

CALIFORNIA SCIENCE AND TECHNOLOGY INDICATORS

**A REPORT PREPARED FOR
THE CALIFORNIA COUNCIL ON SCIENCE AND TECHNOLOGY**

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ABOUT THE CCST CALIFORNIA REPORT ON THE ENVIRONMENT FOR SCIENCE AND TECHNOLOGY

CCST's California Report on the Environment for Science and Technology (CREST) has analyzed the state's science and technology infrastructure to determine if California has the people, capital investment and necessary state governmental policies to maintain California's leadership in the face of increasing worldwide competition. Through eight individual research projects, CREST analyzes the state's ability to create and use new technology. By facilitating a dialog with policy makers, industry leaders, and academic communities, CCST hopes to enhance economic growth and quality of life for Californians.

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1. Introduction

This report presents an overview of science and technology (S&T) indicators for California based on data collected by the federal government. The federal government conducts surveys of industrial and academic expenditures for research and development, as well as tracking federal expenditures, patent statistics, and other science and technology indicators. Most of the data have been collected in a consistent manner for a decade or more. These federal surveys are an important source of information about intertemporal and cross-regional variations of S&T activities in the United States.

The discussion and tables that follow address the following points:

First, California industry conducts a remarkable quantity of research and development. In 1997, over 20% of all US industrial R&D expenditures were spent in California. In that year, the state contained about 12% of the country's population, and generated just under 13% of the country's gross domestic product. The state's economy and workforce, relative to the rest of the country, is highly dependent on science and technology.

Second, whereas disproportionate industry R&D has been the norm in California for at least twenty years, the composition of expenditures has undergone a dramatic change. In 1981, 61% of the R&D performed by industry in California was financed by the federal government, primarily from the Department of Defense and NASA, and the remaining 39% by industry. By 1997 the shares had more than reversed: industry financed over 82% of R&D performed by industry, and the federal government paid for less than 12% of industry R&D. Federal support for industrial R&D in California has declined steadily over the past decade. By 1997 it had fallen by nearly two-thirds in inflation adjusted dollars from its 1989 peak. Alternatively, industry support for industrial R&D doubled over this period (after adjusting for inflation), more than making up for the reduction in federal support. In common with national trends, real expenditures on industry-performed R&D in California have doubled since 1980.

In 1985, 60% of California's manufacturing R&D was conducted by the aircraft and missile industry; by 1995 (the latest year for which this statistic is available), the share had fallen to below 25%. Computers and electronics now account for over half of the manufacturing R&D performed in California. Including the computer and data processing service categories, computers and electronics makes up nearly half of total R&D expenditures within California. California's share of industrial R&D in these categories exceeds 30%.

Mirroring the rise in industry-financed R&D is a dramatic upswing in patent assignments to California firms and inventors. This pattern, particularly during the 1980s, contrasts sharply with the rest of the country, and reflects both an increase in patenting activity by California inventors and a greater concentration of "head offices" of research-intensive firms within the state. The increase in patenting is evident in all technology classes, and is most pronounced in the electronics classes (where California assignees account for nearly a quarter of all patents assigned to U.S. inventors or firms) and biochemistry (approximately 18% in 1997).

Trends in academic spending in California appear disconnected from those of industry. The share of research expenditures spent at California universities and colleges is about 12% of total US academic research expenditures, and is roughly commensurate with California's population. Notwithstanding the increase in California's share of the country's population and gross domestic product, in the past twenty years the share of national academic research expenditures spent in California declined by one to two percent.

This decline is related to the change in the components of national support for academic research. Over the past twenty years, the federal government has become a smaller, though still dominant, supporter of academic research. Historically, California universities and colleges have been much more dependent on federal support for their research activities than is the case in most other states. Although the state's academic institutions continue to receive a substantial share of federal support for research (sources differ on the precise amount), their continuing weak relation with industry, state and local government, and other sources of research support has become critical to the overall academic research enterprise within the state.

Preliminary estimates for 1997 suggest that this trend may be slowing or that it has even reversed. State government support for academic research has increased over the past ten years by a factor of nearly two and a half, and industry support by about 60%. Nevertheless, these sources of support remain low relative to the rest of the country. State and local governments in California support academic research at about 60% the level, on a per capita basis, as such governments do nationally. Industry support for academic research currently accounts for less than ten percent of all industry support for academic research in the United States. This level is low relative to the population of California, and is dramatically low relative to the research intensity of California industry.

Aggregate measures of expenditures for higher education in California show lower per capita levels than in other states. Total expenditures on higher education in

California been nearly constant relative to the rest of the country over the past twenty years, currently accounting for about 11% of the US total. Due to the complexity of university enterprises, which incorporate hospitals, national laboratories and extensive student services, the total expenditure figures tend to be opaque. However, in key subcategories, the picture of higher education in California looks anemic. Instructional expenditures at universities and colleges have declined from 11.3 to 10.8 percent of the country's total between 1975 and 1996.

The average (per capita) research activities and lower per capita instructional expenditures are reflected in statistics about degrees awarded by California universities and colleges. Doctoral degrees are highly sensitive to research opportunities at universities. California institutions conferred 12.3 percent of the country's science and engineering doctorates in 1996. Alternatively the state's universities and colleges awarded only 10% of its bachelor's degrees. In key areas related to the state's high-tech economy, such as engineering, physical sciences, mathematics and computer sciences, the number of bachelors degrees awarded has declined over the past ten years, and account for 9% or less of the country's total.

These trends raise important questions about the science and technology enterprise in California. To what extent is the current industry R&D enterprise related to past investments by the federal government? Will the historical weakness of state and local support for science and technology in California create problems given the withdrawal in federal support? Why have universities and colleges in California failed to maintain their share of instructional resources? What are the implications of the apparent mismatch between the industry and academic sectors?

The remaining sections of this report address first, aggregate trends and the distribution of R&D among sectors, second, details about industry R&D, and third, details about the academic sector. Not all of the data is complete or collected in a manner that is appropriate for the California economy. The subsequent sections also discuss data limitations and recommend areas where additional or different surveys may be desirable.

2. Overview of Science and Technology in California

2.1 Aggregate R&D Spending in California

R&D Expenditures in California increased between 1975 and 1995 from \$7 billion to \$36 billion dollars. Preliminary data for 1997 show a continuation of the rapid increase in R&D activities, to over \$41 billion.

Correcting for inflation, expenditures more than doubled over the past twenty years.

Assessing the appropriateness of this investment is difficult. Economic growth in the United States is dependent on new technology; new technology relies on the conduct of research and development. While measuring the direct social or economic return to R&D investments in California is beyond the scope of this report, we consider a variety of indicators that bear on the issue, particularly in delineating areas that may require greater investigation. The appendix tables present data in four basic formats: first, the actual dollar figures, second, expenditures corrected for inflation, third, expenditures in California as a fraction of the U.S. total, and fourth, the distribution of expenditures within the state. Where available, data is presented for twenty years or more.

The U.S. shares give an indication of how activities in the state compare to the rest of the country. Because California is the largest state in terms of both population and economic activity, we would expect to be in general the largest performer of research. More relevant comparisons involve how the shares compare to the share of the population contained within the state – that is, whether per capita expenditures are large or small relative to the rest of the country – and how they compare to the share of economic activity within the state. Gross state product, a measure of value-added within the state, is used as the measure of economic activity (see Table a.3). Comparing R&D shares to GSP shares provides an indication of the research intensity of economic activity within the state.

Table a.1 contains population statistics for California and other large R&D-conducting states. The population of California increased slightly over the past twenty years, from 11.3% to 12%. Table a.1 also reports the populations of the top ten R&D conducting states. California, the most populous state, also spends the most money on R&D. In 1995, California accounted for nearly 20% of total U.S. R&D. California's share of the total R&D budget for the country has been near 20% for the last twenty years, with a slight increase during the 1980s.

Table a.2 contains statistics for the large R&D conducting states. Michigan, currently the second largest R&D conducting state, conducts 7.25% of the country's R&D (all figures for 1995); New York has fallen from second place in the early 1980s to third place in 1995, at 6%; followed by New Jersey, Massachusetts, Texas, Illinois, Pennsylvania, Washington (the newcomer on the top ten list) and Ohio. Of these states, four, like California, conduct disproportionate per capita R&D: Michigan, New Jersey, Massachusetts, and Washington.

Regional gross state product (GSP) statistics are prepared by the Bureau of Economic Analysis (BEA).

The BEA calculates the sum of wages and salaries, proprietors income, corporate profits (pro-rated for firms that operate in more than one state), depreciation and indirect business taxes. This procedure results in a statistic equivalent to the economic value-added by activities within the state. The BEA calculates the GSP contribution of real estate by imputing a rental value to real estate within the state. The real estate component for California, not surprisingly, is unusually large. Relative to the rest of the country, California has a small manufacturing sector (14% of GSP compared to 17.5% in 1994; see table b.4), a large service sector, and a very large "Finance insurance and real estate" sector. (The sectoral issues are discussed in more detail in the subsequent section.)

Table a.3 presents statistics about Gross State Product for the top ten R&D performing states. Between 1977 and 1991, California's share of the U.S. economy grew from 11.6% to nearly 14%. California GSP fell between 1991 and 1994 to 12.8%. Between 1994 and 1997 the California economy, in concert with the rest of the country, grew at a healthy annual real rate of between two and three percent. Its share of the U.S. economy has remained constant at around 12.7%.

For the past ten years, R&D has in most years comprised more than 4% of GSP in California, substantially higher than the U.S. average or the share of the economies devoted to R&D in either Japan or Germany (table a.4). Of the other major R&D states, Michigan and Massachusetts have higher R&D-to-GSP ratios; some smaller states (most notably New Mexico) have ratios that are still higher.

2.2 Distribution of R&D Expenditures in California

Industrial activities dominate California science and technology, as is the case in most of the major R&D conducting states (table a.5). Industrial activities -- specifically development -- are costly relative to the R&D activities conducted by universities, colleges or government agencies. Hence, the big spenders, not surprisingly, are those states with large industrial R&D operations. In 1997, 83% of California R&D was performed by industry, compared to 77% for the country overall.

In the past decade, industry has taken the lead in California in both performing R&D and in paying for it, taking over the previous dominant position of the federal government, and bringing the aggregate structure of California R&D more into line with other large states. (See tables a.6 and a.7 for breakdowns for other states.) Combining its support for industry, university and college research, FFRDCs and intramural research, the federal

government in 1985 paid for two-thirds of the R&D performed in California, compared to 46% nation-wide. In 1995, the federal share of R&D had declined to 35% at the national level, and to about 38% in California. Preliminary statistics for 1997 show this trend continuing, with the federal share of R&D support at 28% nationally and about 30% within California.

Changes in the sample of firms used in the federal government's industrial research survey in 1992 mean that some caution is required in interpreting the time series of expenditures. During the 1980s, the types of firms conducting R&D in the United States changed. As a result, by the end of the decade, the sample of firms used in the surveys underrepresented some sectors, and resulted in a substantial undercount, particularly for R&D performed by small firms, start-ups, and firms in the service sector. For 1991 (the first year for which the new sample was used) the discrepancy between the old and new samples yielded a 14% increase in estimated industrial R&D performance nationally. The state statistics have not been updated, so that figures reported here for 1989 and earlier years are based on the earlier sample; those for 1991 and later are based on the revised sample. This means that reported industry R&D performance, and particularly industry-supported and industry-performed R&D, has a substantial downward bias in 1989, and is biased as well (although less so) for the mid-1980s. Furthermore, because California industry is more service-sector and start-up firm intensive than the rest of the country, the statistics for California for the late 1980s are probably more biased downward than for the country at large.

Comparisons from the early 1980s to the 1990s, as well as within the 1990s, are considered reliable, and the major trends are valid, although they may appear more concentrated in the late 1980s than is accurate. However, the sampling difficulties imply the following. First, industry-supported and performed R&D reported for 1987 and 1989 may be too low by at least ten percent, and possibly by fifteen percent. Second, industry had probably taken the lead in paying for R&D within California by 1989. Third, the distribution of industry-supported versus federally-supported industry research within California probably did not diverge from the rest of the country in the late 1980s as much as is reported in the tables, although the discrepancy was certainly important. Finally, and most significantly, the increase in industry-supported and performed R&D reported between 1989 and 1991 may be in error: the 5% real increase, and even the 14% nominal increase, is within the error range suggested by the sampling change. Thus, the decline in R&D spending in California between 1989 and 1991 is probably deeper than table a.5 reports.

The distribution of R&D by sector shows considerable variance across states. Table a.7 suggests that the variance in the aggregate levels is largely due to differences in industrial R&D rather than in academia. The share of the country's academic R&D performed in these states is close to their share of the country's population. (Massachusetts is a notable outlier.) California devotes 7% of its R&D to academic research. While low relative to the rest of the country, the number should be interpreted as evidence that the industrial operation is unusually high, rather than that the academic enterprise is particularly low. Academic research expenditures in California are close to 12% of the country's total academic R&D, slightly lower than proportionate to the state's population.

Finally, California contains a remarkable number of university federally-financed R&D centers (ffrdc's), including several national laboratories. While currently a modest share of total R&D within the state, over half of all such expenditures occur within California. These expenditures (which are not subject to the sampling discrepancies discussed earlier) reached a peak in inflation-adjusted dollars in 1989, when they comprised nearly 10% of the R&D activity within the state. This activity has declined by over 30% (inflation-adjusted) since 1989, and is now less than 5% of R&D expenditures within the state.

2.3 Federal Agency Support for R&D in California

Table a.8 presents data about federal support for R&D to California by agency. The agencies report budget obligations, rather than expenditures, so the data in tables a.8 and a.5 are not necessarily comparable. (A second, but less significant difference between the data in tables a.5 and a.8 is that the obligation data are reported for fiscal years, whereas the industry expenditure data are reported for calendar years.) Obligations are useful for planning budgets in Washington, as they include the expenditures committed to be spent in future years for current projects. The data are less useful for assessing trends or status, because it is not possible to sort out annual expenditures from them (this becomes more problematic in the disaggregated data presented in sections 3 and 4), and because the federal government may ultimately choose not to spend money obligated in prior years. In recent years, large discrepancies have occurred in R&D expenditures reported by some agencies and by industry, particularly for the Department of Defense; these discrepancies are more pronounced for obligations data.

In brief, the data reported in Table a.8. need to be viewed with some skepticism, and are probably too high relative to each agencies' expenditures. The biases vary

with agency, and are likely to be largest for the Defense Department. However, within each agency, there is no reason to be more skeptical of the California numbers than those for the rest of the country, so that the relative shares are not particularly problematic for the larger agencies. Large variance in smaller agencies, most notably the National Science Foundation, suggests that high years are actually reporting multi-year expenditures. More recent years are likely to have higher upward biases than earlier years due to greater instability in some of the science programs (e.g., the cancellation of the SSC, cutbacks in defense spending, and changes in the Space Station program).

With these caveats, Table a.8 supports the following points: First, the data confirm the picture presented by the expenditure data in Table a.5: California has enjoyed disproportionate aggregate federal R&D support for the past fifteen years, but the share (as well as the level) has declined. Second, NASA and the Department of Defense have consistently made up three-quarters of the federal agency support to California. These agencies are responsible for both the large federal presence and declining state share of the federal pie. California's share of DOE support is also high. The Departments of Agriculture, Commerce and other smaller science agencies sponsor relatively little R&D in California. The state receives substantial funds from the Department of Health and Human Services. Currently the second largest R&D sponsor in the government (and largest sponsor of research), HHS's obligation of \$1.3 billion to California in 1995 is less than 12% of the total HHS R&D budget.

3. Industry R&D in California

3.1 Federal Support to California Industry

The dramatic shift in industry R&D expenditures over the past fifteen years from federal to private support is shown in Table b.1. The federal share has declined from over 60% in 1981 to under 20% in 1997. The dominant role of defense activities in federal support is also clear in table b.2., which reviews federal agency obligations to California industry. In 1997, combined obligations from DoD and NASA comprised 95% of the federal support to California industry. The science agencies – particularly HHS and NSF – are more active in university support and are discussed in Section 4. However, one puzzle presented by the data on federal agency support to industry which appears in the academic sector as well, is the tiny extent of R&D support from the Department of Agriculture. California typically receives only two to four percent of the Department of Agriculture obligations to industry, notwithstanding the relatively important contribution of California agriculture to the nation's agricultural sector.

3.2 Current Distribution of Industry R&D Expenditures

The remainder of this section reports on disaggregated industry data. The Census Bureau, in conjunction with NSF, conducts an annual survey of industry R&D based on a large sample of industries. State level data is somewhat scanty for specific industry categories, because the confidentiality rules of the Census Bureau preclude it from publishing data that might reveal the identity of survey respondents. Detailed state data has only been available since 1995. Some sketchier information about industries within the manufacturing sector is also available for 1985. Because of the confidentiality requirements of the Census Bureau's survey, progressively less information is available for smaller industries and smaller states. As a result, although some information is available about the other top ten R&D states, the comparisons reported here are only for California and the country at large.

Table b.3.a and b.3.b report the distribution of industry-performed R&D in California and in the United States in 1995 and 1997. This includes both industry-supported and government-supported activities. Similar to the rest of the country, about three-quarters of industry R&D takes place in the manufacturing sector. 4% of the country's R&D, but less than 1% of the state's, is in transportation and utilities, including communication service companies.

Companies are classified in a single SIC category according to their major business activity. Bell Labs, for example, was included in the transportation and utilities (sic 48) R&D account. Lucent Technologies, alternatively, is included in electrical equipment (36), and Bellcore in business or engineering services (73 or 87). Thus, some of the year-to-year variation in R&D is due to the reclassification of firms rather than changes in activities. The larger aggregations are thus substantially more reliable than the disaggregated sectors.

The preliminary statistics for 1997 indicate that R&D has increased in all of the major sectors. As a share of the total, manufacturing R&D declined from 77% to 72%, while R&D in the service sector increased from 16% to 19%.

