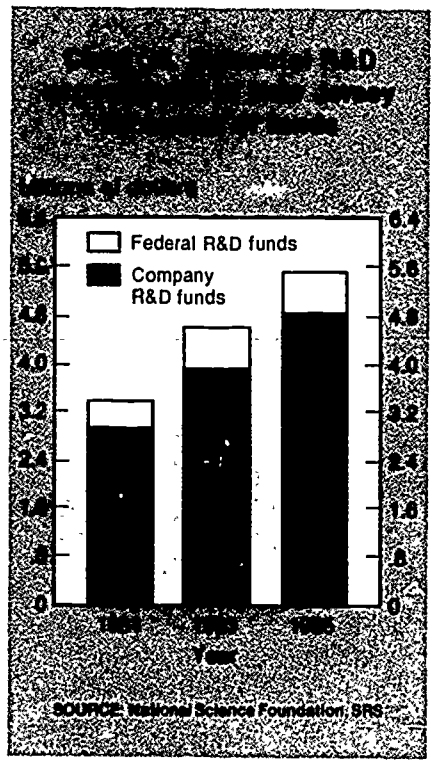
new jersey

Total 1985 R&D expenditures:	$5.547 billion
Electrical equipment	52%
Chemicals	24
Petroleum refining	NA[1]
Instruments	6
Machinery	4
Food	2
All other industries	NA[1]

[14]Census Bureau restrictions prohibit disclosure of R&D data by source of funds for the motor vehicles industry in Michigan.

[1]NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

Industrial R&D expenditures in New Jersey amounted to $5.5 billion in 1985 (appendix table 8). Federal funds comprised less than 15 percent of the total (chart 20). Companies in two industries—electrical equipment and chemicals—each spent more on R&D in New Jersey than in any other State.



- Electrical equipment companies spent $2.2 billion of their own and $636 million in Federal funds on R&D activities undertaken in New Jersey in 1985. Federal funding of electrical equipment industry R&D increased at an average annual constant-dollar rate of 11.3 percent between 1981 and 1985; companies' own R&D funding rose 7.8 percent per year during this period. Although data are only available for the electronic components and "other electrical equipment" segments, it is likely that most of the industry's R&D efforts are performed by companies within the communications equipment segment.

- Firms in the chemicals industry spent $1.3 billion of their own funds on R&D in New Jersey in 1985 and only $1 million in Federal funds. Over 70 percent of these monies were spent by companies in the industry's drugs and medicines segment. New Jersey leads all States in R&D spending by pharmaceutical companies. These firms' R&D expenditures increased at an average annual rate of 5.2 percent between 1981 and 1985.

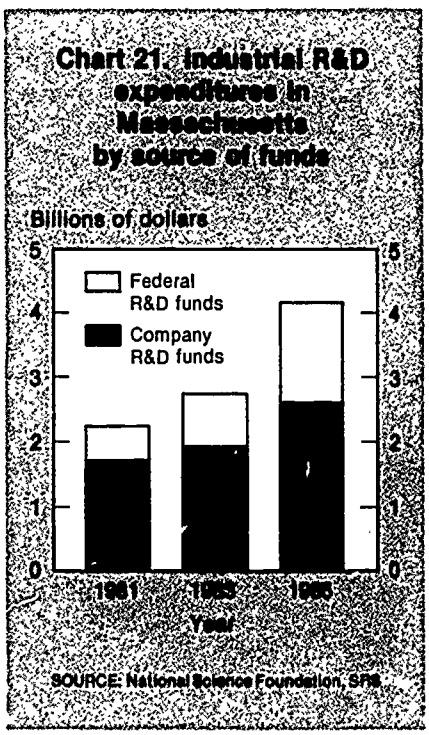
- The petroleum, instruments, and machinery industries ranked third, fourth, and fifth, respectively, in terms of R&D expenditures in New Jersey in 1985. New Jersey ranks second, after Texas, in R&D spending by the petroleum industry. Within the machinery industry, firms in the "other machinery" segment were responsible for most of the R&D expenditures, while companies in the industry's computer segment spent only $83 million (all companies' own funds) in 1985.

massachusetts

Total 1985 R&D expenditures:	$4.173 billion
Electrical equipment	46%
Machinery	23
Instruments	13
Aircraft and missiles	7
Chemicals	3
Nonmanufacturing	2
All other industries	5

Firms spent $4.2 billion on R&D projects undertaken in Massachusetts in 1985 (chart 21); $1.6 billion of these funds was provided by Federal agencies (appendix table 9). Four-fifths of the total, or $3.4 billion, was spent by companies in the electrical equipment, computer, and instruments industries, many of which are located along Massachusetts' high technology corridor, Route 128. Companies in these three industries were largely responsible for Massachusetts' above-average growth rate in industrial R&D spending between 1981 and 1985.

- Almost one-half of industrial R&D program funds in Massachusetts were spent by companies in the electrical equipment industry, making this State second only to New Jersey in terms of R&D expenditures by the electrical equipment industry. These firms spent $746 million of their own and $1.2 billion in Federal funds in Massachusetts in 1985. Federal funding of R&D projects performed by the electrical equipment industry in this State almost tripled in constant dollars between 1981 and 1985. In contrast, companies' own funding fell at an average annual rate of 5.6 percent per year during this period. Almost two-thirds of



the total amount of R&D expenditures in Massachusetts in 1985 reported by electrical equipment companies were spent by firms in the industry's communications segment.

- Companies in the machinery industry's computer segment spent $873 million of their own funds on R&D activities in Massachusetts in 1985. The average annual rate of increase in R&D investment by computer firms was 12.9 percent between 1981 and 1985.
- The instruments industry had the third highest total, $559 million, of R&D expenditures in Massachusetts in 1985; companies in the scientific and mechanical measuring instruments segment accounted for two-thirds of this amount.
- Companies in the aircraft and missiles industry spent $274 million on R&D projects undertaken in Massachusetts in 1985; Federal agencies provided over 90 percent of these funds.
- Firms in the chemicals industry reported spending $125 million of their own funds on R&D projects undertaken in Massachusetts in 1985; almost all of these funds were spent by companies in the industrial chemicals segment. R&D spending by this industry segment rose at an average annual rate of 6.9 percent between 1981 and 1985.

pennsylvania

Total 1985 R&D expenditures:	$3.570 billion
Electrical equipment	37%
Chemicals	20
Aircraft and missiles	8
Machinery	7
Instruments	7
Primary metals	6
Petroleum	3
All other industries	12

Industrial R&D expenditures in Pennsylvania totaled $3.6 billion in 1985; approximately 30 percent of these outlays were Federal funds (appendix table 10). Companies in the electrical equipment and chemicals industries were responsible for most of the industrial R&D spending in Pennsylvania in 1985. Of the 10 leading States in terms of industrial R&D expenditures, Pennsylvania is the only one with a lower level of industrial R&D spending in 1985 than in 1983 (chart 22). This decline is largely attributable to changes in companies' own R&D spending in the electrical equipment industry.

- Companies in the electrical equipment industry spent a total of $1.3 billion on R&D in Pennsylvania in 1985. (Over two-thirds of these funds were spent by companies in the industry's "other electrical equipment" group[15] and one-fourth was spent by firms in the communications equipment segment.) Of this total, Federal funds comprised approximately 60 percent. In 1981, companies' own expenditures on R&D projects were estimated to be $830 million; these outlays first increased to about $1.2 billion in 1983 and then declined in 1985 to $572 million. Companies' R&D budgets shrank because of financial constraints caused by poor sales in some product areas; according to company R&D officials, there was a significant reduction in the purchase of electric transmission equipment by utility companies. In contrast, industry expenditures of Federal funds—which were less than one-half the level of companies' own funding in 1981 and 1983—increased at an average annual rate of 14.9 percent in constant dollars between 1981 and 1985.

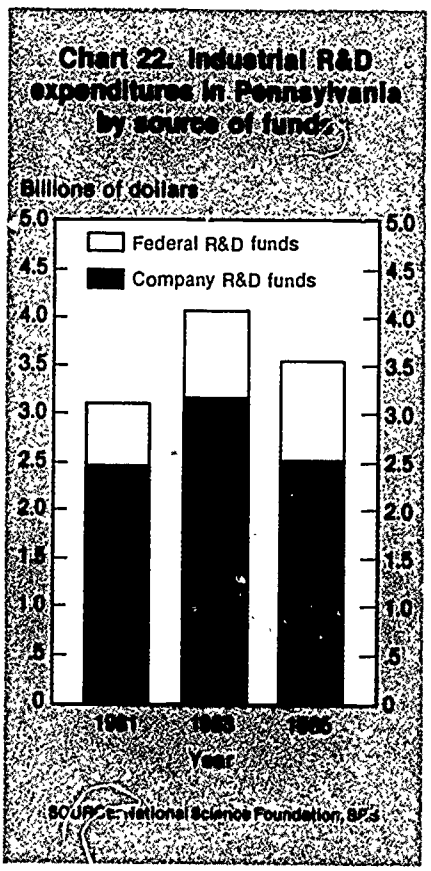


Chart 22. Industrial R&D expenditures in Pennsylvania by source of funds

SOURCE: National Science Foundation, SRS

- Companies in the chemicals industry had the second highest level, $716 million, of R&D spending in Pennsylvania. Federal funds represented less than 3 percent of these expenditures. Within the chemicals industry, companies in the industrial chemicals segment spent a total of $316 million and drugs and medicines firms spent $354 million in 1985. These two industry segments reported average annual increases of 11.1 percent and 4.9 percent, respectively, between 1981 and 1985.
- Aerospace companies spent $239 million in Federal and $61 million in company R&D funds in 1985. Total R&D spending by this industry increased at an average annual rate of 9.9 percent between 1981 and 1985.

[15]The "other electrical equipment" industry group includes firms that manufacture electric transmission and distribution equipment, electrical industrial apparatus, household appliances, and electric lighting and wiring equipment.

- The machinery and instruments industries each had a total of around $250 million in R&D expenditures in Pennsylvania in 1985; less than $5 million in Federal R&D funds were used by companies in these two industries. Firms in the computer segment were responsible for almost 80 percent of the machinery industry's R&D outlays in Pennsylvania.
- Companies in the primary metals industry (which includes steel manufacturers) reported $218 million in R&D expenditures in Pennsylvania in 1985; only $9 million were Federal R&D funds. Likewise, of the $119 million spent by companies in the petroleum industry, only $3 million were Federal R&D funds.