Within the manufacturing sector, California disproportionately emphasizes the electrical equipment category (24% in 1995), specifically the subcategory of electronics (17% of total California R&D), and the transportation equipment category (31%) and its subcategory of aircraft and missiles (18%). In the service categories, the emphases are on computer and data processing (8%) and engineering and management services (8%). These numbers underscore the extent to which information technology -- computers, electronics,

and data processing -- dominates the California industry S&T enterprise. The 1997 data are broadly consistent with these trends, but show a dramatic drop in transportation equipment R&D. However, the NSF reports that this statistic suffers from non-reporting by firms and may be unreliable (see the Data Source Appendix). Taking the number as given, the state still contains a significant amount of transportation equipment R&D, including aircraft and missile research.

The final column in table b.3 presents California's share of total U.S. industry R&D by disaggregated industries. The unfortunate number of blanks in the column owes to non-reporting by the Census Bureau either for California or for the country at large. Thus, it is not possible to calculate California's share of the electronic component R&D in the country. Note, however, that state conduct of R&D in the larger category of electrical equipment is in excess of 36% in 1995 and 30% in 1997; for aircraft and missiles, 30% in 1995 and 13% in 1997; for business services, 25%; and for engineering and management services, about 30%. It must again be emphasized that the quality of this data is not sufficient to reach conclusions about trends between 1995 and 1997; rather, the two years together usefully provide a range of estimates.

Drugs and medicines are a fairly small share of manufacturing R&D (less than 4% of California industry R&D) and not large relative to the country (ten or eleven percent of U.S. drugs and medicine R&D). However, the federal statistics may fail to accurately characterize R&D investments in biomedicine and biotechnology for several reasons. First, firms that do not manufacture a product are not included in the manufacturing census. The Bureau of the Census does not consider patents to be a manufactured product. Firms that solely conduct R&D and produce patents are included in the "Research, development, and testing" subcategory of Engineering and management services, a categories that includes firms in a variety of industries, including software development. Second, clinical trials of drugs do not appear to be included in any of NSF's R&D statistics. Although industry supported, such studies are not usually performed by industry. Universities do not include clinical trials in their research accounts. Moreover, data about the non-profit sector is not available from the sources surveyed in this report, as the most recent published NSF statistics for nonprofit conduct of R&D rely on surveys conducted in 1971. Third, to the extent that firms conducting biotechnology research also manufacture products, they might be included in agriculture, petroleum, and a variety of other industries as well as drugs and medicine.

3.3 R&D Intensity in Industry

Table b.4.a and b.4.b consider R&D intensity of industries in California. The intensity measure used here is the ratio of R&D expenditures to GSP. GSP data are employed here because they are the most complete information available about value added in both manufacturing and service industries. The Bureau of the Census reports conventional value-added data for manufacturing industries within states: the intensity values reported here are equivalent to calculations derived from the Census value-added data in these industries.

R&D intensity in the aggregated manufacturing and services sectors are twice as high in California as in the country at large. Manufacturing is far more research-intensive than other sectors. The subcategories of manufacturing that are highly research-intensive in California are, in general, those industries with high levels of R&D spending. One exception is the chemicals and allied products industry, in which California has a relatively small share of R&D spending, and to which California devotes relatively little of its R&D budget. However, little of the state's GSP derives from chemicals, resulting in a high intensity statistic. The implication is that while the California part of this industry is quite small, it specializes in research activities.

The transportation equipment category (with a calculated California research intensity level of nearly 80% in 1995 and over 40% in 1997) begs for explanation, and, indeed, further investigation. This unlikely-looking estimate (confirmed using Census data for 1995 rather than the BEA statistics) probably results from the structure of the aircraft and missile industry in California. If little aircraft or missile production takes place within the state, and all that remains of the industry are some R&D components (including any prototype development) then the industry would have an intensity measure within the reported range. In other words, what may be inferred (but needs further study to be confirmed) about the very high statistic is that the denominator is unusually small. Whether the R&D activities might follow production elsewhere or whether they are viable as stand-alone operations in California is of considerable importance to the future conduct of R&D on transportation equipment within the state.

3.4 Changes in Industry R&D since 1985

Tables b.5 and b.6 consider differences in the distribution and intensity of manufacturing industry R&D between 1985 and 1997. The service sector is omitted from these tables as the 1985 data is not comparable to the later years. While the manufacturing sector data is also not entirely comparable, conclusions based on large changes are valid. A second problem with the intertemporal comparisons is that the Standard

Industrial Classification was changed in 1987. Among the affected categories are electrical equipment and its subcategories and machinery and its subcategories. It is not possible to correct for the changes, but again, large differences between the two years can be at least partly credited to real, as opposed to definitional, changes.

Table b.5 compares the distribution of manufacturing industry R&D in available industries in the three years. In 1985, nearly 60% of all the R&D performed by California manufacturing industries was in the aircraft and missiles industry. In 1995, aircraft and missiles comprised 23% of manufacturing industry R&D in California. Categories with increased shares include electrical equipment (from 11.5% to over 30%), machinery (7.4% to 14.8% in 1995) and chemicals and allied products (2.3% to over 6%).

The enormous nominal decline in aircraft and missile research (compare tables b.3 and b.6), as well as the decreased share raises an interesting issue, not resolved by this information. Firms are required in the surveys used here to classify establishments under a single SIC. If, for example, aircraft companies have spun off electronics components, if employees have moved from aerospace firms elsewhere, or if aerospace firms now subcontract electronics components and associated R&D to companies that specialize in electronics, then activities would now be classified as electronics that used to be contained in the aircraft and missiles category. Identifying such shifts would give an indication of the importance of the previous structure of S&T in California, specifically the importance of military support, to current activities.

Table b.6 reports R&D intensity numbers for the few industry categories for which both R&D support and gross state product information are available for 1985. Overall, manufacturing intensity has declined slightly, although the difference is small enough that it may be due to discrepancies in reporting between the two periods. Significant increases in R&D intensity occur in chemicals, machinery, electrical equipment and professional and scientific instruments: in other words, in nearly all of the major R&D performing sectors of the manufacturing sector. Transportation equipment intensity is slightly higher in 1995 than 1985 and is lower in 1997 than in 1985. The increase in actual R&D expenditures in all categories except for transportation and professional and scientific instruments suggest that increased intensity is not due in these industries to a loss in production, as was suggested in the aerospace category. Alternatively, the implication of increased intensity combined with constant (real) spending in the instrument category is difficult to interpret because of changes in the standard industrial classification. Note that whatever the underlying cause of the increased intensity statistics,

one implication of the data is that S&T is more important to the California economy in these industries than was the case ten years ago.

3.5 Patent Data

One measure of the effectiveness of industrial S&T activities is patent counts. Factors influencing patent counts include policies by the patent office, details of the industry and technology, judicial reviews, and activities in other countries. As a result, raw numbers by year may not be comparable across years or industries. Nevertheless, tables b.7 - b.10 suggest that the high expenditures in California industries are paralleled by a high rate of inventiveness.

Table b.7 reports the number of U.S. patents assigned to California inventors or firms in the major classifications and subclassifications used by the U.S. Patent Office. These data, and other statistics reported in this section, were compiled from the web site maintained by the U.S. Patent Office. The primary purpose of the web site is to help potential patent holders identify relevant technology. Presumably as a result, patents are frequently listed under more than one subcategory, so the sum of subcategories exceed the number listed in the major categories, and the sum of major categories exceed the total number of patents assigned to California inventors or firms.

Obviously, patents vary widely in their importance. Various methodologies have been used to classify patents by quality as well as quantity, most importantly by examining citations. The data reported here do not make such distinctions, and thus provide only a general picture of patenting within California. Included in the statistics are patents assigned to individuals, firms, universities and colleges, government and other non-profit institutions. The U.S. Patent Office web site can be searched along institutional and citation dimensions, so it can be used to generate statistics that respond to more detailed questions than can be addressed with the data presented here.

Table b.8 reports the percent of all U.S. patents assigned to domestic firms or inventors that were assigned to California firms or inventors. The trends are consistent across the board: nearly every technology category and subcategory shows a substantial increase between 1976 and 1997. In the Chemical/Biology category, California residents were assigned over 14% of all patents to U.S. inventors in 1995, up from 7.4% in 1976. The subfields show similar trends, with particular strength in Biochemistry (18% of patents assigned domestic inventors), which includes important biotechnology categories.

Most dramatic among the patent statistics are in the Electronics category and subcategories. Overall,

California accounts for nearly a quarter of all electronics patents assigned to U.S. inventors and firms, over 33% in computing and data processing classes and over 28% in electronics and electronic devices. In other electronics categories, the California share of domestic patents is around 20%. All of these show large increases in share since the mid-1980s. Some of this may be due to changes in patent laws. Such changes however, would apply to other patent applicants, so the argument must be modified to specify that the changes were biased towards technology that corresponded to strengths of California companies. An alternative (possibly related) hypothesis is that the successful privatization of California industrial R&D led to the increase in patenting. Indeed, given that California conducted 20% of the country's industrial R&D throughout this period, the low level of patent activity prior to 1989 suggests a strong inverse correlation between federal support of industrial R&D and patent activity.

Another consideration lies in changes in the structure of industrial organization of R&D in California. The data reported in this section are for patent assignments, rather than the location of the actual inventor. Patents tend to have multiple inventors, making a state-determination necessarily ambiguous. In their report in this series, Darby and Zucker report patent counts by location of the first inventor listed on the patent, a procedure that is not possible to deploy using the patent office web site. Their data show a similar concentration of inventive activity within California in recent years, but report much higher levels of patenting in the earlier years. A possible interpretation of the discrepancy is that during the 1980s and before, substantial inventive activity occurred within California in research shops for which the head office was located elsewhere, whereas the extent of head offices and research shops are now balanced. (It is still the case that many patents invented by California inventors are assigned elsewhere; however, many patents invented elsewhere are assigned to California firms.) Investigation of this hypothesis requires access to data not available for this report.

Table b.8 implies strength in Aeronautics patenting in California. The increase in share, however, must be balanced against the decline in the actual number of patents (see table b.7). California appears to be dominating a shrinking field in aeronautics. California is not a strong investor in the remaining substantive category, Mechanical technologies. The final Patent Office category is Design, which spans a number of industries. Because of data and conceptual difficulties, we do not report statistics on Design patents.

Between 1976 and 1990, the share of US patents assigned to domestic inventors and firms fell in every category. These statistics formed part of the concern with

the state of high tech enterprises in the United States, particularly in the electronics industries. Trends are shown in Table b.9. For example, in the Computing and Data Processing subcategory, the share of U.S. patents issued to domestic inventors or firms declined from 62% to 43%. While this is the steepest decline of the subcategories shown in the table, the others follow the same pattern. Interestingly, the pattern is reversed between 1990 and 1997.

Table b.10. shows California's share of all US patents assigned to both domestic and foreign inventors and firms. Unlike the country at large, California's share of the total did not decline during the 1980s. Indeed, in most categories it has increased steadily since 1980, although more sharply in the last few years. In Electronics, the share of California patents increased from 5.69% to 6.64% between 1980 and 1987, a period of time when the competitiveness of the US electronics industry was called into question. A puzzle contained in the table is the apparent divergence of California's experience from the rest of the country, and from the other large R&D performing states.

4. Academic S&T in California

4.1 Academic Sector Data Issues

The federal government collects an enormous amount of data about academic research and higher education. This section does not attempt to present a comprehensive view of the academic sector and its role in science and technology in the state. However, the tables discussed below provide a starting point for further investigation.

4.2 Aggregate Sources of Support for Academic Research

Tables c.1 and a.5 present data from NSF's surveys of academic research. Table c.1 shows that, correcting for inflation, academic research has doubled in California in the past twenty years. The federal government remains by far the largest source of support for academic research, although its share has fallen over the past twenty years from 79% to 68%. State and local government supports very little academic research (4.35% in 1997, up from 1.2% in 1975). Industry support of academic research has grown over the past twenty years, but remains a small share of the total at about 5%. Institutional funds from the universities and colleges now accounts for about 15% of academic research. This source of support declined both as a share and (slightly) in constant dollars (see table a.5) between 1991 and 1997. Support from non-profits and others have varied around 7% over most of the past twenty years. As is discussed above, the low levels of support for academic research from state and local

government, and from industry in California has resulted in an overall decline in the share of national academic research performed in California. Industry support for academic research has increased in California, but remains surprisingly low given the nature of the California economy.

Table a.6 shows the share of academic research support contributed by different sectors in the other large R&D performing states. The share of industry support for academic research (column 11) is as high or higher than the share of Industry Performance (column 5), and at least proportional to population size in New York, Massachusetts, Texas, Illinois, Pennsylvania, and Ohio. Like California, Michigan, New Jersey, and Washington have low levels of industry support for academic research relative to research intensity of their industries, although in these states industry support for academic research is at least proportional to the state populations.

4.3 Federal Support for Academic Research

Federal Agency obligations for science and engineering at universities and colleges in California are reported in table c.2. The obligation data, as previously discussed, are not necessarily comparable to the expenditure data reported in table c.1.

The federal agencies obligated about two billion dollars to California universities and colleges in 1997. Over half of this was from the National Institutes of Health, the largest supporter of academic research among the federal agencies. Next in importance to California institutions is NSF (about 18%), then DoD (11%) and NASA (about 8%). California universities and colleges receive a very large share of the academic support budget of NASA (over 20% throughout the past twenty years). The Department of Defense has maintained a steady share of support to California academia since 1991. As its academic research budget has declined relative some other science agencies, its commitment to California represents an increasingly generous stance to California institutions relative to those in other parts of the country. The California share of the budgets of the two largest supporters of academic research, NIH and NSF, has been somewhat larger on a per capita basis than the average for the country. This is especially the case with NSF. In 1995, 1996 and 1997 NSF obligated over 17% of its S&E funds to California institutions, representing a sharp increase from previous years.

As with the industry statistics, support for academic research in California by the Department of Agriculture is very low – only about 4% of all academic research sponsored by the Department. The poor showing in California is surprising given the size of the agricultural enterprise within the state.

4.4 Academic Research Support by Science and Engineering Field

Research expenditures by discipline are contained in Table c.3. While aggregate spending on academic research in California is equivalent, on a per capita basis, to that of the rest of the country, the distribution of expenditures within California diverges in several respects from national averages. The state spends disproportionately on medical sciences, although its share of the U.S. total has declined over the past fifteen years from 18% to 16%. Medical sciences account for over 40% of all academic R&D expenditures within the state. Second, consistent with the large FFRDC enterprise within the state, expenditures on physical sciences are strong in California. While these have increased little in real dollars over the past eight years, California currently accounts for over 16% of the nation's total expenditures within this category.

Real expenditures in engineering, math and computer sciences have increased over the past decade, but spending in these categories is weak (in engineering) or barely average (math and computer sciences) relative to the rest of the country. Overall, the share of R&D expenditures in California universities and colleges in science and engineering fields other than medical sciences is only about 10% of the country's total – low on a per capita basis; exceedingly low relative to the nature of the California economy.

4.5 Expenditures for Higher Education in California

Table c.4 presents information about total expenditures for higher education in California.

Table c.4 reports expenditures for higher education in California, including all institutions of higher education. These data are collected by the Department of Education in its Integrated Post-Secondary Educational Data Survey (IPEDS). The information is based on self-reporting by the institutions. As the table shows, colleges and universities spend money on a wide variety of activities. Consideration of most of these activities is beyond the scope of this report, although many are relevant to the subject of science and technology indicators in the state. However, it is important to emphasize two of the categories: research and instruction. The first, as is discussed above, is roughly commensurate to the size of

California's population. Instruction, disturbingly, is not, and has even declined over the past twenty years although the state's population has grown. As of 1996, the last year for which these data are available, less than 11% of the country's higher education instructional resources were spent in California.

4.6 Higher Education Degrees Conferred in California

The expenditure and research support statistics shown in the previous tables are reflected in graduation rates from California universities and colleges (Tables c.5.a and c.5.b).

For all science and engineering fields, California universities confer about 12% of the country's doctoral degrees, consistent with the research expenditures reported in table a.5, c.1, c.2, and c.3. The number of bachelor's degrees conferred by California institutions in 1995 was slightly over 10% of the country's total, consistent with the educational share of the country's expenditures reported in table c.4. There is relatively little variance across disciplines in 1997.

The consistency between expenditures and degrees show that while per capita expenditures on higher education are relatively low in California, expenditures per degree are average. Thus the statistics do not imply a quality shortfall at the undergraduate level in California colleges and universities; rather, they indicate that the enterprise is small. Given the size of the California population, the state trains fewer scientists and engineers, particularly at the undergraduate level, than does the rest of the country.

Given the dominance of California's industrial research enterprise, particularly in electronics and computers, the paucity of graduates in engineering, math and computer sciences, and physical sciences is stunning. Indeed, the statistics for both engineering and physical sciences show a decline in the number of bachelors degrees awarded over the past decade, and a decline in the share of U.S. bachelors and masters degrees in the past decade.

These statistics carry the clear implication that colleges and universities within California are not training the state's population to participate in the state's economy. The consequences of this pattern, both for the workforce and industry, should be of serious concern.