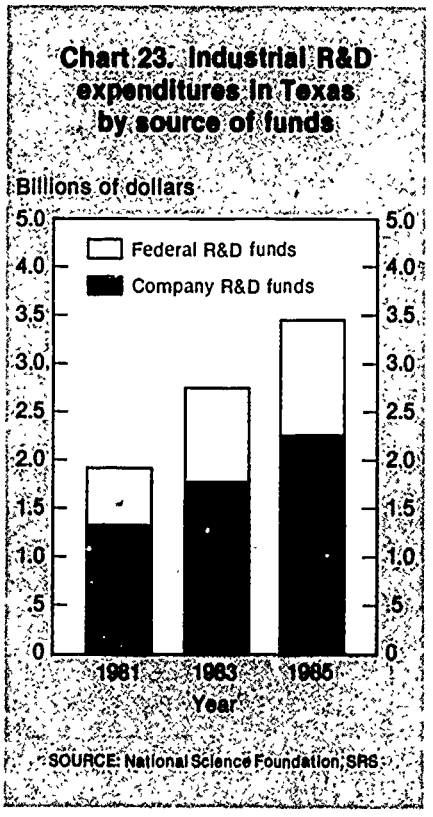
texas

Total 1985 R&D expenditures:	$3.492 billion
Electrical equipment	25%
Primary metals	NA[1]
Petroleum refining	15
Aircraft and missiles	15
Machinery	12
Chemicals	7
Instruments	5
Nonmanufacturing	2
All other industries	NA[1]

[1]NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

Companies spent $2.3 billion of their own and $1.2 billion in Federal funds (chart 23) on R&D activities performed in Texas during 1985 (appendix table 11). Companies in almost all major industries reported R&D spending in Texas: no single industry dominates this State in terms of R&D expenditures.

- The industry with the highest level of R&D expenditures in Texas is the electrical equipment industry which in 1985 had total R&D outlays of $869 million. More than two-thirds of the funds spent by companies in this industry were companies' own. The electrical equipment industry also had the largest percentage increase in R&D expenditures of any industry in Texas. Both companies' own (19.9 percent per year) and Federal (12.4 percent per year) funding increased rapidly between 1981 and 1985. In 1985, two industry segments—electronic components and communications equipment—accounted for 95 percent of the electrical equipment industry's total R&D expenditures.
- Several defense contractors have large operations in Texas. These companies, which are in the primary metals and aircraft and missiles industries, spent $847 million in Federal funds, accounting for 70 percent of the total amount of Federal R&D support to industry in Texas in 1985. In the aircraft and missiles industry, Federal R&D expenditures increased 10.9 percent per year between 1981 and 1985; in contrast, companies' own funding fell 5.9 percent annually during this period.
- Texas is the leading State in terms of R&D expenditures by companies in the petroleum industry; about one-fourth of this industry's own R&D funds were spent in Texas in 1985. (Between 1981 and 1985, all R&D spending in the United States by the petroleum industry fell at an average annual rate of 1.6 percent in real dollars.) Firms in the petroleum industry spent only a small amount of Federal funds on R&D in Texas in 1985.
- The machinery industry had the fifth highest level, $413 million, of R&D spending in Texas in 1985. Most of these funds were used by computer companies to finance their own R&D programs.
- Companies in the chemicals industry spent a total of $250 million on R&D activities undertaken in Texas in 1985; at least three-fourths of these funds were reported by firms in the industrial chemicals segment of this industry. The average annual rate of increase in R&D spending for all companies in the chemicals industry was 8.2 percent between 1981 and 1985. Nearly all funds spent by firms in the chemicals industry in Texas are companies' own financial resources.



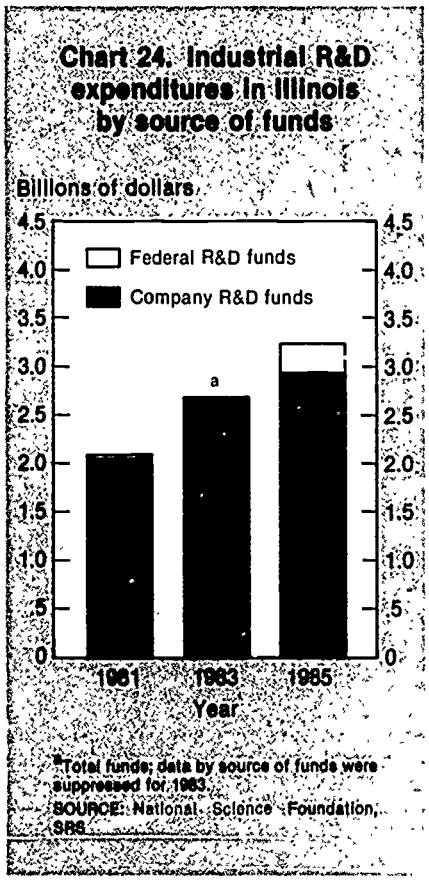
illinois

Total 1985 R&D expenditures:	$3.231 billion
Electrical equipment	33%
Machinery	20
Chemicals	16
Aircraft and missiles	10
Food and tobacco	4
Instruments	3
All other industries	14

Illinois' industrial R&D outlays were $3.2 billion in 1985 (appendix table 12). Less than 10 percent of these expenditures were Federal funds (chart 24). Three of the four major R&D-performing industries in this State—aircraft and missiles, chemicals, and electrical equipment—had significant increases in R&D spending between 1981 and 1985. Concurrently, there was a decline in constant dollars in R&D outlays in the machinery industry.

- Companies in the electrical equipment industry have the largest amount of expenditures on R&D activities in Illinois, totaling $1.1 billion; all but $30 million of these funds were companies' own financial resources. Total R&D expenditures by firms in this industry increased at an average annual rate of 8.9 percent between 1981 and 1985. Companies in the communications equipment segment are responsible for most of the electrical equipment industry's R&D spending in Illinois.
- The machinery industry had the second highest level of R&D funding in Illinois in 1985. The "other machinery" segment[16] of this industry spent $595 million in 1985, almost no change over its 1981 R&D funding level. Companies in this group that manufacture farm machinery and machine tools experienced a significant decline in both foreign and domestic sales that limited the amount of financial resources available for their R&D programs.[17]
- Chemicals companies spent $514 million on R&D in Illinois in 1985. This represented a 13.9-percent average annual increase over the 1981 level.
- Firms in the aircraft and missiles industry reported spending $328 million of their own and Federal funds on R&D projects undertaken in Illinois in 1985. This industry's 1981-85 average annual rate of increase was 22.8 percent, the highest of any industry in this State.
- Among the smaller R&D-performing industries in Illinois, food and tobacco companies and instruments firms spent $140 million and $92 million, respectively, in 1985.

Chart 24. Industrial R&D expenditures in Illinois by source of funds



[a]Total funds; data by source of funds were suppressed for 1983.
SOURCE: National Science Foundation, SRS

[16]The "other machinery" industry segment includes firms that manufacture engines and turbines, farm machinery and equipment, construction, mining, and materials-handling machinery and equipment, and metal-working machinery and equipment.

[17]National Science Foundation, "Plans for Company-Funded Research and Development Show 12% Annual Increases Through 1985," *Science Resources Studies Highlights* (NSF 84-329) (Washington, D.C., October 15, 1984.)

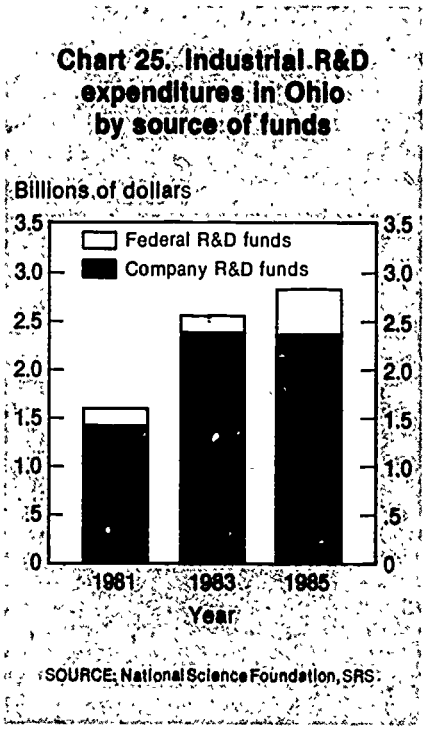
ohio

Total 1985 R&D expenditures:	$2.847 billion
Electrical equipment	24%
Chemicals	20
Rubber products	19
Machinery	7
Motor vehicles	NA[1]
Stone, clay, and glass	NA[1]
Petroleum refining	NA[1]
Nonmanufacturing	3
Primary metals	3
Aircraft and missiles	2
Instruments	2
All other industries	5

[1]NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

Companies spent $2.4 billion of their own and $484 million in Federal funds (chart 25) on R&D activities undertaken in Ohio in 1985 (appendix table 13). Although Ohio has a diversified economic base—all of its industries have significant R&D expenditures—almost two-thirds of all R&D outlays in 1985 were accounted for by firms in three industries: electrical equipment, chemicals, and rubber.

Chart 25. Industrial R&D expenditures in Ohio by source of funds



SOURCE: National Science Foundation, SRS

- R&D funds spent by companies in the electrical equipment industry in Ohio tripled in constant dollars between 1981 and 1985, rising to $692 million. Most of this increase occurred in companies' own R&D funding between 1981 and 1983. Companies in the "other electrical equipment" group were responsible for 85 percent of the electrical equipment industry's R&D expenditures in 1985.
- Companies in the chemicals industry had the second highest level, $571 million, of R&D expenditures in Ohio. Almost all of these expenditures were companies' own funds. R&D spending by this industry increased at an average annual rate of 9.7 percent between 1981 and 1985.
- Firms in the rubber industry, most of which are tire manufacturers, spent a total of $533 million on R&D activities in Ohio in 1985, almost one-half of all R&D expenditures made by this industry.
- Companies in the computer and "other machinery" segment of the machinery industry spent $80 million and $110 million, respectively, of their own funds on R&D activities undertaken in Ohio in 1985.
- The motor vehicles; stone, clay, and glass; and petroleum refining industries which rank fifth, sixth, and seventh in terms of R&D spending in Ohio had a combined total of $439 million in 1985. Less than $2 million of these expenditures were Federal funds.
- Nonmanufacturing industries and three others—primary metals, aircraft and missiles, and instruments—each had R&D expenditures of $50-75 million in Ohio in 1985.