Table a.1. State Population as a Share of US Total, Major R&D Performing States

	1977	1981	1985	1989	1991	1993	1995	1996	1997	1998
CA	11.31%	10.58%	11.11%	11.84%	12.03%	12.08%	12.01%	11.98%	12.02%	12.09%
MI	4.64%	4.01%	3.81%	3.75%	3.74%	3.69%	3.65%	3.67%	3.65%	3.63%
NY	9.01%	7.66%	7.48%	7.29%	7.19%	7.07%	6.93%	6.84%	6.78%	6.72%
NJ	3.71%	3.23%	3.18%	3.13%	3.09%	3.06%	3.03%	3.02%	3.01%	3.00%
MA	2.90%	2.51%	2.47%	2.44%	2.39%	2.34%	2.32%	2.29%	2.28%	2.27%
TX	6.68%	6.43%	6.84%	6.81%	6.88%	7.00%	7.12%	7.18%	7.24%	7.31%
IL	5.76%	4.99%	4.79%	4.62%	4.59%	4.55%	4.51%	4.50%	4.48%	4.46%
PA	6.02%	5.17%	4.95%	4.81%	4.76%	4.69%	4.62%	4.54%	4.49%	4.44%
WA	1.91%	1.85%	1.85%	1.92%	1.98%	2.03%	2.06%	2.08%	2.10%	2.10%
OH	5.45%	4.70%	4.51%	4.39%	4.36%	4.31%	4.26%	4.21%	4.18%	4.15%
CA population	22,352,396	24,285,933	26,441,109	29,218,164	30,130,222	30,971,160	31,390,001	31,762,190	32,182,118	32,666,550
US population	197,598,690	229,465,714	237,923,795	246,819,230	250,527,077	256,328,217	261,406,824	265,189,794	267,743,595	270,298,524

Table a.2. State R&D as a Share of US Total, Major R&D Performing States

	1977	1981	1985	1989	1991	1993	1995	1997 (preliminary)
CA	17.44%	18.97%	20.75%	21.94%	17.69%	20.43%	19.74%	20.03%
MI	6.88%	6.03%	5.93%	6.43%	5.53%	6.53%	7.25%	
NY	7.57%	6.23%	7.79%	7.03%	6.47%	6.65%	5.99%	
NJ	5.00%	5.31%	6.26%	5.14%	5.47%	5.56%	4.99%	
MA	4.82%	4.64%	5.60%	5.65%	5.35%	5.75%	5.45%	
TX	3.36%	3.58%	4.07%	4.68%	4.14%	4.22%	4.58%	
IL	4.23%	3.73%	3.87%	3.77%	4.01%	4.11%	4.09%	
PA	5.28%	5.26%	4.05%	4.11%	4.76%	5.02%	3.78%	
WA	2.06%	na	2.42%	2.29%	2.43%	3.29%	2.86%	
OH	4.12%	3.29%	3.43%	3.89%	3.73%	3.88%	2.90%	
Share of US R&D, top ten States	60.77%	57.04%	64.15%	64.93%	59.58%	65.42%	61.64%	
CA R&D (millions)	7,463	13,634	22,293	30,881	28,337	33,721	36,133	41,165
US R&D (millions)	42,783	71,870	107,456	140,763	160,157	165,048	183,013	205,561

Table a.3. State GSP as a Share of US Total, Major R&D Performing States

	1977	1981	1985	1989	1991	1993	1994	1995	1996	1997
CA	11.58%	11.99%	12.74%	13.76%	13.88%	13.09%	12.81%	12.71%	12.67%	12.75%
MI	4.41%	3.68%	3.64%	3.45%	3.26%	3.38%	3.52%	3.43%	3.40%	3.36%
NY	8.90%	8.37%	8.78%	8.83%	8.59%	8.44%	8.35%	8.15%	8.14%	8.04%
NJ	3.36%	3.28%	3.54%	3.84%	3.77%	3.81%	3.73%	3.69%	3.66%	3.63%
MA	2.52%	2.48%	2.78%	2.95%	2.75%	2.72%	2.72%	2.71%	2.72%	2.73%
TX	6.65%	8.18%	7.63%	6.66%	6.93%	6.97%	7.02%	7.13%	7.27%	7.42%
IL	5.82%	5.23%	4.96%	4.86%	4.83%	4.86%	4.87%	4.89%	4.86%	4.86%
PA	5.04%	4.61%	4.34%	4.37%	4.39%	4.39%	4.31%	4.32%	4.23%	4.20%
WA	1.81%	1.88%	1.79%	1.93%	2.08%	2.12%	2.10%	2.08%	2.10%	2.13%
OH	4.93%	4.39%	4.23%	4.04%	3.98%	3.98%	4.02%	4.04%	3.98%	3.96%
GSP of top ten R&D performing states	55.03%	54.09%	54.44%	54.69%	54.45%	53.76%	53.46%	53.09%	52.93%	53.07%
CA GSP (millions)	229,489	367,075	525,989	738,537	810,323	842,068	875,697	918,928	966,778	1,033,016
US "GSP" (millions)	1,981,660	3,060,815	4,128,383	5,366,174	5,837,351	6,430,519	6,835,641	7,231,814	7,629,503	8,103,234

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Table a.4. R&D as a Share of Gross State Product, Major R&D Performing States

	1977	1981	1985	1989	1991	1993	1995	1997 (preliminary)
CA	3.25%	3.71%	4.24%	4.18%	3.50%	4.00%	3.96%	3.98%
US	2.16%	2.35%	2.60%	2.62%	2.74%	2.57%	2.54%	2.54%
MI	3.36%	3.85%	4.24%	4.90%	4.65%	4.96%	5.28%	
NY	1.84%	1.75%	2.31%	2.09%	2.07%	2.02%	1.84%	
NJ	3.21%	3.80%	4.60%	3.50%	3.98%	3.75%	3.44%	
MA	4.13%	4.39%	5.25%	5.02%	5.34%	5.43%	5.08%	
TX	1.09%	1.03%	1.39%	1.84%	1.64%	1.55%	1.65%	
IL	1.57%	1.67%	2.03%	2.03%	2.28%	2.17%	2.15%	
PA	2.26%	2.68%	2.43%	2.47%	2.98%	2.94%	2.23%	
WA	2.46%	na	3.50%	3.11%	3.21%	3.97%	3.51%	
OH	1.80%	1.76%	2.11%	2.53%	2.57%	2.50%	1.83%	
Japan	2.00%	2.10%	2.60%	2.80%	2.90%	2.70%	2.8%	
Germany	2.10%	2.40%	2.70%	2.90%	2.60%	2.50%	2.3%	

Table a.5. California Expenditures for R&D: Performance by Sector, Broken Down by Sources of Funds

Perform- ing Sector:	Total R&D	Federal Govt.	Industry			Universities & Colleges						U&C FFRDCs	Nonprofit sector*
Funding Sector:	Total R&D	Federal Govt.	Total	Federal Govt.	Industry	Total	Federal Govt.	Nonfed. Govt.	Industry	U&C	Non- Profits/ Other	Federal Govt.	Federal Govt
a.5.a. Thousands of Current Dollars													
1997#	41,165,492	1,454,133	34,011,000	5,977,000	28,034,000	2,982,373	2,029,550	129,764	161,625	440,018	221,416	2,034,903	683,083
1995	36,132,656	1,843,729	28,710,000	6,925,000	21,785,000	2,594,280	1,796,691	107,055	120,080	372,941	197,513	2,377,815	607,320
1993	33,721,000	1,785,000	26,541,000	7,463,000	19,078,000	2,380,000	1,630,000	112,000	99,000	368,000	171,000	2,499,000	516,000
1991	28,337,300	1,885,300	21,279,000	8,911,000	12,368,000	2,137,200	1,431,800	84,100	85,800	387,300	148,200	2,562,800	473,000
1989	30,881,000	2,478,000	23,675,000	12,857,000	10,818,000	1,846,000	1,281,000	43,000	83,000	322,000	116,000	2,385,000	497,000
1987	24,161,170	2,011,033	18,636,000			1,558,609	1,069,307	36,690	72,676	289,628	90,308	1,572,409	383,119
1985	22,293,000	1,177,000	17,760,000	10,816,000	6,944,000	1,233,347	878,709	15,355	18,499	216,142	104,642	1,726,000	398,000
1983	17,545,239	1,143,229	14,237,000	8,298,000	5,939,000	999,168	717,284	18,702	11,884	167,936	83,362	887,279	278,563
1981	13,633,596	968,248	10,765,000	6,585,000	4,180,000	874,011	648,415	17,935	14,093	136,254	57,314	669,497	356,840
1979	9,836,700	929,853	7,437,000			653,047	509,343	17,474	8,400	72,554	45,276	559,071	257,729
1977	7,462,828	688,013	5,600,000			531,719	419,762	6,995	5,787	65,410	33,765	439,089	204,007
1975	6,937,443	708,793	5,263,000			454,023	357,402	5,625	5,035	60,286	25,675	316,951	194,676
a.5.b. Thousands of Constant 1987 Dollars													
1997#	30,299,844	1,070,314	25,033,783	4,399,368	20,634,415	2,195,174	1,493,849	95,513	118,964	323,875	162,973	1,497,790	502,783
1995	28,184,599	1,438,166	22,394,696	5,401,716	16,992,980	2,023,619	1,401,475	83,506	93,666	290,906	154,066	1,854,770	473,729
1993	27,304,453	1,445,344	21,490,688	6,042,915	15,447,773	1,927,126	1,319,838	90,688	80,162	297,976	138,462	2,023,482	417,814
1991	24,096,344	1,603,146	18,094,388	7,577,381	10,517,007	1,817,347	1,217,517	71,514	72,959	329,337	126,020	2,179,252	402,211
1989	28,461,751	2,283,871	21,820,276	11,849,770	9,970,507	1,701,382	1,180,645	39,631	76,498	296,774	106,912	2,198,157	458,065
1987	24,161,170	2,011,033	18,636,000			1,558,609	1,069,307	36,690	72,676	289,628	90,308	1,572,409	383,119
1985	23,615,466	1,246,822	18,813,559	11,457,627	7,355,932	1,306,512	930,836	16,266	19,596	228,964	110,850	1,828,390	421,610
1983	20,120,687	1,311,042	16,326,835	9,516,055	6,810,780	1,145,835	822,573	21,447	13,628	192,587	95,599	1,017,522	319,453
1981	17,279,589	1,227,184	13,643,853	8,346,008	5,297,845	1,107,745	821,819	22,731	17,862	172,692	72,641	848,539	452,269
1979	14,994,970	1,417,459	11,336,890			995,498	776,438	26,637	12,805	110,601	69,018	852,242	392,880
1977	13,350,318	1,230,792	10,017,889			951,197	750,916	12,513	10,352	117,013	60,403	785,490	364,950
1975	14,100,494	1,440,636	10,697,154			922,811	726,427	11,433	10,234	122,533	52,185	644,209	395,683

* Nonprofit data available only for federal obligations. Other expenditures by non-profits are omitted from non-profit category and from total spending in the state.

1997 data are preliminary (see notes in Sources)

Table a.5. (continued) California Expenditures for R&D: Performance by Sector, Broken Down by Sources of Funds

Perform-ing Sector:	Total R&D	Federal Govt.	Industry			Universities & Colleges						U&C FFRDCs	Nonprofit sector*
Funding Sector:	Total R&D	Federal Govt.	Total	Federal Govt.	Industry	Total	Federal Govt.	Nonfed. Govt.	Industry	U&C	Non-Profits/Other	Federal Govt.	Federal Govt
a.5.c. Share of US Total													
1997#	20.03%	9.00%	21.59%	24.98%	20.98%	12.29%	14.04%	7.00%	9.45%	9.70%	12.94%	55.20%	17.92%
1995	19.74%	10.63%	21.73%	29.53%	20.05%	11.74%	13.48%	6.47%	8.05%	9.27%	12.35%	43.99%	16.69%
1993	20.43%	10.71%	22.61%	32.72%	20.21%	11.94%	13.63%	7.18%	7.27%	10.29%	11.51%	47.20%	8.97%
1991	17.69%	12.37%	18.19%	33.79%	13.65%	12.12%	14.00%	5.67%	7.09%	11.38%	11.29%	50.46%	9.01%
1989	21.94%	16.39%	23.24%	41.09%	15.33%	12.30%	14.26%	3.48%	8.32%	11.87%	10.73%	50.43%	12.27%
1987	19.27%	15.50%	20.22%			13.04%	14.79%	3.69%	9.35%	13.56%	11.05%	49.43%	18.40%
1985	20.75%	9.09%	22.71%	40.84%	13.43%	12.95%	14.73%	2.11%	3.36%	13.57%	15.27%	48.91%	12.25%
1983	19.68%	11.20%	22.45%	40.40%	13.86%	12.91%	14.63%	3.08%	3.12%	13.13%	14.65%	39.75%	16.48%
1981	18.97%	12.03%	20.78%	40.20%	11.80%	13.01%	14.45%	3.39%	4.94%	13.81%	13.41%	38.10%	24.17%
1979	17.90%	13.19%	19.46%			12.39%	14.40%	3.81%	4.42%	10.07%	12.45%	38.21%	21.31%
1977	17.44%	11.80%	18.78%			13.34%	15.67%	1.93%	4.26%	13.00%	10.96%	34.01%	21.61%
1975	18.60%	13.60%	21.76%			13.60%	15.92%	1.75%	4.56%	14.75%	10.13%	34.15%	23.72%
a.5.d. Share of CA R&D													
1997#	100%	3.53%	82.62%	14.52%	68.10%	7.24%	4.93%	0.32%	0.39%	1.07%	0.54%	4.94%	1.66%
1995	100%	5.10%	79.46%	19.17%	60.29%	7.18%	4.97%	0.30%	0.33%	1.03%	0.55%	6.58%	1.68%
1993	100%	5.29%	78.71%	22.13%	56.58%	7.06%	4.83%	0.33%	0.29%	1.09%	0.51%	7.41%	1.53%
1991	100%	6.65%	75.09%	31.45%	43.65%	7.54%	5.05%	0.30%	0.30%	1.37%	0.52%	9.04%	1.67%
1989	100%	8.02%	76.67%	41.63%	35.03%	5.98%	4.15%	0.14%	0.27%	1.04%	0.38%	7.72%	1.61%
1987	100%	8.32%	77.13%			6.45%	4.43%	0.15%	0.30%	1.20%	0.37%	6.51%	1.59%
1985	100%	5.28%	79.67%	48.52%	31.15%	5.53%	3.94%	0.07%	0.08%	0.97%	0.47%	7.74%	1.79%
1983	100%	6.52%	81.14%	47.29%	33.85%	5.69%	4.09%	0.11%	0.07%	0.96%	0.48%	5.06%	1.59%
1981	100%	7.10%	78.96%	48.30%	30.66%	6.41%	4.76%	0.13%	0.10%	1.00%	0.42%	4.91%	2.62%
1979	100%	9.45%	75.60%			6.64%	5.18%	0.18%	0.09%	0.74%	0.46%	5.68%	2.62%
1977	100%	9.22%	75.04%			7.12%	5.62%	0.09%	0.08%	0.88%	0.45%	5.88%	2.73%
1975	100%	10.22%	75.86%			6.54%	5.15%	0.08%	0.07%	0.87%	0.37%	4.57%	2.81%

* Nonprofit data available only for federal obligations. Other expenditures by non-profits are omitted from non-profit category and from total spending in the state.

1997 data are preliminary (see notes in Sources)

Table a.6. Distribution of R&D within Selected States by Performing and Funding Sectors

Performing Sector:		Federal Govt.	Industry			Universities & Colleges						U&C FFRDCs	Nonprofit
Funding Sector:		Federal Govt.	Total	Federal Govt.	Industry	Total	Federal Govt.	Nonfed. Govt.	Industry	U&C	Non-Profits	Federal Govt.	Federal Govt.
Total US	1995	9.48%	72.18%	12.81%	59.37%	12.08%	7.28%	0.90%	0.82%	2.20%	0.87%	2.95%	3.31%
	1993	10.10%	71.13%	13.82%	57.19%	12.08%	7.24%	0.94%	0.82%	2.17%	0.90%	3.21%	3.48%
	1991	9.51%	73.02%	16.47%	56.56%	11.01%	6.39%	0.93%	0.76%	2.13%	0.82%	3.17%	3.28%
	1989	10.74%	72.36%	22.23%	50.13%	10.66%	6.38%	0.88%	0.71%	1.93%	0.77%	3.36%	2.88%
	1985	12.05%	72.78%	24.65%	48.14%	8.86%	5.56%	0.69%	0.51%	1.49%	0.62%	3.28%	3.02%
CA	1995	5.10%	79.46%	19.17%	60.29%	7.18%	4.97%	0.30%	0.33%	1.03%	0.55%	6.58%	1.68%
	1993	5.29%	78.71%	22.13%	56.58%	7.06%	4.83%	0.33%	0.29%	1.09%	0.51%	7.41%	1.53%
	1991	6.65%	75.09%	31.45%	43.65%	7.54%	5.05%	0.30%	0.30%	1.37%	0.52%	9.04%	1.67%
	1989	8.02%	76.67%	41.63%	35.03%	5.98%	4.15%	0.14%	0.27%	1.04%	0.38%	7.72%	1.61%
	1985	5.28%	79.67%	48.52%	31.15%	5.52%	3.93%	0.07%	0.08%	0.97%	0.47%	7.74%	1.79%
MI	1995	0.62%	93.32%	1.11%	92.20%	5.69%	3.15%	0.37%	0.38%	1.36%	0.43%	0.00%	0.37%
	1993	0.89%	92.08%	1.42%	90.66%	6.49%	3.50%	0.37%	0.44%	1.60%	0.59%	0.00%	0.54%
	1991	1.04%	91.70%	1.01%	90.70%	6.79%	3.50%	0.45%	0.56%	1.76%	0.52%	0.00%	0.47%
	1989	0.78%	93.49%	1.09%	92.39%	5.38%	2.91%	0.40%	0.40%	1.28%	0.39%	0.00%	0.35%
	1985	1.19%	93.80%	1.33%	92.46%	4.73%	2.75%	0.38%	0.30%	1.07%	0.23%	0.00%	0.28%
NY	1995	1.07%	78.97%	16.62%	62.36%	15.54%	10.11%	0.88%	0.90%	1.88%	1.78%	2.57%	1.85%
	1993	1.19%	80.37%	12.68%	67.69%	14.08%	9.59%	0.69%	0.80%	1.64%	1.36%	2.67%	1.69%
	1991	1.68%	79.78%	15.03%	64.75%	14.16%	9.01%	0.74%	0.82%	1.84%	1.74%	2.74%	1.64%
	1989	0.90%	81.54%	14.95%	66.59%	13.46%	8.76%	0.70%	0.72%	1.74%	1.56%	2.58%	1.53%
	1985	1.04%	83.85%	22.85%	61.00%	11.34%	7.52%	0.50%	0.58%	1.35%	1.39%	2.38%	1.40%
NJ	1995	3.77%	89.84%	2.16%	87.67%	4.86%	2.29%	0.43%	0.28%	1.49%	0.37%	1.38%	0.17%
	1993	5.54%	88.90%	4.12%	84.78%	4.07%	1.82%	0.39%	0.28%	1.26%	0.30%	1.26%	0.22%
	1991	5.85%	89.08%	9.75%	79.33%	3.91%	1.68%	0.49%	0.22%	1.22%	0.29%	1.04%	0.13%
	1989	5.95%	88.27%	8.31%	79.96%	3.91%	1.63%	0.62%	0.24%	1.15%	0.28%	1.56%	0.30%
	1985	13.30%	82.52%	10.82%	71.70%	2.10%	1.12%	0.25%	0.09%	0.49%	0.15%	1.96%	0.12%
MA	1995	3.17%	74.39%	14.62%	59.76%	11.51%	8.27%	0.13%	0.90%	0.92%	1.28%	3.46%	7.48%
	1993	4.05%	73.29%	19.80%	53.49%	11.53%	8.14%	0.16%	1.03%	0.84%	1.35%	3.74%	7.39%
	1991	3.25%	74.00%	17.29%	56.71%	11.08%	7.93%	0.15%	1.06%	0.78%	1.17%	4.54%	7.12%
	1989	5.04%	73.28%	21.27%	52.01%	10.92%	7.82%	0.24%	0.99%	0.74%	1.13%	4.58%	6.18%
	1985	2.96%	69.30%	25.84%	43.46%	9.70%	7.70%	0.12%	0.85%	0.51%	0.52%	4.38%	13.67%