appendix

detailed statistical tables

appendix

detailed statistical tables

Appendix table 1. Ranking of States by selected characteristics: 1985

State	R&D Performance			All scientists and engineers	Population
	Total Industrial	Federal Intra-mural	Universities and colleges		
California	1	3	1	1	1
New York	2	20	2	2	2
Michigan	3	25	8	8	8
New Jersey	4	5	21	7	9
Massachusetts	5	13	4	9	12
Pennsylvania ..	6	11	6	4	4
Texas	7	10	3	3	3
Illinois	8	22	7	6	5
Ohio	9	7	9	5	7
Washington ...	10	19	13	12	19
Connecticut ...	11	14	15	16	28
Minnesota	12	32	16	18	21
Florida	13	9	14	13	6
Maryland	14	1	5	10	20
Indiana	15	27	20	20	14
Missouri	16	28	19	17	15
Arizona	17	18	22	28	27
Colorado	18	17	18	15	26
Delaware	19	50	45	37	47
Virginia	20	6	17	14	13

NOTE: Information on 30 States and the [illegible] Columbia was not included because of Census Bureau restrictions prohibiting the disclosure of industrial R&D data for some [illegible]tes.
SOURCES: National Science Foundation, SRS, [illegible]ureau of the Census

Appendix table 2. Industry R&D expenditures by State: 1981, 1983, and 1985

[Dollars in millions]

State	1981	1983	1985
All States, total[1]	$51,810	$63,403	$78,208
Northeast, total	14,171	18,737	23,058
New England, total	4,2?5	5,156	6,922
Maine	NA	NA	NA
New Hampshire	NA	NA	294
Vermont	NA	NA	NA
Massachusetts	2,223	2,775	4,173
Rhode Island	98	169	198
Connecticut	1,571	1,864	1,976
Middle Atlantic, total	9,955	13,581	16,136
New York	3,490	4,866	7,019
New Jersey	3,354	4,655	5,547
Pennsylvania	3,111	4,060	3,570
North Central, total	11,781	14,495	18,001
East North Central	9,294	11,481	14,161
Ohio	1,581	2,544	2,847
Indiana	956	1,107	1,433
Illinois	2,073	2,689	3,231
Michigan	4,029	4,477	5,975
Wisconsin	655	664	676
West North Central, total	2,487	3,104	3,840
Minnesota	1,019	1,477	1,971
Iowa	334	322	317
Missouri	901	818	1,208
North Dakota	NA	NA	10
South Dakota	NA	NA	7
Nebraska	NA	24	42
Kansas	218	368	285
South, total	7,251	9,297	12,020
South Atlantic, total	3,933	4,726	6,812
Delaware	NA	NA	NA
Maryland	525	547	1,437
District of Columbia	NA	NA	NA
Virginia	523	845	800
West Virginia	NA	NA	NA
North Carolina	508	754	797
South Carolina	136	149	389
Georgia	2?7	342	515
Florida	1,404	1,347	1,832
East South Central, total	955	1,221	1,209
Kentucky	NA	NA	221
Tennessee	452	495	538
Alabama	144	299	387
Mississippi	NA	NA	62

Appendix table 2. Industry R&D expenditures by State: 1981, 1983, and 1985—Continued

[Dollars in millions]

State	1981	1983	1985
West South Central, total	2,363	3,350	3,998
Arkansas	8	5	15
Louisiana	152	229	187
Oklahoma	243	337	304
Texas	1,940	2,771	3,492
West, total	15,124	18,087	23,738
Mountain, total	2,246	2,903	3,496
Montana	NA	NA	NA
Idaho	244	303	419
Wyoming	4	2	3
Colorado	496	776	917
New Mexico	NA	NA	NA
Arizona	728	895	1,002
Utah	NA	247	317
Nevada	NA	NA	NA
Pacific, total	12,878	15,984	20,242
Washington	NA	1,413	2,183
Oregon	NA	NA	285
California	10,765	14,237	17,760
Alaska	NA	NA	NA
Hawaii	NA	NA	NA
Undistributed funds	3,483	1,987	1,391

[1]Includes companies' own funds and Federal funds spent by companies to perform R&D.

NOTE. NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

SOURCE: National Science Foundation, SRS

Appendix table 3. Federal R&D funds spent by industry by State: 1981, 1983, and 1985

[Dollars in millions]