Table a.6. (continued) Distribution of R&D within Selected States by Performing and Funding Sectors

Performing Sector:		Federal Govt.	Industry			Universities & Colleges						U&C FFRDCs	Nonprofit
Funding Sector:		Federal Govt.	Total	Federal Govt.	Industry	Total	Federal Govt.	Nonfed. Govt.	Industry	U&C	Non-Profits	Federal Govt.	Federal Govt.
TX	1995	6.41%	74.07%	10.88%	63.18%	17.56%	8.92%	1.89%	1.22%	3.54%	1.99%	0.00%	1.95%
	1993	6.72%	70.08%	9.19%	60.90%	19.91%	9.80%	2.27%	1.29%	4.21%	2.35%	0.07%	3.22%
	1991	6.11%	71.66%			18.32%	8.30%	2.09%	1.24%	4.27%	2.41%	0.03%	3.87%
	1989	7.05%	76.40%	28.08%	48.32%	15.41%	7.42%	1.88%	0.97%	3.19%	1.98%	0.00%	1.14%
	1985	5.70%	79.87%	27.65%	52.22%	13.52%	7.53%	1.55%	0.85%	3.03%	0.57%	0.00%	0.91%
IL	1995	1.08%	77.15%	1.95%	75.20%	10.92%	6.25%	0.63%	0.57%	2.61%	0.86%	10.29%	0.55%
	1993	1.22%	77.34%	3.48%	73.86%	11.18%	6.27%	0.68%	0.66%	2.63%	0.94%	9.58%	0.68%
	1991	1.06%	78.33%	2.96%	75.37%	10.93%	5.64%	0.82%	0.77%	2.82%	0.89%	8.94%	0.73%
	1989	1.11%	76.34%			11.37%	6.37%	0.64%	0.74%	2.85%	0.77%	9.95%	1.23%
	1985	2.07%	77.78%	6.91%	70.87%	9.46%	5.78%	0.57%	0.39%	2.17%	0.55%	9.03%	1.66%
PA	1995	3.29%	77.05%	5.43%	71.61%	16.47%	10.90%	0.51%	1.74%	2.37%	0.95%	0.46%	2.74%
	1993	4.28%	81.07%	13.80%	67.27%	12.31%	8.18%	0.24%	1.35%	1.80%	0.74%	0.42%	1.92%
	1991	4.13%	82.17%	27.03%	55.14%	11.53%	7.25%	0.35%	1.31%	1.83%	0.79%	0.36%	1.81%
	1989	4.73%	79.99%	32.93%	47.06%	13.14%	8.10%	0.55%	1.59%	1.88%	1.02%	0.36%	1.78%
	1985	5.47%	82.11%	24.17%	57.93%	10.53%	6.96%	0.32%	1.11%	1.23%	0.93%	0.05%	1.82%
WA	1995	3.05%	81.94%			9.27%	6.49%	0.26%	0.75%	1.47%	0.29%	0.00%	5.74%
	1993	2.08%	86.48%	16.43%	70.05%	7.89%	5.75%	0.26%	0.63%	0.96%	0.30%	0.00%	3.54%
	1991	3.41%	82.65%			8.99%	6.51%	0.29%	0.72%	1.16%	0.30%	0.00%	4.95%
	1989	3.44%	84.22%			8.59%	6.36%	0.19%	0.65%	1.12%	0.25%	0.00%	3.75%
	1985	3.85%	84.09%	49.38%	34.71%	8.09%	6.02%	0.10%	0.40%	0.77%	0.80%	0.00%	3.97%
OH	1995	11.27%	75.29%	10.80%	64.51%	12.09%	7.06%	0.90%	1.02%	2.01%	1.11%	0.00%	1.35%
	1993	9.11%	80.40%	16.10%	64.30%	9.28%	5.44%	0.72%	0.75%	1.39%	0.97%	0.00%	1.20%
	1991	11.53%	79.09%	13.02%	66.07%	8.43%	4.77%	0.89%	0.63%	1.24%	0.91%	0.00%	0.95%
	1989	19.29%	72.07%	12.44%	59.63%	7.80%	4.44%	0.88%	0.69%	1.13%	0.69%	0.00%	0.84%
	1985	14.51%	77.20%	13.12%	64.07%	7.10%	4.37%	0.41%	0.46%	1.15%	0.70%	0.00%	1.17%

Table a.7. Share of US Total R&D for Selected States, by Performing and Funding Sector

Performing Sector:		Total R&D	Federal Govt.	Industry			Universities & Colleges						U&C FFRDCs
Funding Sector:		Total R&D	Federal Govt.	Total	Federal Govt.	Industry	Total	Federal Govt.	Nonfed. Govt.	Industry	U&C	Non-Profits	Federal Govt.
CA	1995	19.74%	10.63%	21.73%	29.53%	20.05%	11.74%	13.48%	6.47%	8.05%	9.27%	12.35%	43.99%
CA	1993	20.43%	10.71%	22.61%	32.72%	20.21%	11.94%	13.63%	7.18%	7.27%	10.29%	11.51%	47.20%
CA	1991	17.69%	12.37%	18.19%	33.79%	13.65%	12.12%	14.00%	5.67%	7.09%	11.38%	11.29%	50.46%
CA	1989	21.94%	16.39%	23.24%	41.09%	15.33%	12.30%	14.26%	3.48%	8.32%	11.87%	10.73%	50.43%
CA	1985	20.75%	9.09%	22.71%	40.84%	13.43%	12.93%	14.68%	2.07%	3.30%	13.51%	15.80%	48.91%
MI	1995	7.25%	0.47%	9.38%	0.63%	11.27%	3.42%	3.13%	2.96%	3.39%	4.50%	3.56%	0.00%
MI	1993	6.53%	0.58%	8.45%	0.67%	10.35%	3.51%	3.15%	2.57%	3.45%	4.81%	4.31%	0.00%
MI	1991	5.53%	0.60%	6.94%	0.34%	8.86%	3.41%	3.03%	2.70%	4.12%	4.57%	3.53%	0.00%
MI	1989	6.43%	0.47%	8.31%	0.32%	11.86%	3.24%	2.94%	2.92%	3.61%	4.28%	3.24%	0.00%
MI	1985	5.93%	0.59%	7.64%	0.32%	11.39%	3.16%	2.93%	3.24%	3.52%	4.25%	2.19%	0.00%
NY	1995	5.99%	0.68%	6.55%	7.77%	6.29%	7.70%	8.31%	5.80%	6.58%	5.13%	12.17%	5.20%
NY	1993	6.65%	0.79%	7.51%	6.10%	7.87%	7.75%	8.80%	4.87%	6.47%	5.03%	10.03%	5.53%
NY	1991	6.47%	1.14%	7.07%	5.91%	7.41%	8.32%	9.13%	5.16%	7.05%	5.61%	13.73%	5.59%
NY	1989	7.03%	0.59%	7.92%	4.73%	9.34%	8.87%	9.65%	5.59%	7.11%	6.34%	14.25%	5.39%
NY	1985	7.79%	0.67%	8.97%	7.22%	9.87%	9.96%	10.54%	5.68%	8.75%	7.04%	17.62%	5.64%
NJ	1995	4.99%	1.98%	6.21%	0.84%	7.36%	2.01%	1.57%	2.39%	1.73%	3.37%	2.09%	2.33%
NJ	1993	5.56%	3.05%	6.95%	1.66%	8.25%	1.88%	1.40%	2.31%	1.91%	3.24%	1.88%	2.19%
NJ	1991	5.47%	3.37%	6.68%	3.24%	7.68%	1.94%	1.44%	2.92%	1.60%	3.14%	1.92%	1.79%
NJ	1989	5.14%	2.84%	6.26%	1.92%	8.19%	1.89%	1.31%	3.65%	1.70%	3.06%	1.85%	2.39%
NJ	1985	6.26%	6.91%	7.09%	2.75%	9.32%	1.48%	1.26%	2.25%	1.09%	2.04%	1.55%	3.74%
MA	1995	5.45%	1.82%	5.61%	6.22%	5.48%	5.19%	6.19%	0.80%	5.99%	2.29%	7.98%	6.38%
MA	1993	5.75%	2.30%	5.92%	8.23%	5.38%	5.49%	6.46%	0.96%	7.20%	2.24%	8.61%	6.70%
MA	1991	5.35%	1.82%	5.42%	5.61%	5.36%	5.38%	6.64%	0.89%	7.51%	1.95%	7.61%	7.66%
MA	1989	5.65%	2.65%	5.72%	5.40%	5.86%	5.78%	6.92%	1.54%	7.92%	2.18%	8.33%	7.70%
MA	1985	5.60%	1.38%	5.34%	5.88%	5.06%	6.13%	7.76%	0.95%	9.30%	1.91%	4.77%	7.48%
TX	1995	4.58%	3.10%	4.70%	3.89%	4.88%	6.66%	5.61%	9.60%	6.87%	7.37%	10.41%	0.00%
TX	1993	4.22%	2.81%	4.16%	2.81%	4.49%	6.96%	5.71%	10.13%	6.61%	8.19%	11.04%	0.09%
TX	1991	4.14%	2.66%	4.07%			6.89%	5.38%	9.37%	6.82%	8.33%	12.19%	0.05%
TX	1989	4.68%	3.07%	4.94%	5.91%	4.51%	6.76%	5.43%	10.05%	6.41%	7.74%	12.03%	0.00%
TX	1985	4.07%	1.92%	4.47%	4.57%	4.41%	6.21%	5.51%	9.16%	6.73%	8.27%	3.75%	0.00%

Table a.7. (continued) Share of US Total R&D for Selected States, by Performing and Funding Sector

Performing Sector:		Total R&D	Federal Govt.	Industry			Universities & Colleges						U&C FFRDCs
Funding Sector:		Total R&D	Federal Govt.	Total	Federal Govt.2	Industry2	Total	Federal Govt.	Nonfed. Govt.	Industry	U&C	Non-Profits	Federal Govt.
IL	1995	4.09%	0.46%	4.37%	0.62%	5.18%	3.70%	3.51%	2.83%	2.88%	4.85%	4.05%	14.26%
IL	1993	4.11%	0.50%	4.47%	1.03%	5.30%	3.80%	3.55%	2.95%	3.31%	4.97%	4.31%	12.26%
IL	1991	4.01%	0.45%	4.30%	0.72%	5.34%	3.98%	3.54%	3.54%	4.10%	5.31%	4.34%	11.29%
IL	1989	3.77%	0.39%	3.98%			4.02%	3.76%	2.76%	3.91%	5.57%	3.79%	11.17%
IL	1985	3.87%	0.66%	4.13%	1.08%	5.69%	4.13%	4.02%	3.22%	2.93%	5.63%	3.45%	10.63%
PA	1995	3.78%	1.31%	4.04%	1.60%	4.56%	5.16%	5.66%	2.11%	8.06%	4.08%	4.10%	0.58%
PA	1993	5.02%	2.12%	5.72%	5.01%	5.90%	5.11%	5.66%	1.28%	8.23%	4.16%	4.10%	0.66%
PA	1991	4.76%	2.07%	5.35%	7.81%	4.64%	4.98%	5.40%	1.80%	8.28%	4.10%	4.56%	0.53%
PA	1989	4.11%	1.81%	4.55%	6.09%	3.86%	5.07%	5.22%	2.59%	9.22%	4.02%	5.46%	0.44%
PA	1985	4.05%	1.84%	4.56%	3.97%	4.87%	4.81%	5.06%	1.86%	8.74%	3.34%	6.08%	0.06%
WA	1995	2.86%	0.92%	3.25%			2.20%	2.55%	0.83%	2.64%	1.92%	0.95%	0.00%
WA	1993	3.29%	0.68%	3.99%	3.91%	4.02%	2.15%	2.61%	0.90%	2.50%	1.45%	1.08%	0.00%
WA	1991	2.43%	0.87%	2.75%			1.98%	2.48%	0.77%	2.32%	1.33%	0.88%	0.00%
WA	1989	2.29%	0.73%	2.67%			1.85%	2.28%	0.49%	2.10%	1.33%	0.74%	0.00%
WA	1985	2.42%	0.77%	2.79%	4.84%	1.74%	2.20%	2.62%	0.34%	1.88%	1.25%	3.12%	0.00%
OH	1995	2.90%	3.45%	3.03%	2.45%	3.16%	2.91%	2.81%	2.88%	3.64%	2.65%	3.68%	0.00%
OH	1993	3.88%	3.50%	4.38%	4.52%	4.36%	2.98%	2.91%	2.95%	3.53%	2.49%	4.17%	0.00%
OH	1991	3.73%	4.52%	4.04%	2.95%	4.36%	2.86%	2.79%	3.58%	3.13%	2.17%	4.12%	0.00%
OH	1989	3.89%	6.98%	3.87%	2.18%	4.63%	2.84%	2.70%	3.89%	3.81%	2.29%	3.52%	0.00%
OH	1985	3.43%	4.13%	3.64%	1.83%	4.57%	2.75%	2.70%	2.07%	3.10%	2.66%	3.92%	0.00%

Table a.8. Federal Obligations for Research and Development in California by Agency

Year	Total	Dept of Agriculture	Dept of Commerce	Dept of Defense	Dept of Energy	Dept. of Health & Human Services	Dept. of the Interior	Dept of Transportation	EPA	NASA	National Science Foundation
Thousands of Current Dollars											
1997	13,731,238	77,948	72,647	8,170,552	1,031,311	1,391,314	44,704	25,372	2,291	2,594,307	320,792
1996	12,617,601	71,854	96,918	7,370,786	901,842	1,351,322	46,415	24,387	13,947	2,447,940	292,190
1995	12,703,572	76,788	86,514	7,272,250	1,058,345	1,305,366	45,125	33,854	25,367	2,503,332	296,631
1994	11,279,888	79,673	36,871	6,597,594	1,012,937	1,210,119	49,720	31,395	15,035	1,962,011	284,533
1993	14,883,737	75,054	51,500	9,525,466	1,150,362	1,147,249	40,275	29,876	13,937	2,564,287	285,731
1992	15,999,143	76,838	53,685	10,747,737	1,213,247	1,007,661	43,133	7,519	21,169	2,592,326	235,828
1991	14,488,289	71,271	22,746	9,319,433	1,122,209	1,242,492	44,509	9,039	4,292	2,424,342	227,936
1990	16,249,328	59,808	28,345	11,620,874	1,011,694	981,917	34,405	14,647	28,054	2,160,073	309,511
1989	15,919,376	58,260	39,406	11,675,020	1,102,807	943,380	32,481	21,563	21,093	1,793,143	232,223
1988	14,895,772	61,336	21,154	11,143,780	1,022,586	853,511	26,722	20,324	27,628	1,510,668	208,063
1987	13,670,882	55,737	34,352	10,445,684	943,756	777,992	27,939	20,310	20,239	1,142,106	202,767
1983	8,439,931	54,125	13,233	6,001,252	853,581	483,831	40,429	34,755	27,377	774,416	156,932
1980	7,138,014	45,221	14,319	3,762,778	772,311	410,307	41,511	28,934	17,595	1,891,098	153,940
Thousands of 1987 Constant Dollars											
1997	10,082,548	57,236	53,343	5,999,458	757,269	1,021,611	32,825	18,630	1,682	1,904,943	235,551
1996	9,500,446	54,103	72,975	5,549,847	679,044	1,017,480	34,948	18,362	10,501	1,843,181	220,005
1995	9,947,981	60,132	67,748	5,694,792	828,774	1,022,213	35,337	26,511	19,865	1,960,323	232,287
1994	8,995,126	63,535	29,403	5,261,239	807,765	965,007	39,649	25,036	11,990	1,564,602	226,900
1993	12,100,599	61,020	41,870	7,744,281	935,254	932,723	32,744	24,289	11,331	2,084,786	232,302
1992	13,321,518	63,978	44,700	8,948,990	1,010,197	839,018	35,914	6,261	17,626	2,158,473	196,360
1991	12,414,986	61,072	19,491	7,985,804	961,619	1,064,689	38,140	7,746	3,678	2,077,414	195,318
1990	14,508,329	53,400	25,308	10,375,780	903,298	876,712	30,719	13,078	25,048	1,928,637	276,349
1989	14,712,917	53,845	36,420	10,790,222	1,019,230	871,885	30,019	19,929	19,494	1,657,249	214,624
1988	14,378,158	59,205	20,419	10,756,544	987,052	823,852	25,793	19,618	26,668	1,458,174	200,833
1987	13,670,882	55,737	34,352	10,445,684	943,756	777,992	27,939	20,310	20,239	1,142,106	202,767
1983	9,701,070	62,213	15,210	6,897,991	981,128	556,128	46,470	39,948	31,468	890,133	180,382
1980	10,110,501	64,052	20,282	5,329,714	1,093,925	581,171	58,797	40,983	24,922	2,678,609	218,045

Table a.8. (continued) Federal Obligations for Research and Development in California by Agency

Year	Total	Dept of Agriculture	Dept of Commerce	Dept of Defense	Dept of Energy	Dept. of Health & Human Services	Dept. of the Interior	Dept of Transportation	EPA	NASA	National Science Foundation
Share of U.S. Total											
1997	20.04%	5.63%	7.25%	23.57%	18.41%	10.92%	7.73%	4.82%	0.47%	27.96%	14.33%
1996	19.04%	5.53%	9.10%	21.43%	16.88%	11.35%	8.20%	4.42%	3.02%	28.83%	13.40%
1995	18.89%	5.58%	7.62%	21.23%	17.29%	11.44%	8.05%	4.66%	4.63%	27.91%	13.84%
1994	17.13%	5.71%	4.47%	19.15%	16.78%	11.03%	7.18%	5.07%	2.72%	23.76%	13.98%
1993	22.64%	5.67%	7.85%	26.70%	18.38%	11.14%	6.52%	5.49%	2.81%	32.07%	15.20%
1992	24.96%	5.81%	8.24%	29.87%	19.67%	11.28%	7.10%	1.69%	4.37%	34.00%	12.65%
1991	24.20%	5.79%	4.65%	29.12%	18.76%	12.80%	7.51%	2.38%	0.99%	33.35%	12.82%
1990	26.16%	5.43%	6.47%	31.34%	17.98%	11.74%	6.77%	4.01%	6.68%	33.14%	18.34%
1989	26.76%	5.63%	9.91%	31.72%	21.25%	12.01%	6.93%	7.16%	5.55%	33.32%	13.92%
1988	26.77%	6.06%	5.44%	31.68%	20.31%	12.00%	6.41%	6.77%	7.95%	35.03%	13.59%
1987	25.29%	5.93%	8.54%	29.77%	19.85%	11.84%	6.92%	6.26%	5.81%	30.29%	13.80%
1983	22.43%	6.44%	3.95%	26.17%	18.85%	11.18%	10.60%	10.00%	11.38%	29.43%	14.81%
1980	23.42%	6.64%	4.19%	27.02%	16.30%	10.93%	10.11%	8.01%	5.13%	37.50%	17.49%
Distribution of Federal Agency Support in California											
1997	100.00%	0.57%	0.53%	59.50%	7.51%	10.13%	0.33%	0.18%	0.02%	18.89%	2.34%
1996	100.00%	0.57%	0.77%	58.42%	7.15%	10.71%	0.37%	0.19%	0.11%	19.40%	2.32%
1995	100.00%	0.60%	0.68%	57.25%	8.33%	10.28%	0.36%	0.27%	0.20%	19.71%	2.34%
1994	100.00%	0.71%	0.33%	58.49%	8.98%	10.73%	0.44%	0.28%	0.13%	17.39%	2.52%
1993	100.00%	0.50%	0.35%	64.00%	7.73%	7.71%	0.27%	0.20%	0.09%	17.23%	1.92%
1992	100.00%	0.48%	0.34%	67.18%	7.58%	6.30%	0.27%	0.05%	0.13%	16.20%	1.47%
1991	100.00%	0.49%	0.16%	64.32%	7.75%	8.58%	0.31%	0.06%	0.03%	16.73%	1.57%
1990	100.00%	0.37%	0.17%	71.52%	6.23%	6.04%	0.21%	0.09%	0.17%	13.29%	1.90%
1989	100.00%	0.37%	0.25%	73.34%	6.93%	5.93%	0.20%	0.14%	0.13%	11.26%	1.46%
1988	100.00%	0.41%	0.14%	74.81%	6.86%	5.73%	0.18%	0.14%	0.19%	10.14%	1.40%
1987	100.00%	0.41%	0.25%	76.41%	6.90%	5.69%	0.20%	0.15%	0.15%	8.35%	1.48%
1983	100.00%	0.64%	0.16%	71.11%	10.11%	5.73%	0.48%	0.41%	0.32%	9.18%	1.86%
1980	100.00%	0.63%	0.20%	52.71%	10.82%	5.75%	0.58%	0.41%	0.25%	26.49%	2.16%

Table b.1. Industrial R&D in California by Source

Year	Total, millions of current dollars	Total, millions of constant 1987dollars	% Industry financed	% Federal financed
1997	34,011	25,034	82.43%	17.57%
1995	28,710	22,395	75.88%	24.12%
1993	26,541	21,491	71.88%	28.12%
1991	21,279	18,094	58.12%	41.88%
1989	23,675	21,820	45.69%	54.31%
1985	17,760	18,814	39.10%	60.90%
1983	14,237	16,327	41.72%	58.28%
1981	10,765	13,644	38.83%	61.17%

Table b.2. Federal Obligations to Industry in California by Agency

Year	Total	Dept of Agriculture	Dept of Commerce	Dept of Defense		Dept Energy	Dept Health & Human Services	Dept Interior	Dept Trans.	EPA	NASA	NSF
				Research	Development							
Thousands of Current Dollars												
1997	7,816,020	429	46,744	314,663	6,293,623	63,580	74,465	571	11,723	0	985,825	24,397
1995	6,685,458	0	62,180	442,001	4,910,910	107,416	119,258	1,139	6,737	8,399	998,238	29,180
1994	6,046,504	320	10,406	404,777	4,440,323	114,309	41,992	1,224	7,797	9,050	983,870	32,436
1993	9,194,852	273	10,464	500,257	6,985,727	130,571	35,484	1,906	11,514	7,887	1,486,755	24,014
1992	10,007,506	336	8,450	346,459	8,060,166	150,432	30,599	581	2,971	11,388	1,384,197	11,927
1991	8,722,782	321	1,430	399,451	6,793,432	140,739	37,828	1,457	1,316	0	1,337,777	8,921
1989	9,761,017	41	13,901	8,807,178		116,103	38,702	716	9,406	12,792	751,578	10,600
1987	8,603,576	0	20,072	8,046,512		105,854	30,775	193	6,511	13,016	369,579	11,064
1983	5,154,605	37	1,119	4,551,849		120,939	9,486	1,872	20,928	21,300	421,810	5,265
1980	4,642,427	463	3,867	2,749,927		201,370	22,216	12,546	20,473	7,846	1,616,209	7,510
Thousands of 1987 Constant Dollars												
1997	5,739,132	315	34,323	231,050	4,621,270	46,685	54,678	419	8,608	0	723,870	17,914
1995	5,235,284	0	48,692	346,125	3,845,662	84,116	93,389	892	5,276	6,577	781,706	22,850
1994	4,821,774	255	8,298	322,789	3,540,927	91,156	33,486	976	6,218	7,217	784,585	25,866
1993	7,475,489	222	8,507	406,713	5,679,453	106,155	28,849	1,550	9,361	6,412	1,208,744	19,524
1992	8,332,644	280	7,036	288,475	6,711,212	125,256	25,478	484	2,474	9,482	1,152,537	9,931
1991	7,474,535	275	1,225	342,289	5,821,278	120,599	32,415	1,249	1,128	0	1,146,338	7,644
1989	9,021,273	38	12,848	8,139,721		107,304	35,769	662	8,693	11,823	694,619	9,797
1987	8,603,576	0	20,072	8,046,512		105,854	30,775	193	6,511	13,016	369,579	11,064
1983	5,924,833	43	1,286	5,232,010		139,010	10,903	2,152	24,055	24,483	484,839	6,052
1980	6,575,676	656	5,477	3,895,081		285,227	31,467	17,771	28,999	11,113	2,289,248	10,637

Table b.2. (continued) Federal Obligations to Industry in California by Agency

Year	Total	Dept of Agriculture	Dept of Commerce	Dept of Defense		Dept Energy	Dept Health & Human Services	Dept Interior	Dept Trans.	EPA	NASA	NSF
				Research	Development							
Share of US Total												
1997	24.88%	3.86%	20.31%	24.76%	27.57%	5.17%	11.55%	4.43%	6.79%	0.00%	20.68%	21.33%
1995	21.94%	0.00%	16.52%	29.28%	23.34%	6.51%	19.92%	6.95%	2.51%	5.60%	21.30%	26.87%
1994	19.85%	2.74%	7.46%	29.02%	20.17%	7.48%	9.09%	3.77%	3.38%	4.53%	22.86%	41.16%
1993	30.32%	3.46%	11.12%	28.38%	31.91%	9.03%	7.89%	6.37%	8.45%	2.97%	36.15%	32.36%
1992	33.64%	4.00%	18.25%	24.07%	35.56%	14.66%	8.11%	1.99%	2.52%	7.79%	36.76%	27.05%
1991	33.12%	5.18%	8.41%	30.78%	34.42%	16.46%	10.14%	4.44%	1.49%	0.00%	36.48%	8.68%
1989	34.27%	0.70%	62.30%	35.61%		17.85%	11.66%	2.70%	11.16%	8.98%	30.98%	18.56%
1987	30.19%	0.00%	62.54%	33.17%		4.98%	11.98%	1.40%	5.93%	7.56%	25.26%	19.20%
1983	30.17%	2.28%	5.06%	31.30%		11.57%	7.52%	8.96%	11.65%	22.97%	40.96%	20.23%
1980	32.38%	8.09%	11.51%	30.48%		14.62%	12.28%	16.96%	12.65%	8.71%	47.87%	46.06%
Share of Federal Obligations to Industry in California												
1997	100%	0.01%	0.60%	4.03%	80.52%	0.81%	0.95%	0.01%	0.15%	0.00%	12.61%	0.31%
1995	100%	0.00%	0.93%	6.61%	73.46%	1.61%	1.78%	0.02%	0.10%	0.13%	14.93%	0.44%
1994	100%	0.01%	0.17%	6.69%	73.44%	1.89%	0.69%	0.02%	0.13%	0.15%	16.27%	0.54%
1993	100%	0.00%	0.11%	5.44%	75.97%	1.42%	0.39%	0.02%	0.13%	0.09%	16.17%	0.26%
1992	100%	0.00%	0.08%	3.46%	80.54%	1.50%	0.31%	0.01%	0.03%	0.11%	13.83%	0.12%
1991	100%	0.00%	0.02%	4.58%	77.88%	1.61%	0.43%	0.02%	0.02%	0.00%	15.34%	0.10%
1989	100%	0.00%	0.14%	90.23%		1.19%	0.40%	0.01%	0.10%	0.13%	7.70%	0.11%
1987	100%	0.00%	0.23%	93.53%		1.23%	0.36%	0.00%	0.08%	0.15%	4.30%	0.13%
1983	100%	0.00%	0.02%	88.31%		2.35%	0.18%	0.04%	0.41%	0.41%	8.18%	0.10%
1980	100%	0.01%	0.08%	59.23%		4.34%	0.48%	0.27%	0.44%	0.17%	34.81%	0.16%

Table b.3.a. Distribution of Industry Performed R&D in California and the United States, 1995, Selected Industries

Industry	SIC code	CA Industry R&D, 1995	Distribution of CA Industry R&D, 1995	US Industry R&D, 1995	Distribution of US Industry R&D, 1995	CA Share of US Total, 1995
All Industries		\$28,710	100.00%	\$132,103	100.00%	21.73%
Manufacturing		22,354	77.86%	100,067	75.75%	22.34%
Food, kindred, and tobacco products	20,21	36	0.13%	1,566	1.19%	2.30%
Chemicals and allied products	28	1,360	4.74%	17,547	13.28%	7.75%
Industrial chemicals	281-82, 286	230	0.80%	(D)	(D)	
Drugs and medicines	283	1,057	3.68%	10,215	7.73%	10.35%
Machinery	35	3,306	11.52%	(D)	(D)	
Office, computing, and accounting machines	357	2,700	9.40%	(D)	(D)	
Other machinery, except electrical	351-56, 358-59	606	2.11%	5,041	3.82%	12.02%
Electrical equipment	36	6,786	23.64%	18,751	14.19%	36.19%
Radio and TV receiving equipment .	365	19	0.07%	(D)	(D)	
Communication equipment	366	748	2.61%	(D)	(D)	
Electronic components	367	4,902	17.07%	(D)	(D)	
Other electrical equipment	361-64, 369	1,117	3.89%	(D)	(D)	
Transportation equipment	37	8,875	30.91%	32,441	24.56%	27.36%
Aircraft and missiles	372, 376	5,096	17.75%	16,951	12.83%	30.06%
Professional and scientific instruments	38	1,394	4.86%	11,976	9.07%	11.64%
Scientific and mechanical measuring instruments	381-82	753	2.62%	7,146	5.41%	10.54%
Optical, surgical, photographic, and other instruments	384-87	641	2.23%	4,831	3.66%	13.27%
Nonmanufacturing		\$6,356	22.14%	\$32,036	24.25%	19.84%
Transportation and utilities	40-42, 44-49	280	0.98%	5,435	4.11%	5.15%
Communications	48	222	0.77%	(D)	(D)	
Telephone communications	481	215	0.75%	(D)	(D)	
Other communications	482-484, 489	7	0.02%	59	0.04%	11.86%

(D) means data withheld to protect confidentiality of firms

Table b.3.a. (continued) Distribution of Industry Performed R&D in California and the United States, 1995, Selected Industries

Industry	SIC code	CA Industry R&D, 1995	Distribution of CA Industry R&D, 1995	US Industry R&D, 1995	Distribution of US Industry R&D, 1995	CA Share of US Total, 1995
Trade	50-59	1,320	4.60%	(D)	(D)	
Finance, insurance, and real estate	60-65, 67	6	0.02%	(D)	(D)	
Services	701, 72, 73, 75- 81, 83, 84, 87, 89	4,734	16.49%	17,876	13.53%	26.48%
Business services	73	2,325	8.10%	9,293	7.03%	25.02%
Computer and data processing services	737	2,286	7.96%	9,059	6.86%	25.23%
Other business services	731-736, 738	39	0.14%	234	0.18%	16.67%
Health services	80	124	0.43%	756	0.57%	16.40%
Engineering and management services	87	2,256	7.86%	7,662	5.80%	29.44%
Research, development, and testing	873	1,836	6.39%	(D)	(D)	

(D) means data withheld to protect confidentiality of firms

Table b.3.b. Distribution of Industry Performed R&D in California and the United States, 1997, Selected Industries

Industry	SIC code	CA Industry R&D, 1997	Distribution of CA Industry R&D, 1997	US Industry R&D, 1997	Distribution of US Industry R&D, 1997	CA Share of US Total, 1997
All Industries		\$34,011	100.00%	\$157,539	100.00%	21.59%
Manufacturing		24,488	72.00%	121,025	76.82%	20.23%
Food, kindred, and tobacco products	20,21	39	0.11%	1,787	1.13%	2.18%
Chemicals and allied products .	28	1,674	4.92%	(D)		
Drugs and medicines	283	1,285	3.78%	11,589	7.36%	11.09%
Fabricated metal products	34	326	0.96%	1,798	1.14%	18.13%
Machinery	35	5,818	17.11%	18,499	11.74%	31.45%
Office, computing, and accounting machines	357	4,838	14.22%	12,840	8.15%	37.68%
Other machinery, except electrical	351-56, 358-59	980	2.88%	5,659	3.59%	17.32%
Electrical equipment	36	7,480	21.99%	24,585	15.61%	30.43%
Radio and TV receiving equipment .	365	48	0.14%	(D)		
Communication equipment	366	1,248	3.67%	(D)		
Electronic components .	367	5,164	15.18%	(D)		
Other electrical equipment	361-64, 369	1,021	3.00%	4,909	3.12%	20.80%
Transportation equipment	37	4,225	12.42%	31,993	20.31%	13.21%
Professional and scientific instruments	38	3,795	11.16%	13,458	8.54%	28.20%
Scientific and mechanical measuring instruments	381-82	3,318	9.76%	8,135	5.16%	40.79%
Optical, surgical, photographic, and other instruments	384-87	477	1.40%	5,323	3.38%	8.96%
Nonmanufacturing		\$9,523	28.00%	\$36,514	23.18%	26.08%
Transportation and utilities	40-42, 44-49	110	0.32%	3,013	1.91%	3.65%
Communications	48	46	0.14%	(D)		
Trade	50-59	2,348	6.90%	(D)		
Finance, insurance, and real estate .	60-65, 67	53	0.16%	(D)		
Services	701, 72, 73, 75-81, 83, 84, 87, 89	6,561	19.29%	22,400	14.22%	29.29%
Business services	73	3,350	9.85%	11,960	7.59%	28.01%
Computer and data processing services	737	3,304	9.71%	11,706	7.43%	28.22%
Other business services	731-736, 738	45	0.13%	254	0.16%	17.72%
Health services	80	37	0.11%	(D)		
Engineering and management services	87	2,872	8.44%	9,290	5.90%	30.91%
Engineering, architectural, and surveying	871	323	0.95%	2,039	1.29%	15.84%
Research, development, and testing	873	2,527	7.43%	(D)		

(D) means data withheld to protect confidentiality of firms

Table b.4.a. R&D Intensity in California and US Industry, 1995

Industry	SIC code	GSP (million \$)		Share of GSP		R&D Intensity	
		US	CA	US	CA	US	CA
Manufacturing		1,285,428	125,531	17.78%	13.74%	7.78%	17.81%
Transportation and utilities.	40-42, 44-49	622,350	65,737	8.61%	7.20%	0.87%	0.43%
Trade	50-59	1,122,037	144,178	15.52%	15.78%	(D)	0.92%
Finance, insurance, and real estate	60-65, 67	1,361,290	209,035	18.83%	22.88%	(D)	0.00%
Services	701, 72, 73, 75-81,	1,440,342	205,908	19.93%	22.54%	1.24%	2.30%
total, industries		5,831,447	750,389	80.68%	82.15%	2.27%	3.83%
selected subcategories							
Food, kindred, and tobacco products	20, 21	136,305	13,144	1.89%	1.44%	1.15%	0.27%
Chemicals and allied products	28	155,852	8,588	2.16%	0.94%	11.26%	15.84%
Petroleum refining and extraction	13, 29	30,242	4,618	0.42%	0.51%	5.82%	(D)
Machinery	35	142,368	20,265	1.97%	2.22%	(D)	16.31%
Electrical equipment.	36	134,048	21,186	1.85%	2.32%	13.99%	32.03%
Transportation equipment	37	134,206	9,080	1.86%	0.99%	24.17%	97.74%
Professional and scientific instruments	38	49,657	10,782	0.69%	1.18%	24.12%	12.93%
Business & Engineering	73, 87	483,200	77,621	6.68%	8.50%	3.51%	5.90%
Business services	73	283,284	45,262	3.92%	4.95%	3.28%	5.14%