State	1981	1983	1985
All States, total	$16,382	$20,542	$26,484
Northeast, total	2,574	3,938	6,064
New England, total	1,074	1,525	2,373
Maine	NA	NA	NA
New Hampshire	NA	NA	NA
Vermont	NA	NA	NA
Massachusetts	523	819	1,556
Rhode Island	NA	NA	NA
Connecticut	456	534	520
Middle Atlantic, total	1,500	2,413	3,691
New York	446	844	1,913
New Jersey	427	681	727
Pennsylvania	627	888	1,051
North Central, total	1,479	1,327	1,959
East North Central, total	600	526	1,081
Ohio	175	162	484
Indiana	121	140	NA
Illinois	49	NA	287
Michigan	NA	NA	85
Wisconsin	NA	NA	NA
West North Central, total	879	801	878
Minnesota	NA	NA	NA
Iowa	NA	NA	NA
Missouri	NA	NA	NA
North Dakota	0	0	1
South Dakota	0	0	0
Nebraska	NA	NA	NA
Kansas	NA	NA	NA
South, total	2,183	3,102	4,205
South Atlantic, total	1,186	1,431	2,327
Delaware	NA	NA	NA
Maryland	305	258	813
District of Columbia	NA	NA	NA
Virginia	243	420	459
West Virginia	NA	NA	NA
North Carolina	NA	NA	1
South Carolina	NA	NA	NA
Georgia	NA	NA	NA
Florida	435	555	820
East South Central, total	396	545	621
Kentucky	NA	NA	0
Tennessee	NA	NA	NA
Alabama	66	175	253
Mississippi	NA	NA	NA
West South Central, total	601	1,036	1,257

Appendix table 3. Federal R&D funds spent by industry by State: 1981, 1983, and 1985—Continued

[Dollars in millions]

State	1981	1983	1985
Arkansas	NA	NA	0
Louisiana	NA	NA	NA
Oklahoma	NA	NA	NA
Texas	580	971	1,209
West, total	8,559	10,551	13,737
Mountain, total	1,210	1,407	1,626
Montana	0	NA	NA
Idaho	NA	NA	NA
Wyoming	0	NA	0
Colorado	124	139	150
New Mexico	NA	NA	NA
Arizona	197	215	218
Utah	NA	NA	NA
Nevada	NA	NA	NA
Pacific, total	7,349	9,144	12,111
Washington	NA	NA	1,282
Oregon	NA	NA	NA
California	6,585	8,298	10,816
Alaska	0	0	NA
Hawaii	NA	NA	NA
Undistributed funds	1,587	1,714	519

NOTE NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

SOURCE: National Science Foundation, SRS

Appendix table 4. Companies' own R&D funds by State: 1981, 1983, and 1985

[Dollars in millions]

State	1981	1983	1985
All States, total	$35,428	$42,861	$51,724
Northeast, total	11,597	14,799	16,994
New England, total	3,142	3,631	4,549
Maine	NA	NA	23
New Hampshire	NA	NA	NA
Vermont	NA	NA	NA
Massachusetts	1,700	1,956	2,617
Rhode Island	NA	NA	NA
Connecticut	1,115	1,330	1,456
Middle Atlantic, total	8,455	11,168	12,445
New York	3,044	4,022	5,106
New Jersey	2,927	3,974	4,820
Pennsylvania	2,484	3,172	2,519
North Central, total	10,302	13,168	16,042
East North Central, total	8,694	10,955	13,080
Ohio	1,406	2,382	2,363
Indiana	835	967	NA
Illinois	2,024	NA	2,944
Michigan	NA	NA	5,890
Wisconsin	NA	NA	NA
West North Central, total	1,608	2,213	2,962
Minnesota	NA	NA	NA
Iowa	NA	NA	NA
Missouri	NA	NA	NA
North Dakota	NA	NA	9
South Dakota	NA	NA	7
Nebraska	NA	NA	NA
Kansas	NA	NA	NA
South, total	5,068	6,285	7,815
South Atlantic, total	2,747	3,295	4,485
Delaware	NA	NA	NA
Maryland	220	289	624
District of Columbia	NA	NA	NA
Virginia	280	425	341
West Virginia	NA	NA	94
North Carolina	NA	NA	796
South Carolina	NA	NA	NA
Georgia	NA	NA	NA
Florida	969	792	1,012
East South Central, total	559	676	588
Kentucky	NA	NA	221
Tennessee	NA	NA	NA
Alabama	78	124	134
Mississippi	NA	NA	NA
West South Central, total	1,762	2,314	2,741

Appendix table 4. Companies' own R&D funds by State: 1981, 1983, and 1985—Continued

[Dollars in millions]

State	1981	1983	1985
Arkansas	NA	NA	15
Louisiana	NA	NA	NA
Oklahoma	NA	NA	NA
Texas	1,360	1,800	2,283
West, total	6,565	8,336	10,001
Mountain, total	1,036	1,496	1,870
Montana	NA	NA	NA
Idaho	NA	NA	NA
Wyoming	NA	NA	3
Colorado	372	637	767
New Mexico	NA	NA	38
Arizona	531	680	784
Utah	NA	NA	NA
Nevada	NA	NA	28
Pacific, total	5,529	6,840	8,131
Washington	NA	NA	901
Oregon	NA	NA	NA
California	4,180	5,939	6,944
Alaska	NA	NA	NA
Hawaii	NA	NA	NA
Undistributed funds	1,896	273	872

NOTE. NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies. For most, if not all, States, companies' own funding data are being withheld because of restrictions affecting the publication of data on Federal R&D support to industry.