(D) means data withheld to protect confidentiality of firms

Table b.4.b. R&D Intensity in California and U.S. Industry, 1997

Industry	SIC code	GSP (million \$)		Share of GSP		R&D Intensity	
		US	CA	US	CA	US	CA
Total GSP		8,103,234	1,033,016	100.00%	100.00%	2.54%	3.98%
Total, Private Industries		7,139,050	918,054	88.10%	88.87%	2.21%	3.70%
Agriculture, Farms, Agricultural Services		263,490	43,266	3.25%	4.19%	n.a.	n.a.
Manufacturing		1,378,869	146,173	17.02%	14.15%	8.78%	16.75%
Transportation and utilities	40-42, 44- 49	676,313	72,301	8.35%	7.00%	0.45%	0.15%
Trade	50-59	1,275,645	162,477	15.74%	15.73%	(D)	1.45%
Finance, insurance, and real estate	60-65, 67	1,570,308	237,282	19.38%	22.97%	(D)	0.02%
Services	701, 72, 73, 75-81,	1,656,849	236,925	20.45%	22.94%	1.35%	2.77%
selected subcategories							
Chemicals and allied products	28	158,814	8,241	1.96%	0.80%	(D)	20.31%
Machinery	35	158,895	24,351	1.96%	2.36%	11.64%	23.89%
Electrical equipment.	36	157,283	26,664	1.94%	2.58%	15.63%	28.05%
Transportation equipment	37	136,058	9,699	1.68%	0.94%	23.51%	43.56%
Professional and scientific instruments	38	55,905	13,040	0.69%	1.26%	24.07%	29.10%
Business & Engineering	73, 87	599,368	96,383	7.40%	9.33%	3.50%	6.41%
Business services	73	364,722	59,275	4.50%	5.74%	3.28%	5.65%

(D) means data withheld to protect confidentiality of firms

Table b.5. Distribution of Manufacturing Industry Performed R&D in California, 1985, 1995, 1997

Industry	SIC code	Share of California manufacturing R&D, 1985	Share of California Manufacturing R&D, 1995	Share of California Manufacturing R&D, 1997
All Manufacturing		100%	100%	100%
Food, kindred, and tobacco products	20, 21	n.a.	0.16%	0.16%
Chemicals and allied products .	28	2.30%	6.08%	6.84%
Industrial chemicals	281-82, 286	0.27%	1.03%	n.a.
Drugs and medicines	283	1.55%	4.73%	5.25%
Other chemicals	284-85, 287-89	0.47%	0.33%	n.a.
Machinery	35	7.42%	14.79%	23.76%
Office, computing, and accounting machines	357	6.58%	12.08%	19.76%
Other machinery, except electrical	351-56, 358-59	0.84%	2.71%	4.00%
Electrical equipment	36	11.51%	30.36%	30.55%
Radio and TV receiving equipment .	365	0.04%	0.08%	0.20%
Communication equipment	366	4.26%	3.35%	5.10%
Electronic components .	367	5.28%	21.93%	21.09%
Other electrical equipment	361-64, 369	1.93%	5.00%	4.17%
Transportation equipment	37	n.a.	39.70%	17.25%
Aircraft and missiles	372, 376	59.67%	22.80%	n.a.
Professional and scientific instruments	38	6.36%	6.24%	15.50%
Scientific and mechanical measuring instruments	381-82	3.76%	3.37%	13.55%
Optical, surgical, photographic, and other instruments	384-87	2.60%	2.87%	1.95%

Table b.6. R&D Intensity in Industry, 1985

Industry	SIC code	1985 GSP (million \$)		Share of GSP		R&D Expenditures (million \$)		R&D Intensity	
		US	CA	US	CA	US	CA	US	CA
Total, 1985		4,128,383	525,989	100.00%	100.00%	107,456	22,293	2.60%	4.24%
All Industries		3,600,680	460,706	87.22%	87.59%	78,268	17,760	2.17%	3.85%
Manufacturing		802,938	86,031	19.45%	16.36%	75,354	16,681	9.38%	19.39%
Chemicals and allied products	28	67,681	3,423	1.64%	0.65%	8,690	383	12.84%	11.19%
Petroleum refining and extraction	13, 29	21,297	4,041	0.52%	0.77%	(D)	29	(D)	0.72%
Machinery	35	89,865	8,855	2.18%	1.68%	10,853	1,237	12.08%	13.97%
Electrical equipment	36	89,853	18,519	2.18%	3.52%	18,030	1,920	20.07%	10.37%
Transportation equipment	37	105,549	12,875	2.56%	2.45%	26,371	9,953*	24.98%	77.30%
Professional and scientific instruments	38	24,886	3,717	0.60%	0.71%	5,421	1,061	21.78%	28.54%

* aircraft and missile R&D only

(D) means data withheld to protect confidentiality of firms

Table b.7. Number of Patents Assigned to California Inventors or Firms

YEAR	1976	1980	1985	1987	1989	1991	1993	1995
All Chemical/Biology	1,192	1,086	1,246	1,332	1,640	1,677	2,152	2,267
Biochemistry	170	139	185	275	379	407	585	567
Chemical Engineering	362	358	374	353	427	419	488	473
Organic Chemistry	318	246	286	308	311	311	466	442
Surgery/ Body Care/ Cosmetics	119	151	190	254	335	356	497	680
Materials/ Compositions/ Explosives	379	360	401	398	437	490	543	498
Agriculture/ Farming	188	186	206	190	285	225	238	212
All Electronics Classes	1,410	1,214	1,572	2,162	2,860	2,927	3,405	4,576
Computing and Data Processing	255	216	336	521	709	735	1,062	1,559
Electricity and Electric Power	388	288	401	526	643	651	603	790
Electronics & Electronic Components	402	324	446	564	793	853	852	1,200
Radiant Energy/ Optics/ Photography	289	252	302	511	609	697	636	688
Communications	277	218	279	411	572	522	634	881
Others/ Measurement/ Nuclear	348	285	333	345	456	420	532	556
Music/ Education/ Amusement	64	73	64	85	89	85	111	154
All Engineering/ Transportation	1,184	1,099	1,358	1,615	1,935	2,003	2,447	3,199
Aeronautics	44	25	36	55	53	67	66	53
Vehicle and Transportation	188	125	149	172	145	158	179	178
Material of Article Handling	170	146	135	134	165	149	160	175
Earthworking/Civil Engineering	115	109	160	142	105	99	100	83
Heating/Cooling/Building/Fluid & Gas Handling	344	334	366	293	342	331	356	368
Office Devices/Paper Handling/Coatings/	199	187	226	357	507	515	776	1177
Textile & Apparel	50	38	38	39	43	52	52	84
All Mechanical	835	622	710	750	900	815	857	805

Table b.8. California's Share of All Patents in Class Assigned to US Inventors or Firms

YEAR	1976	1980	1985	1987	1989	1991	1993	1995
All Chemical/Biology	7.42%	8.31%	8.90%	9.70%	9.75%	9.75%	11.50%	12.45%
Biochemistry	8.99%	7.99%	10.44%	12.76%	12.69%	13.11%	15.65%	15.20%
Chemical Engineering	7.86%	9.22%	9.37%	9.55%	9.66%	9.61%	10.15%	10.91%
Organic Chemistry	5.33%	5.05%	5.78%	7.16%	6.11%	5.76%	7.73%	8.42%
Surgery/ Body Care/ Cosmetics	12.73%	15.98%	15.35%	16.45%	17.59%	16.76%	20.39%	21.94%
Materials/ Compositions/ Explosives	6.47%	7.99%	8.32%	8.75%	8.03%	9.11%	9.87%	9.43%
Agriculture/ Farming	8.98%	10.28%	9.97%	9.60%	11.80%	10.33%	10.83%	10.17%
All Electronics Classes	10.91%	11.34%	12.37%	14.82%	17.02%	17.51%	18.91%	21.86%
Computing and Data Processing	14.22%	13.28%	15.19%	19.43%	19.82%	22.22%	24.34%	28.15%
Electricity and Electric Power	9.70%	9.29%	10.51%	12.68%	14.71%	15.67%	15.47%	18.56%
Electronics & Electronic Components	11.67%	11.79%	13.35%	15.05%	19.10%	19.32%	20.35%	24.94%
Radiant Energy/ Optics/ Photography	12.35%	12.82%	14.46%	19.28%	19.25%	19.97%	19.20%	20.13%
Communications	11.37%	10.82%	11.72%	13.49%	17.54%	16.53%	18.01%	20.28%
Others/ Measurement/ Nuclear	10.58%	10.79%	11.34%	11.30%	12.83%	13.93%	15.63%	16.01%
Music/ Education/ Amusement	10.77%	14.99%	14.95%	17.89%	14.96%	14.63%	17.16%	19.57%
All Engineering/ Transportation	9.16%	10.00%	10.40%	11.74%	11.98%	12.02%	13.51%	16.00%
Aeronautics	15.71%	14.71%	17.39%	23.40%	20.15%	24.01%	27.05%	25.36%
Vehicle and Transportation	11.05%	9.77%	11.03%	11.54%	8.98%	8.98%	10.35%	9.85%
Material of Article Handling	9.96%	11.21%	9.01%	8.97%	10.46%	9.16%	9.95%	11.41%
Earthworking/Civil Engineering	11.31%	11.61%	14.91%	120.34%	9.79%	10.00%	9.73%	8.08%
Heating/Cooling/Building/Fluid & Gas Handling	9.55%	10.60%	10.87%	9.21%	9.88%	9.86%	10.12%	10.94%
Office Devices/Paper Handling/Coatings/	9.37%	10.25%	9.74%	14.69%	14.86%	15.55%	18.78%	24.00%
Textile & Apparel	4.60%	5.07%	4.98%	5.41%	5.26%	6.12%	7.43%	10.29%
All Mechanical	8.55%	7.97%	8.22%	8.92%	9.01%	8.50%	8.76%	8.90%

Table b.9. Share of Patents in Class Assigned to US Inventors or Firms

YEAR	1976	1980	1985	1987	1989	1991	1993	1995
All Chemical/Biology	55.86%	52.23%	51.55%	48.41%	47.79%	48.20%	49.66%	49.63%
Biochemistry	56.60%	53.10%	52.29%	52.48%	51.51%	53.13%	55.12%	55.61%
Chemical Engineering	55.56%	51.91%	52.07%	48.39%	48.68%	49.56%	51.77%	49.67%
Organic Chemistry	58.54%	58.93%	57.33%	53.82%	52.24%	52.36%	52.84%	52.05%
Surgery/ Body Care/ Cosmetics	45.68%	40.38%	43.79%	41.36%	41.49%	42.24%	46.62%	51.69%
Materials/ Compositions/ Explosives	59.40%	55.33%	52.54%	49.09%	48.78%	49.11%	48.51%	47.33%
Agriculture/ Farming	51.79%	47.01%	49.78%	45.95%	44.13%	44.24%	45.94%	45.66%
All Electronics Classes	55.73%	50.20%	47.21%	44.81%	42.87%	42.99%	43.90%	45.39%
Computing and Data Processing	62.50%	57.92%	47.79%	44.20%	43.79%	43.43%	46.28%	48.69%
Electricity and Electric Power	58.59%	53.11%	50.46%	46.69%	46.51%	47.59%	45.71%	48.00%
Electronics & Electronic Components	63.49%	61.20%	57.32%	54.75%	52.50%	52.27%	49.18%	49.11%
Radiant Energy/ Optics/ Photography	53.60%	46.80%	42.52%	40.10%	38.47%	39.77%	40.13%	40.94%
Communications	60.49%	54.39%	50.53%	49.28%	43.43%	45.21%	46.57%	47.60%
Others/ Measurement/ Nuclear	54.24%	48.44%	45.71%	43.93%	43.77%	41.82%	45.07%	45.82%
Music/ Education/ Amusement	34.53%	26.89%	26.31%	25.96%	25.16%	24.22%	26.87%	28.92%
All Engineering/ Transportation	50.25%	45.59%	44.59%	41.12%	41.21%	41.64%	43.84%	45.68%
Aeronautics	62.08%	57.43%	58.81%	50.87%	54.23%	52.25%	53.86%	56.79%
Vehicle and Transportation	43.26%	38.98%	37.76%	32.21%	31.73%	33.00%	35.54%	37.88%
Material of Article Handling	47.26%	42.37%	42.86%	39.47%	37.46%	38.26%	39.97%	40.13%
Earthworking/Civil Engineering	51.65%	48.60%	53.38%	5.12%	47.10%	45.37%	49.45%	50.10%
Heating/Cooling/Building/Fluid & Gas Handling	49.36%	43.96%	43.21%	39.95%	39.99%	40.56%	43.00%	43.18%
Office Devices/Paper Handling/Coatings/	58.48%	54.11%	48.15%	45.13%	45.78%	44.53%	48.55%	50.69%
Textile & Apparel	40.66%	35.72%	32.50%	27.91%	30.31%	30.74%	30.72%	33.50%
All Mechanical	47.40%	43.07%	41.08%	36.88%	38.02%	37.91%	40.46%	40.80%

Table b.10. California's Share of All US Patents Issued in Class

YEAR	1976	1980	1985	1987	1989	1991	1993	1995
All Chemical/Biology	4.15%	4.34%	4.59%	4.69%	4.66%	4.70%	5.71%	6.18%
Biochemistry	5.09%	4.24%	5.46%	6.70%	6.54%	6.96%	8.63%	8.45%
Chemical Engineering	4.37%	4.79%	4.88%	4.62%	4.70%	4.76%	5.25%	5.42%
Organic Chemistry	3.12%	2.98%	3.32%	3.85%	3.19%	3.02%	4.09%	4.38%
Surgery/ Body Care/ Cosmetics	5.81%	6.45%	6.72%	6.80%	7.30%	7.08%	9.51%	11.34%
Materials/ Compositions/ Explosives	3.84%	4.42%	4.37%	4.30%	3.92%	4.47%	4.79%	4.46%
Agriculture/ Farming	4.65%	4.83%	4.96%	4.41%	5.21%	4.57%	4.97%	4.65%
All Electronics Classes	6.08%	5.69%	5.84%	6.64%	7.30%	7.53%	8.30%	9.92%
Computing and Data Processing	8.89%	7.69%	7.26%	8.59%	8.68%	9.65%	11.26%	13.71%
Electricity and Electric Power	5.68%	4.94%	5.30%	5.92%	6.84%	7.46%	7.07%	8.91%
Electronics & Electronic Components	7.41%	7.22%	7.65%	8.24%	10.03%	10.10%	10.01%	12.25%
Radiant Energy/ Optics/ Photography	6.62%	6.00%	6.15%	7.73%	7.40%	7.94%	7.71%	8.24%
Communications	6.88%	5.89%	5.92%	6.65%	7.62%	7.47%	8.39%	9.65%
Others/ Measurement/ Nuclear	5.74%	5.23%	5.18%	4.96%	5.62%	5.82%	7.04%	7.34%
Music/ Education/ Amusement	3.72%	4.03%	3.93%	4.64%	3.76%	3.54%	4.61%	5.66%
All Engineering/ Transportation	4.60%	4.56%	4.64%	4.83%	4.94%	5.00%	5.92%	7.31%
Aeronautics	9.76%	8.45%	10.23%	11.90%	10.93%	12.55%	14.57%	14.40%
Vehicle and Transportation	4.78%	3.81%	4.16%	3.72%	2.85%	2.96%	3.68%	3.73%
Material of Article Handling	4.71%	4.75%	3.86%	3.54%	3.92%	3.50%	3.98%	4.58%
Earthworking/Civil Engineering	5.84%	5.64%	7.96%	6.16%	4.61%	4.54%	4.81%	4.05%
Heating/Cooling/Building/Fluid & Gas Handling	4.71%	4.66%	4.70%	3.68%	3.95%	4.00%	4.35%	4.72%
Office Devices/Paper Handling/Coatings/	5.48%	5.54%	4.69%	6.63%	6.80%	6.93%	9.12%	12.16%
Textile & Apparel	1.87%	1.81%	1.62%	1.51%	1.59%	1.88%	2.28%	3.45%
All Mechanical	4.05%	3.43%	3.37%	3.29%	3.42%	3.22%	3.55%	3.63%

Table c.1. Academic R&D in California by Source of Funds

Year	Current, total dollars	Total, 1987 constant dollars	Distribution of Academic Support in California				
			Federal Govt.	Nonfed. Govt.	Industry	U&C	Non-Profits/ Other
1997	2,982,373	2,195,174	68.05%	4.35%	5.42%	14.75%	7.42%
1995	2,594,280	2,023,619	69.26%	4.13%	4.63%	14.38%	7.61%
1993	2,380,000	1,927,126	68.49%	4.71%	4.16%	15.46%	7.18%
1991	2,137,200	1,817,347	66.99%	3.94%	4.01%	18.12%	6.93%
1989	1,846,000	1,701,382	69.39%	2.33%	4.50%	17.44%	6.28%
1987	1,558,609	1,558,609	68.61%	2.35%	4.66%	18.58%	5.79%
1985	1,233,347	1,306,512	71.25%	1.24%	1.50%	17.52%	8.48%
1983	999,168	1,145,835	71.79%	1.87%	1.19%	16.81%	8.34%
1981	874,011	1,107,745	74.19%	2.05%	1.61%	15.59%	6.56%
1979	653,047	995,498	77.99%	2.68%	1.29%	11.11%	6.93%
1977	531,719	951,197	78.94%	1.32%	1.09%	12.30%	6.35%
1975	454,023	922,811	78.72%	1.24%	1.11%	13.28%	5.65%

Table c.2. Distribution of Federal Obligations for Science and Engineering to California Universities and Colleges

Year	Total	DOA	DOD	HHS	(NIH)	DOE	NASA	NSF	D.ED	OTHER
Thousands of Current Dollars										
1997	2,119,395	41,243	224,154	1,143,601	1,121,799	79,226	174,059	382,152	22,618	52,342
1996	2,085,734	33,411	235,588	1,096,151	1,076,711	88,536	169,240	393,446	20,683	48,679
1995	2,036,386	36,529	218,045	1,041,152	1,018,993	83,288	169,986	411,462	22,010	53,914
1994	1,900,549	38,069	203,279	1,052,752	1,031,799	83,848	159,770	299,707	18,892	44,232
1993	1,710,662	37,473	171,262	923,451	902,725	87,722	147,347	288,481	18,716	36,210
1992	1,771,195	37,777	180,857	952,271	934,975	112,376	148,341	283,115	32,819	23,639
1991	1,596,399	31,404	162,808	871,896	858,311	90,181	133,550	248,696	27,528	30,336
1989	1,396,648	25,576	169,266	731,443	715,950	94,490	109,625	217,031	27,160	22,057
1987	1,153,609	22,922	159,998	610,964	603,293	64,612	71,731	188,910	13,154	21,318
1985	994,839	25,451	136,074	505,623	498,221	67,839	53,755	180,685	5,763	19,649
1980	653,140	16,115	66,859	323,355	316,153	38,165	36,680	136,484	4,539	30,943
1975	400,618	9,037	35,590	212,505	204,031	18,812	21,918	89,315	2,833	10,608
Thousands of 1987 Constant Dollars										
1997	1,556,225	30,284	164,591	839,721	823,712	58,174	127,808	280,606	16,608	38,434
1996	1,570,457	25,157	177,386	825,349	810,712	66,663	127,430	296,246	15,573	36,653
1995	1,594,660	28,605	170,747	815,309	797,957	65,221	133,113	322,209	17,236	42,219
1994	1,515,589	30,358	162,104	839,515	822,806	66,864	127,408	239,001	15,065	35,273
1993	1,390,782	30,466	139,237	750,773	733,923	71,319	119,794	234,537	15,216	29,439
1992	1,474,767	31,455	150,589	792,898	778,497	93,569	123,515	235,733	27,326	19,683
1991	1,367,939	26,910	139,509	747,119	735,478	77,275	114,438	213,105	23,588	25,995
1989	1,290,802	23,638	156,438	676,010	661,691	87,329	101,317	200,583	25,102	20,385
1987	1,153,609	22,922	159,998	610,964	603,293	64,612	71,731	188,910	13,154	21,318
1985	1,054,972	26,989	144,299	536,186	528,336	71,940	57,004	191,607	6,111	20,837
1980	925,127	22,826	94,701	458,010	447,809	54,058	51,955	193,320	6,429	43,829
1975	841,634	18,985	74,769	446,439	428,637	39,521	46,046	187,637	5,952	22,286

Table c.2. (continued) Distribution of Federal Obligations for Science and Engineering to California Universities and Colleges

Year	Total	DOA	DOD	HHS	(NIH)	DOE	NASA	NSF	D.ED	OTHER
Share of U.S. Total										
1997	14.05%	4.21%	13.09%	14.40%	14.60%	12.26%	21.21%	17.00%	13.21%	9.32%
1996	14.46%	3.81%	13.19%	14.75%	14.87%	13.50%	22.32%	17.84%	11.80%	9.00%
1995	14.10%	3.84%	11.77%	14.63%	14.85%	13.08%	20.61%	18.61%	11.71%	8.15%
1994	13.71%	4.03%	10.75%	15.10%	15.33%	13.18%	21.53%	14.67%	11.06%	9.53%
1993	13.33%	3.95%	9.33%	15.15%	15.41%	11.90%	20.17%	15.43%	11.96%	7.83%
1992	13.80%	3.98%	11.97%	15.16%	15.25%	15.90%	21.63%	15.46%	8.16%	5.09%
1991	13.41%	3.62%	10.57%	14.97%	15.10%	13.62%	22.50%	15.14%	7.77%	7.24%
1989	13.86%	3.54%	11.39%	14.88%	14.86%	16.68%	23.73%	16.23%	10.07%	6.95%
1987	13.46%	3.40%	12.51%	14.56%	14.59%	13.60%	23.15%	17.65%	4.68%	7.52%
1985	13.71%	3.90%	12.82%	14.70%	14.70%	15.02%	21.42%	16.75%	8.29%	7.76%
1980	13.63%	3.63%	12.03%	14.18%	14.35%	12.33%	21.43%	18.79%	9.45%	12.15%
1975	14.28%	3.11%	18.68%	14.73%	15.08%	15.14%	20.29%	18.21%	11.33%	7.89%
Distribution of Agency S&E Support to University and Colleges within California										
1997	100%	1.95%	10.58%	53.96%	52.93%	3.74%	8.21%	18.03%	1.07%	2.47%
1996	100%	1.60%	11.30%	52.55%	51.62%	4.24%	8.11%	18.86%	0.99%	2.33%
1995	100%	1.79%	10.71%	51.13%	50.04%	4.09%	8.35%	20.21%	1.08%	2.65%
1994	100%	2.00%	10.70%	55.39%	54.29%	4.41%	8.41%	15.77%	0.99%	2.33%
1993	100%	2.19%	10.01%	53.98%	52.77%	5.13%	8.61%	16.86%	1.09%	2.12%
1992	100%	2.13%	10.21%	53.76%	52.79%	6.34%	8.38%	15.98%	1.85%	1.33%
1991	100%	1.97%	10.20%	54.62%	53.77%	5.65%	8.37%	15.58%	1.72%	1.90%
1989	100%	1.83%	12.12%	52.37%	51.26%	6.77%	7.85%	15.54%	1.94%	1.58%
1987	100%	1.99%	13.87%	52.96%	52.30%	5.60%	6.22%	16.38%	1.14%	1.85%
1985	100%	2.56%	13.68%	50.82%	50.08%	6.82%	5.40%	18.16%	0.58%	1.98%
1980	100%	2.47%	10.24%	49.51%	48.41%	5.84%	5.62%	20.90%	0.69%	4.74%
1975	100%	2.26%	8.88%	53.04%	50.93%	4.70%	5.47%	22.29%	0.71%	2.65%

Table c.3. R&D Expenditures by Doctorate-granting Universities in California by Science and Engineering Field

Year	S&E Total (includes Medical/Other Life Sciences)	Medical/Other Life Sciences	S&E Total (Excludes Medical/Other Life Sciences)	Engineering	Physical Sciences	Geo-Sciences	Math and Computer Sciences	Life Sciences	Psychology	Social Sciences	Interdisciplinary or Other Sciences
Thousands of Current Dollars											
1997	2,982,373	1,212,625	1,769,748	433,060	387,182	201,338	124,337	1,666,266	39,755	104,605	25,830
1995	2,601,876	1,050,658	1,551,218	342,954	320,274	197,462	112,413	1,478,301	38,118	95,463	16,891
1993	2,443,899	985,938	1,457,961	322,805	316,455	169,340	107,990	1,395,408	38,260	78,992	14,649
1991	2,184,878	869,098	1,315,780	283,260	299,426	147,362	92,578	1,240,744	42,187	67,358	11,963
1989	1,882,320	742,231	1,140,089	243,035	247,576	141,459	84,939	1,070,046	33,728	54,470	7,067
1985	1,255,980	446,463	809,517	156,491	182,935	108,145	50,780	694,883	24,310	35,596	2,840
1981	889,906	315,878	574,028	100,036	118,219	93,450	31,189	495,720	18,066	31,259	1,967
1977	537,838	139,531	398,307	61,531	69,988	70,617	9,795	277,895	8,501	29,486	10,025
Thousands of Constant 1987 Dollars											
1997	2,195,174	892,552	1,302,622	318,754	284,985	148,195	91,518	1,226,454	29,262	76,994	19,012
1995	2,009,441	811,428	1,198,013	264,865	247,349	152,501	86,817	1,141,699	29,439	73,727	13,045
1993	1,979,415	798,552	1,180,863	261,453	256,310	137,155	87,466	1,130,199	30,988	63,979	11,865
1991	1,866,016	742,261	1,123,755	241,921	255,728	125,856	79,067	1,059,669	36,030	57,528	10,217
1989	1,743,822	687,619	1,056,203	225,153	229,360	131,051	78,689	991,314	31,246	50,462	6,547
1985	1,327,887	472,024	855,863	165,450	193,408	114,337	53,687	734,666	25,702	37,634	3,003
1981	1,118,777	397,117	721,660	125,764	148,623	117,484	39,210	623,212	22,712	39,298	2,473
1977	940,933	244,106	696,828	107,647	122,442	123,543	17,136	486,170	14,872	51,585	17,538
Share of U.S. Total											
1997	12.25%	16.38%	10.44%	11.34%	16.38%	13.08%	12.28%	12.24%	10.27%	9.37%	5.13%
1995	11.72%	16.07%	9.90%	9.80%	14.23%	13.67%	11.61%	12.10%	10.35%	9.35%	3.92%
1993	12.25%	17.13%	10.27%	10.23%	14.85%	12.86%	12.27%	12.86%	10.94%	8.81%	3.98%
1991	12.43%	17.56%	10.41%	9.74%	15.45%	13.19%	11.80%	13.10%	14.90%	8.98%	3.61%
1989	12.57%	17.93%	10.52%	10.16%	15.03%	14.10%	12.36%	13.27%	14.44%	8.60%	2.22%
1985	12.97%	17.87%	11.26%	11.04%	15.93%	15.33%	12.43%	13.16%	15.37%	9.29%	1.52%
1981	13.00%	18.41%	11.19%	10.35%	15.43%	16.99%	13.50%	13.42%	14.25%	8.53%	1.36%
1977	13.22%	13.60%	13.10%	12.34%	16.53%	22.11%	9.08%	12.30%	9.99%	11.00%	9.48%
Distribution of Academic R&D Expenditures within California											
1997	100%	40.66%	59.34%	14.52%	12.98%	6.75%	4.17%	55.87%	1.33%	3.51%	0.87%
1995	100%	40.38%	59.62%	13.18%	12.31%	7.59%	4.32%	56.82%	1.47%	3.67%	0.65%
1993	100%	40.34%	59.66%	13.21%	12.95%	6.93%	4.42%	57.10%	1.57%	3.23%	0.60%
1991	100%	39.78%	60.22%	12.96%	13.70%	6.74%	4.24%	56.79%	1.93%	3.08%	0.55%
1989	100%	39.43%	60.57%	12.91%	13.15%	7.52%	4.51%	56.85%	1.79%	2.89%	0.38%
1985	100%	35.55%	64.45%	12.46%	14.57%	8.61%	4.04%	55.33%	1.94%	2.83%	0.23%
1981	100%	35.50%	64.50%	11.24%	13.28%	10.50%	3.50%	55.70%	2.03%	3.51%	0.22%
1977	100%	25.94%	74.06%	11.44%	13.01%	13.13%	1.82%	51.67%	1.58%	5.48%	1.86%

Table c.4. Expenditures on Higher Education in California

Year	Total	Instruction	Research	Public Service	Academic Support	Student Services	Institutional Support	Operation and Maintenance of Plant	Scholarships and Fellowships	Auxiliary Enterprises	Hospital	Independent Operations
Thousands of Current Dollars												
1996	21,560,552	6,236,202	2,208,068	274,849	1,745,228	1,212,188	2,298,169	1,247,574	1,167,299	1,345,452	2,375,067	1,191,962
1995	20,006,269	5,827,755	2,086,844	244,298	1,569,570	1,217,190	1,964,692	1,123,267	1,110,388	1,361,515	2,093,150	1,155,046
1993	19,000,809	5,705,199	1,914,552	217,181	1,441,050	1,282,678	1,963,853	1,037,488	802,667	1,287,092	1,918,878	1,197,286
1991	16,227,877	5,029,753	1,659,683	137,277	1,284,913	838,398	1,435,408	945,329	611,546	1,227,688	1,682,015	1,209,637
1987	12,555,017	3,953,073	1,250,710	161,901	1,047,457	692,296	1,148,322	741,352	415,008	984,413	982,343	880,199
1983	8,452,347	2,833,868	831,993	125,196	698,381	452,295	718,830	596,483	274,396	696,132	670,254	429,214
1979	5,663,409	1,892,885	565,342	79,339	442,465	315,534	527,861	365,282	173,456	385,669	379,743	326,596
1975	4,160,060	1,337,016	405,937	58,779	290,084	180,399	295,939	219,043	115,407	235,935	239,234	223,588
Thousands of Constant 1987 Dollars												
1996	16,288,017	4,711,167	1,668,095	207,636	1,318,440	915,753	1,736,162	942,485	881,841	1,016,428	1,794,255	900,473
1995	15,450,938	4,500,803	1,611,680	188,673	1,212,186	940,042	1,517,341	867,505	857,558	1,051,505	1,616,550	892,048
1993	15,389,544	4,620,878	1,550,675	175,904	1,167,166	1,038,894	1,590,606	840,305	650,113	1,042,469	1,554,179	969,732
1991	13,859,574	4,295,709	1,417,468	117,243	1,097,392	716,042	1,225,924	807,367	522,297	1,048,519	1,436,541	1,033,102
1987	12,555,017	3,953,073	1,250,710	161,901	1,047,457	692,296	1,148,322	741,352	415,008	984,413	982,343	880,199
1983	9,595,492	3,217,137	944,517	142,128	792,834	513,466	816,049	677,155	311,507	790,281	760,903	487,263
1979	8,510,475	2,844,462	849,546	119,224	664,898	474,157	793,223	548,914	260,654	579,550	570,645	490,780
1975	8,191,966	2,632,844	799,369	115,747	571,232	355,241	582,761	431,338	227,259	464,602	471,098	440,288
Share of U.S. Total												
1996	11.28%	10.76%	12.55%	3.87%	13.00%	12.62%	12.53%	10.08%	8.84%	7.65%	13.18%	34.12%
1995	10.87%	10.39%	12.15%	3.62%	12.69%	13.34%	11.53%	9.48%	9.00%	7.90%	11.57%	32.68%
1993	11.43%	11.26%	12.47%	3.63%	12.90%	15.61%	12.74%	9.54%	7.88%	8.26%	11.23%	32.78%
1991	11.05%	10.99%	12.30%	2.68%	12.70%	11.85%	10.36%	9.32%	8.04%	8.59%	11.74%	36.10%
1987	11.76%	11.65%	13.32%	4.28%	14.28%	13.82%	11.29%	9.41%	8.62%	8.91%	10.68%	29.99%
1983	11.06%	11.40%	13.23%	5.35%	13.61%	12.97%	10.25%	9.26%	9.19%	8.07%	9.58%	30.52%
1979	11.09%	11.28%	12.66%	4.94%	12.68%	13.79%	11.44%	8.68%	8.79%	6.69%	9.19%	32.43%
1975	11.78%	11.26%	12.84%	5.30%	12.81%	12.45%	9.55%	7.81%	7.83%	5.78%	10.18%	20.59%

Table c.5.a. Degrees Conferred in California by Discipline and Year

		1975	1980	1985	1987	1989	1991	1992	1993	1994	1995	1996
S&E TOTAL (Includes Medical/Other Life Sciences)	Doc	2,413	2,579	2,683	2,704	2,967	3,111	3,123	3,557	3,578	3,880	3,498
	Mast	9,935	11,313	12,970	12,536	13,065	11,404	11,586	13,807	14,298	14,203	15,177
	Bach	38,928	37,375	39,931	41,709	40,357	41,712	44,412	47,748	48,208	48,262	49,329
S&E TOTAL (Excludes Medical/Other Life Sciences)	Doc	2,290	2,532	2,620	2,657	2,863	2,994	2,995	3,446	3,438	3,708	3,343
	Mast	8,839	10,000	11,511	11,217	11,677	10,021	9,602	11,495	11,705	11,530	11,951
	Bach	35,516	32,637	36,455	38,269	37,418	38,752	41,495	44,216	44,525	44,372	45,466
ENGINEERING	Doc	460	423	506	538	642	638	627	798	780	778	794
	Mast	2,365	2,560	3,211	3,264	3,384	2,933	3,076	3,950	3,986	3,601	3,640
	Bach	3,159	5,134	6,791	7,306	6,576	6,279	6,128	6,710	6,361	6,364	6,181
PHYSICAL SCIENCES	Doc	357	356	416	434	424	430	483	483	498	495	501
	Mast	450	390	422	370	361	409	382	361	374	399	409
	Bach	1,295	1,441	1,411	1,391	1,269	1,215	1,211	1,225	1,215	1,284	1,330
GEOSCIENCES	Doc	83	101	91	111	87	100	93	98	97	90	91
	Mast	172	189	257	225	192	192	158	157	152	147	172
	Bach	459	633	677	468	245	245	280	289	289	382	376
MATH AND COMPUTER SCIENCES	Doc	160	151	154	156	195	159	234	246	260	306	263
	Mast	720	833	989	1,080	1,379	1,179	1,310	1,551	1,411	1,424	1,574
	Bach	1,909	1,827	4,484	5,251	4,246	3,747	3,684	3,658	3,496	3,493	3,463
LIFE SCIENCES	Doc	551	541	564	515	603	626	695	759	829	856	819
	Mast	1,947	2,236	2,233	2,023	2,009	1,995	2,592	2,957	3,237	3,343	4,054
	Bach	11,001	11,633	9,337	9,152	8,269	8,671	9,759	10,971	11,826	12,552	13,257
PSYCHOLOGY	Doc	274	607	471	475	547	728	630	678	668	792	572
	Mast	1,345	1,505	1,705	1,634	1,837	1,661	1,634	1,890	2,129	2,105	2,099
	Bach	6,132	5,407	5,010	5,514	6,084	6,618	7,410	7,790	8,109	8,244	8,434
SOCIAL SCIENCES	Doc	502	394	448	440	418	351	361	495	444	562	455
	Mast	2,695	2,586	2,473	2,294	2,177	2,180	2,156	2,445	2,512	2,762	2,827
	Bach	14,305	10,418	9,910	10,521	11,489	13,121	14,296	15,289	15,074	14,162	14,484