SOURCE: National Science Foundation, SRS

Appendix table 5. Total R&D expenditures by industry and source of funds in California: 1985

[Dollars in millions]

Industry	SIC code	Total R&D funds	Federal R&D funds	Company R&D funds
All industries, total	—	$17,760	$10,816	$6,944
Chemicals and allied products	28	383	NA	NA
Industrial chemicals	281-82,286	45	NA	NA
Drugs and medicines	283	259	NA	NA
Other chemicals	284-85,287-89	79	NA	NA
Petroleum refining	29	442	NA	NA
Machinery	35	1,237	95	1,142
Office, computing, and accounting machines	357	1,098	NA	NA
Other machinery	351-56,358-59	140	NA	NA
Electrical equipment	36	1,920	575	1,345
Radio and TV receiving equipment	365	6	NA	NA
Communication equipment	366	711	386	325
Electronic components	367	881	NA	NA
Other electrical equipment	361-64,369	322	NA	NA
Aircraft and missiles	372,376	9,953	9,443	510
Professional and scientific instruments	38	1,061	36	1,025
Scientific and mechanical measuring instruments	381-82	628	NA	NA
Optical, surgical, photographic, other instruments	383-87	433	NA	NA
Nonmanufacturing industries	10-17,41-67, 737,739,807, 891	1,079	438	641
All other industries	—	1,685	165	1,520

NOTE. NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

SOURCE: National Science Foundation, SRS

Appendix table 6. Total R&D expenditures by industry and source of funds in New York: 1985

[Dollars in millions]

Industry	SIC code	Total R&D funds	Federal R&D funds	Company R&D funds
All industries, total	—	$7,019	$1,912	$5,107
Chemicals and allied products	28	1,154	NA	NA
Industrial chemicals	281-82,286	632	NA	NA
Drugs and medicines	283	231	NA	NA
Other chemicals	284-85,287-89	291	NA	NA
Machinery	35	NA	NA	NA
Electrical equipment	36	1,503	678	825
Radio and TV receiving equipment	365	NA	NA	NA
Communication equipment	366	798	427	371
Electronic components	367	99	NA	NA
Other electrical equipment	361-64,369	NA	NA	NA
Motor vehicles	371	232	NA	NA
Aircraft and missiles	372,376	413	253	160
Professional and scientific instruments	38	NA	NA	NA
Nonmanufacturing industries	10-17,41-67, 737,739,807, 891	147	88	59
All other industries	—	412	2	410

NOTE NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

SOURCE: National Science Foundation, SRS

Appendix table 7. Total R&D expenditures by industry and source of funds in Michigan: 1985

[Dollars in millions]

Industry	SIC code	Total R&D funds	Federal R&D funds	Company R&D funds
All industries, total	—	$5,975	$85	$5,890
Chemicals and allied products	28	607	NA	NA
Primary metals	33	70	25	45
Machinery	35	127	0	127
Office, computing, and accounting machines	357	20	0	20
Other machinery	351-56,358-59	106	0	106
Electrical equipment	36	60	5	55
Radio and TV receiving equipment	365	NA	0	NA
Comunication equipment	366	11	5	6
Electronic components	367	NA	0	NA
Other electrical equipment	361-64,369	32	0	32
Motor vehicles	371	4,796	NA	NA
Aircraft and missiles	372,376	114	33	81
Nonmanufacturing industries	10-17,41-67, 737,739,807, 891	58	NA	NA
All other industries	—	143	1	142

NOTE: NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

SOURCE: National Science Foundation, SRS

Appendix table 8. Total R&D expenditures by industry and source of funds in New Jersey: 1985

[Dollars in millions]

Industry	SIC code	Total R&D funds	Federal R&D funds	Company R&D funds
All industries, total	—	$5,547	$727	$4,820
Food and tobacco products	20,21	109	0	109
Chemicals and allied products	28	1,322	1	1,321
Industrial chemicals	281-82,286	250	1	249
Drugs and medicines	283	940	0	940
Other chemicals	284-85,287-89	132	0	132
Petroleum refining	29	NA	NA	NA
Machinery	35	244	NA	NA
Office, computing, and accounting machines	357	83	0	83
Other machinery	351-56,358-59	161	NA	NA
Electrical equipment	36	2,878	636	2,242
Radio and TV receiving equipment	365	NA	NA	NA
Communication equipment	366	NA	NA	NA
Electronic components	367	35	NA	NA
Other electrical equipment	361-64,369	40	NA	NA
Professional and scientific instruments	38	333	NA	NA
All other industries	—	NA	NA	140

NOTE. NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

SOURCE: National Science Foundation, SRS

Appendix table 9. Total R&D expenditures by industry and source of funds in Massachusetts: 1985

[Dollars in millions]

Industry	SIC code	Total R&D funds	Federal R&D funds	Company R&D funds
All industries, total	—	$4,173	$1,556	$2,617
Chemicals and allied products	28	125	0	125
Industrial chemicals	281-82,286	112	0	112
Drugs and medicines	283	NA	0	NA
Other chemicals	284-85,287-89	NA	0	NA
Machinery	35	954	NA	NA
Office, computing, and accounting machines	357	873	0	873
Other machinery	351-56,358-59	81	NA	NA
Electrical equipment	36	1,940	1,194	746
Radio and TV receiving equipment	365	NA	NA	NA
Communication equipment	366	1,239	NA	NA
Electronic components	367	242	NA	NA
Other electrical equipment	361-64,369	NA	NA	NA
Aircraft and missiles	372,376	274	250	24
Professional and scientific instruments	38	559	NA	NA
Scientific and mechanical measuring instruments	381-82	378	NA	NA
Optical, surgical, photographic, and other instruments	383-87	181	NA	NA
Nonmanufacturing industries	10-17,41-67, 737,739,807, 891	103	75	28
All other industries	—	1,685	4	1,681

NOTE. NA indicates that data were suppressed because of the Census Bureau restrictions on publication of data that would reveal operations of individual companies.