Table c.5.b. Share of US Degrees Conferred in California by Discipline and Year

		1975	1980	1985	1987	1989	1991	1992	1993	1994	1995	1996
S&E TOTAL (Includes Medical/Other Life Sciences)	Doc	12.78%	14.58%	13.98%	13.37%	13.42%	12.70%	12.37%	13.43%	13.14%	13.87%	12.29%
	Mast	13.45%	14.01%	14.40%	13.46%	13.34%	11.28%	10.97%	12.11%	11.80%	11.18%	11.55%
	Bach	10.44%	9.80%	9.56%	10.05%	10.04%	10.03%	10.22%	10.60%	10.36%	10.15%	10.03%
S&E TOTAL (Excludes Medical/Other Life Sciences)	Doc	12.53%	14.96%	14.43%	13.86%	13.72%	12.93%	12.62%	13.85%	13.48%	14.21%	12.59%
	Mast	13.77%	15.15%	15.18%	14.38%	14.23%	11.99%	11.32%	12.69%	12.22%	11.63%	11.90%
	Bach	10.75%	10.05%	10.04%	10.62%	10.68%	10.65%	10.94%	11.32%	11.17%	10.98%	10.94%
ENGINEERING	Doc	14.76%	16.83%	15.65%	14.08%	14.17%	12.11%	11.42%	13.70%	13.08%	12.73%	12.46%
	Mast	15.60%	16.06%	15.32%	14.80%	14.27%	12.23%	12.31%	14.30%	13.92%	12.61%	13.11%
	Bach	8.02%	8.79%	8.80%	9.89%	9.92%	10.19%	10.01%	10.82%	10.22%	10.20%	9.79%
PHYSICAL SCIENCES	Doc	11.38%	13.85%	14.29%	13.58%	12.93%	11.93%	12.86%	13.11%	12.56%	12.84%	12.79%
	Mast	10.53%	11.49%	11.77%	10.39%	9.36%	10.87%	9.77%	9.15%	8.81%	9.45%	9.37%
	Bach	8.15%	8.37%	8.80%	9.10%	9.09%	8.98%	8.86%	8.77%	8.42%	8.81%	8.64%
GEOSCIENCES	Doc	17.29%	19.96%	19.49%	24.03%	15.56%	14.93%	15.02%	14.18%	14.52%	14.47%	13.96%
	Mast	11.44%	10.54%	11.90%	10.97%	10.56%	12.83%	11.09%	11.24%	10.72%	9.91%	11.57%
	Bach	9.42%	10.29%	8.94%	9.98%	7.72%	8.99%	8.76%	8.28%	7.49%	8.53%	8.44%
MATH AND COMPUTER SCIENCES	Doc	13.47%	15.66%	16.19%	14.19%	13.73%	9.61%	12.81%	12.61%	13.40%	14.79%	12.96%
	Mast	10.87%	12.80%	9.89%	9.15%	10.76%	9.12%	9.84%	11.02%	9.86%	9.84%	10.96%
	Bach	8.23%	8.11%	8.28%	9.37%	9.26%	9.43%	9.32%	9.35%	8.99%	9.12%	9.20%
LIFE SCIENCES	Doc	11.65%	10.53%	10.33%	9.68%	10.50%	9.76%	10.24%	10.78%	11.25%	11.23%	10.53%
	Mast	10.43%	9.18%	9.98%	8.88%	8.59%	8.03%	9.05%	9.39%	9.50%	9.06%	9.82%
	Bach	10.16%	9.70%	8.92%	8.95%	8.60%	8.69%	9.00%	9.25%	9.04%	8.84%	8.57%
PSYCHOLOGY	Doc	11.22%	21.93%	16.20%	15.53%	16.85%	21.36%	19.21%	19.20%	19.27%	21.37%	15.66%
	Mast	19.03%	19.28%	20.28%	20.11%	21.52%	17.09%	16.74%	18.35%	18.70%	16.30%	16.09%
	Bach	12.03%	12.89%	12.58%	12.87%	12.54%	11.32%	11.67%	11.68%	11.72%	11.45%	11.42%
SOCIAL SCIENCES	Doc	13.58%	12.52%	14.91%	14.64%	13.73%	11.26%	11.06%	14.09%	12.15%	14.93%	12.01%
	Mast	13.95%	13.73%	14.52%	13.48%	12.19%	11.59%	11.02%	11.85%	11.26%	11.92%	11.78%
	Bach	12.91%	11.30%	11.78%	11.94%	11.82%	11.87%	12.16%	12.88%	12.90%	12.65%	12.96%

5. Data Sources for Tables

Table a.1: State Population

Current and historical state population data is available on the U.S. Census Bureau server at:

<http://www.census.gov/population/estimates/state>

Data in Table a.1 is from the following tables:

<http://www.census.gov/population/estimates/state/stts/st7080ts.txt> for 1970-1980 data; [/state/stts/st8090.txt](http://www.census.gov/population/estimates/state/stts/st8090.txt) for 1980-1990 data; [/state/ST9096T1.txt](http://www.census.gov/population/estimates/state/stts/st9096T1.txt) for 1990-1995 data and [/state/st-98-3.txt](http://www.census.gov/population/estimates/state/stts/st983.txt) for 1996-1998 data. All intercensal years are population estimates as of July 1; census years are population estimates for April 1. The intercensal estimates are updated regularly so that entries for the same date in a table published in different years tend to vary slightly. The trends in the population shares reported in Table a.1 are robust.

Tables a.2, a.5, a.6, a.7: R&D expenditures in the states by performing sector and source of funds.

The NSF series, *National Patterns of R&D Resources*, has included a table with R&D expenditures by performing sector and source of funds for each state since its 1992 issue (with data for 1989). The data in these tables are aggregated from NSF's annual surveys of industry, academia, and federal funds. Descriptions of the surveys are available at www.nsf.gov/sbe/srs/survey.htm. Current issues of *National Patterns* are available at: www.nsf.gov/sbe/srs/nprdr/start.htm. As of August, 1999, the latest State R&D statistics included in *National Patterns* publications was for 1995.

Tables a.2 - a.7 are constructed as follows:

1995: all data from Table 6, *National Patterns of Research and Development Resources: 1997 Data Update* (available at the NSF website)

1993: all data from Table C-16, *National Patterns of Research and Development Resources: 1996*, NSF-96-333 (available at the NSF website)

1991: all data from Table B-17, *National Patterns of Research and Development Resources: 1994*, NSF-95-304 (available at the NSF website)

1989: all data from Table B-17, *National Patterns of R&D Resources: 1992*, NSF 92-330, Oct. 1992. (Paper only)

Data for 1997 (which should be treated as preliminary) and for earlier years are constructed from multiple sources.

R&D performed by universities and colleges: data is available by funding source for 1972-1997 from Webcaspar, NSF's on-line database for academic data.

The numbers here are based on the Survey of R&D Expenditures at Doctorate-granting Institutions (this covers virtually all academic research expenditures). Webcaspar can be accessed from the NSF home page or from: <http://caspar.nsf.gov/>. The procedure used to construct this and other academic resources tables are described below. Readers, however, should be warned that the website is fairly new and (so far) has been modified a number of times. It is therefore useful to consult the on-line tutorial before using the database.

For Table a.5, construction used the following procedure:

- a. choose "categories by multiple sources"
- b. choose "state/region" and click on "select categories"
- c. choose: total R&D Expenditures at Doctoral Institutions; federally financed R&D Expenditures at Doctoral Institutions; State&Local R&D Expenditures at Doctoral Institutions; Industry R&D Expenditures at Doctoral Institutions; Institutional Expenditures at Doctoral Institutions; Other Expenditures at Doctoral Institutions and click on "select variables"
- d. The program then provides options on years, states, and formatting, and constructs the specified table which can be viewed or downloaded in Excel or other formats.

The values generated for 1989-1995 from this procedure agree with those published in the *National Patterns* publications in the years for which expenditures are broken down by state.

Industry-performed R&D for 1975 - 1993 (not by funding source) is from Table A-45, *R&D in Industry - 1993*, NSF-96-304, available at www.nsf.gov/sbe/srs/indus/start.htm. This source breaks down expenditures by states, but is missing some years for some states. Industry data for 1997 is from Table A-49, *R&D in Industry: 1997, Early Release Tables*, available at the NSF web site.

Industry R&D by source of funds for 1981, 1983, and 1985 are from Appendix Table 2 and Appendix Table 3, *Geographic Distribution of Industrial R&D Expenditures*, *National Science Foundation Special Report*, NSF 88-317.

Other performing and funding categories for 1981, 1983, and 1985 are from *Geographic Patterns: R&D in the United States*, *National Science Foundation Special Report*, NSF 89-317, Appendix C.

Data on R&D performed by the federal government, by U&C FFRDCs and the nonprofit sector and funded by the federal government for all other years are from NSF's federal funds surveys, collected in *Federal Funds for Research and Development: Detailed Historical Tables*,

fiscal years 56-94, available at <http://www.nsf.gov/sbe/srs/fedfunds/pubs/dht42>

Tables used for this report are: #57,57a,57b (Federal obligations to intramural performer for research and development by state); #60, 60a, 60b (Federal obligations to FFRDCs administered by universities and colleges for research and development by state); #61, 61a, 61b (Federal funds to other nonprofit performers for research and development by state). These statistics agree with those reported in the same categories in *National Patterns*, 1992, 1994, 1996, 1997.

Data on R&D performed by the federal government, by U&C FFRDCs and by the nonprofit sector for 1997 are from Table C-83, *Federal Funds for Research and Development Fiscal Years 1997, 1998, 1999*, NSF 99-333. As with earlier years, this table reports obligations rather than expenditures.

Federal obligations for industry performed research and development are also available by state for other years, however, these numbers are substantially different from and not comparable to the expenditure data reported in the tables in this report. Consequently, funding sources for industry performed R&D is not available in years other than those included in the tables here.

Finally, for the 1997 data on the California share of U.S. Total: U.S. total statistics in each of the subcategories are drawn from the same sources as the California data. For the state share of total national R&D, the total U.S. statistic is from Table B-1A, *National Patterns for Research and Development Resources - 1998*, NSF 99-335.

Table a.3, State Gross State Product.

These data are collected by the U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Analysis Group. Data for 1994 and earlier years in Table a.3 is from www.bea.doc.gov/bea/dr/gsp0697c.prn. More recent data is drawn from

http://www.bea.doc.gov/bea/regional/gsp/gspsum_c.htm.

Table a.4: calculated from tables a.2 and a.3. Data for Germany and Japan for 1977 are from *Science & Engineering Indicators - 1989*, Appendix Table 4-19, p. 187; and for later years from *Science & Engineering Indicators - 1998*, Appendix Table 4-42.

Table a.8, b.2, c.2: Federal Obligations by Agency and Performer

Federal obligations by agency is from NSF's federal funds survey. Current issues are available on NSF's website: <http://www.nsf.gov/sbe/srs/fedfunds/start.htm>. The table that breaks down obligations by agency, state,

and performer is not included in the historical federal funds table at the website and is available only in the published (paper) version of the federal funds survey. Issues used for table a.8:

1997: Table C-84, *Federal Funds for Research and Development, fiscal years 1997, 1998, 1999*, NSF-99-333 (at the NSF website)

1996: Table C-84, *Federal Funds for Research and Development, fiscal years 1996, 1997, 1998*, NSF-98-332 (at the NSF website)

1995: Table C-84, *Federal Funds for Research and Development, fiscal years 1995, 1996, 1997*, NSF-97-327 (at the NSF website)

1994: Table C-80, *Federal Funds for Research and Development, fiscal years 1994, 1995, 1996*, NSF 97-302 (at the NSF website)

1993: Table C-80, *Federal Funds for Research and Development, fiscal years 1993, 1994, 1995*, NSF 95-334 (at the NSF website)

1992: Table C-80, *Federal Funds for Research and Development, fiscal years 1992, 1993, 1994*, NSF 94-328 (at the NSF website)

1991: Table C-135, *Federal Funds for Research and Development, fiscal years 1991, 1992, 1993*, NSF 93-323 (paper only)

1990: Table C-135, *Federal Funds for Research and Development, fiscal years 1990, 1991, 1992*, (paper only)

1989: Table C-135, *Federal Funds for Research and Development, fiscal years 1989, 1990, 1991* (paper)

1987: Table 33, *Federal Funds for Research and Development, fiscal years 1987, 1988, and 1989*, NSF 89-304 (paper)

1983: Table C-106, *Federal Funds for Research and Development, fiscal years 1983, 1984, and 1985* NSF 94-336 (paper)

1980: Table C-101, , *Federal Funds for Research and Development fiscal years 1980, 1981, and 1982*, NSF 81-325 (paper)

Table b.1 : calculated from Table a.5

Tables b.3 - b.6: details on industry-performed R&D in the U.S. and California

R&D by industry by state and total for 1995 is available from NSF's survey of industrial research and Development. 1995 data is published in Tables A-48, A-49, and A-50 in *Research and Development in Industry, 1995* at <http://www.nsf.gov/sbe/srs/indus/start.htm>. Data for 1997 Research and Development in Industry 1997: Early Release Tables, at the same web site.

The only earlier year for which similar data by state is available is 1985, published in *Geographic Patterns: R&D in the United States, National Science Foundation Special Report*, NSF 89-317, and *Geographic Distribution of Industrial R&D Expenditures, National Science Foundation Special Report*, NSF 88-317.

Tables b.7–b.10: patent data

These tables were constructed by searching the US Patent Office website. Care must be used in searching this data base as patents may be classified under more than one category. Consequently, it is necessary to conduct separate searches for classes, including as search parameters all of the subclasses, rather than summing over the subclass searches. (The program will automatically delete duplicates if multiple parameters are included in the same search.) For domestic patent holders, we included as search parameters each of the fifty states. Total patents omits any parameter in the location category. The following procedure was used: from the U.S. patent office homepage at <http://www.uspto.gov/>: select “search patents”; then “advanced search”. Searches were specified using field codes AS (assignee state) and CCL (current U.S. Classification). Classification categories from the US Patent Classification are as follows:

ALL CHEMICAL / BIOLOGY:

BIOCHEMISTRY : # 127, 800, 435, 436, 930, 935, 514, 424

CHEMICAL ENGINEERING : 427, 502, 210, 205, 201, 202, 203, 494, 422, 95, 96, 55, 261, 159, 588, 23, 8, 184, 148, 366, 44, 196, 208, 134, 34

ORGANIC CHEMISTRY : 71, 512, 260, 518, 520, 521, 522, 523, 524, 525, 526, 527, 528, 530, 532, 534, 536, 540, 544, 546, 548, 549, 552, 260, 552, 554, 556, 558, 560, 562, 564, 568, 570, 585, 987

SURGERY / BODY CARE / COSMETICS : 482, 433, 128, 600, 602, 604, 606, 607, 601, 623, 132, 63, 27, 512

MATERIALS / COMPOSITIONS / EXPLOSIVES : 65, 252, 505, 428, 156, 420, 75, 507, 106, 117, 501, 423, 71, 419, 102, 149, 86, 89, 42, 34, 148, 366

AGRICULTURE / FARMING : PLT, 99, 426, 111, 166, 449, 452, 43, 47, 119, 54, 56, 59, 168, 231, 131, 239, 426, 504, 147, 71, 256

ALL ELECTRONIC CLASSES:

COMPUTING AND DATA PROCESSING : 380, 377, 371, 364, 395, 901, 902, 235, 347, 360, 365, 369

ELECTRICITY AND ELECTRIC POWER : 505, 318, 320, 322, 323, 324, 361, 218, 219, 392, 373, 290, 388, 307, 333, 363, 310, 313, 314, 315, 335, 336, 337, 200, 174, 191, 136

ELECTRONICS & ELECTRONIC COMPONENTS : 437, 216, 257, 116, 326, 327, 330, 331, 333, 338, 361, 336, 174, 377, 439, 445, 505, 136

RADIANT ENERGY/OPTICS/PHOTOGRAPHY : 250, 351, 352, 353, 354, 355, 503, 356, 359, 378, 372, 385, 362

COMMUNICATIONS : 340, 341, 342, 343, 348, 358, 382, 370, 381, 379, 178, 375, 455, 367, 334, 332, 329

OTHERS / MEASUREMENT / NUCLEAR : 181, 204, 345, 346, 368, 374, 376, 429, 430, 431, 976, 33, 177, 73, 968

MUSIC / EDUCATION / AMUSEMENT : 434, 446, 40, 472, 473, 273, 124, 84, 281, 462, 984

ALL ENGINEERING / TRANSPORTATION:

AERONAUTICS : 244

VEHICLES AND TRANSPORTATION : 187, 244, 114, 440, 441, 191, 104, 105, 246, 238, 278, 280, 298, 180, 296, 301, 305, 295, 152, 213, 293, 410, 258, 404, 14, 405, 291, 44

MATERIAL OR ARTICLE HANDLING : 414, 258, 186, 406, 212, 198, 187, 193, 224, 901, 222, 221, 232, 254, 209, 141, 413

EARTHWORKING / CIVIL ENGINEERING : 405, 404, 14, 299, 166, 171, 172, 175, 37, 56, 111, 256

HEATING / COOLING/ BUILDING / FLUID HANDLING / GAS HANDLING : 62, 237, 236, 432, 122, 126, 431, 110, 165, 135, 109, 52, 182, 194, 137, 138, 454, 4, 15, 251, 169, 494, 239, 141, 48, 134, 34

OFFICE DEVICES / PAPER HANDLING / COATINGS : 118, 101, 347, 400, 199, 276, 401, 281, 283, 462, 184, 364, 395, 412, 453, 162, 229, 194

TEXTILE AND APPAREL : 24, 8, 245, 289, 19, 26, 28, 66, 68, 87, 139, 57, 38, 2, 223, 450, 36, 12, 69, 112

ALL MECHANICAL:

TOOLS, HARDWARE, PIPE, JOINTS: 7, 16, 70, 72, 81, 100, 140, 249, 277, 279, 285, 292, 294, 403, 411, 425, 492

RECEPTACLES, CONTAINERS, SUPPORTS, PARTITIONS, FURNITURE: 220, 312, 190, 206, 215, 217, 248, 229, 150, 383 5, 297, 211, 108, 256, 267, 49, 160

MOTORS, ENGINES, PUMPS: 60, 123, 477, 415, 416, 417, 418, 91, 185, 92

MANUFACTURING, ASSEMBLING, METAL WORKING: 65, 164, 266, 29, 412, 53, 59, 76, 79, 493, 147, 157, 163, 227, 270, 271, 300, 445, 162, 402, 228, 226, 242, 254

ROTARY MACHINES AND MECHANICAL
POWER: 74, 474, 475, 476, 29, 464, 384, 173, 188, 192,
254, 269, 303

MACHINING AND CUTTING: 483, 234, 460, 241,
470, 29, 407, 408, 30, 451, 51, 82, 83, 409, 125, 142, 144,
225, 264, 413

Table c1: calculated from Table a.5.

Table c.2: see notes to table a.8

Table c.3: R&D Expenditures by Doctorate-granting
Institutions in California by Science and Engineering
Field.

This table was generated from the CASPAR database
(see notes to Table a.5).

Tables c4, c5.

These tables were constructed from the CASPAR
database (see the notes to table a.5), using the National
Center for Educational Statistics Survey Database,
Financial Statistics: Current Funds Expenditures and
Transfers, FY66-96, and Earned Degrees, 1966-96.