SOURCE: National Science Foundation, SRS

Appendix table 10. Total R&D expenditures by industry and source of funds in Pennsylvania: 1985

[Dollars in millions]

Industry	SIC code	Total R&D funds	Federal R&D funds	Company R&D funds
All industries, total	—	$3,570	$1,051	$2,519
Chemicals and allied products	28	716	NA	NA
Industrial chemicals	281-82,286	316	NA	NA
Drugs and medicines	283	354	NA	NA
Other chemicals	284-85,287-89	47	NA	NA
Petroleum refining	29	119	3	116
Primary metals	33	190	9	181
Machinery	35	255	3	252
Office, computing, and accounting machines	357	250	NA	NA
Other machinery	351-56,358-59	55	NA	NA
Electrical equipment	36	1,325	753	572
Radio and TV receiving equipment	365	NA	NA	NA
Communication equipment	366	344	NA	NA
Electronic components	367	NA	NA	NA
Other electrical equipment	361-64,369	901	NA	NA
Aircraft and missiles	372,376	300	239	61
Professional and scientific instruments	38	252	NA	NA
All other industries	—	1,685	23	1,662

NOTE: NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

SOURCE: National Science Foundation, SRS

Appendix table 11. Total R&D expenditures by industry and source of funds in Texas: 1985

[Dollars in millions]

Industry	SIC code	Total R&D funds	Federal R&D funds	Company R&D funds
All industries, total	—	$3,492	$1,209	$2,283
Chemicals and allied products	28	250	10	240
Industrial chemicals	281-82,286	207	NA	NA
Drugs and medicines	283	NA	NA	NA
Other chemicals	284-85,287-89	NA	NA	NA
Petroleum refining	29	535	NA	NA
Machinery	35	413	NA	NA
Electrical equipment	36	869	270	599
Aircraft and missiles	372,376	531	NA	NA
Professional and scientific instruments	38	169	0	169
Nonmanufacturing industries	10-17,41-67, 737,739,807, 891	82	2	80
All other industries	—	643	473	170

NOTE. NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

SOURCE: National Science Foundation, SRS

Appendix table 12. Total R&D expenditures by industry and source of funds in Illinois: 1985

[Dollars in millions]

Industry	SIC code	Total R&D funds	Federal R&D funds	Company R&D funds
All industries, total	—	$3,231	$286	$2,945
Food and tobacco products	20,21	140	0	140
Chemicals and allied products	28	514	0	514
Industrial chemicals	281-82,286	NA	0	NA
Drugs and medicines	283	378	0	378
Other chemicals	284-85,287-89	NA	0	NA
Machinery	35	632	NA	NA
Office, computing, and accounting machines	357	37	0	37
Other machinery	351-56,358-59	595	NA	NA
Electrical equipment	36	1,072	30	1,042
Radio and TV receiving equipment	365	NA	NA	NA
Communication equipment	366	NA	NA	NA
Electronic components	367	164	6	158
Other electrical equipment	361-64,369	NA	NA	NA
Aircraft and missiles	372,376	328	NA	NA
Professional and scientific instruments	38	92	NA	NA
Scientific and mechanical measuring instruments	381-82	68	NA	NA
Optical, surgical, photographic, and other instruments	383-87	23	NA	NA
All other industries	—	453	10	443

NOTE: NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

SOURCE: National Science Foundation, SRS

Appendix table 13. Total R&D expenditures by industry and source of funds in Ohio: 1985

[Dollars in millions]

Industry	SIC code	Total R&D funds	Federal R&D funds	Company R&D funds
All industries, total	—	$2,847	$484	$2,363
Chemicals and allied products	28	571	NA	NA
Industrial chemicals	281-82,286	239	NA	NA
Drugs and medicines	283	NA	0	NA
Other chemicals	284-85,287-89	NA	0	NA
Rubber products	30	533	NA	NA
Primary metals	33	74	NA	NA
Machinery	35	190	0	190
Office, computing, and accounting machines	357	80	0	80
Other machinery	351-56,358-59	110	0	110
Electrical equipment	36	692	NA	NA
Radio and TV receiving equipment	365	NA	0	NA
Communication equipment	366	NA	0	NA
Electronic components	367	NA	0	NA
Other electrical equipment	361-64,369	591	NA	NA
Aircraft and missiles	372,376	60	NA	NA
Professional and scientific instruments	38	52	0	52
Scientific and mechanical measuring instruments	381-82	19	0	19
Optical, surgical, photographic, and other instruments	383-87	33	0	33
Nonmanufacturing industries	10-17,41-67, 737,739,807, 891	75	68	7
All other industries	—	453	2	451

NOTE. NA indicates that data were suppressed because of Census Bureau restrictions on publication of data that would reveal operations of individual companies.

SOURCE: National Science Foundation, SRS