InfoBrief

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2011 Data Show U.S. Business R&D Highly Concentrated by State and Metropolitan Location

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Nearly half of the research and development paid for and performed by companies in the 50 United States and the District of Columbia in 2011 was performed in five states: California, Washington, Texas, Massachusetts, and Michigan. Companies performed $239 billion of R&D paid for by their own company expenses in the United States in 2011, of which $233 billion was distributed across the 50 states and the District of Columbia. These findings are from the National Science Foundation's 2011 Business R&D and Innovation Survey (BRDIS).[2]

Concentration of R&D Performance within States

Business R&D is concentrated in a small number of states, with the 10 states with the highest levels of R&D performance accounting for $163 billion (70%) of the $233 billion total (table 1). Not included in these figures but discussed at the end of this InfoBrief is R&D performed by companies but paid for by others, such as the federal government and other customers or business partners.

The largest state in terms of self-funded business R&D performance, California, accounted for 28% ($64 billion) of business R&D performance in the

TABLE 1. Top 10 states with the highest level of business R&D performed and paid for by companies from companies' own funds: 2011

State	Business R&D performed ($millions)	R&D/GDP (%)	Largest R&D industry in location	Largest industry's share of location R&D (%)
U.S. total[a]	238,768	1.6	Pharmaceuticals and medicines (NAICS 3254)	17
California	64,104	3.4	Semiconductor and other electronic components (NAICS 3344)	17
Washington	13,659	3.8	Software publishers (NAICS 5112)	56
Texas	12,920	1.0	Semiconductor and other electronic components (NAICS 3344)	21
Massachusetts	12,712	3.3	Pharmaceuticals and medicines (NAICS 3254)	30
Michigan	12,156	3.2	Automobiles, bodies, trailers, and parts (NAICS 3361–3363)	73
New Jersey	11,977	2.4	Pharmaceuticals and medicines (NAICS 3254)	50
Illinois	10,764	1.6	Pharmaceuticals and medicines (NAICS 3254)	31
New York	9,141	0.8	Software publishers (NAICS 5112)	21
Pennsylvania	9,018	1.6	Pharmaceuticals and medicines (NAICS 3254)	43
Connecticut	6,272	2.8	Pharmaceuticals and medicines (NAICS 3254)	65

GDP = gross domestic product for state; NAICS = 2002 North American Industry Classification System.

[a] Of the U.S. total, $6,111 million could not be distributed to one of the 50 states or the District of Columbia.

NOTES: State and industry rankings are based on point estimates and do not take into account the variance of the survey sample. Industry classification is based on the dominant business code for domestic R&D performance, where available. For companies that did not report business codes, the classification used for sampling was assigned.

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, and U.S. Census Bureau, Business R&D and Innovation Survey, 2011. GDP data are from the U.S. Bureau of Economic Analysis.

United States (table 1). The next four states represented a combined 22% ($51 billion) of this R&D. A single industry dominates the business R&D of 4 of the top 10 states in table 1. The software industry accounted for 56% of Washington's total, automobile manufacturers for 73% of Michigan's total, and the pharmaceutical industry for 50% and 65% of New Jersey's and Connecticut's totals, respectively.

Of the industries estimated to have at least $1 billion of self-funded U.S. R&D performance, only four had more than half their R&D concentrated in a single state in 2011 (table 2). California accounts for over half of the semiconductor machinery manufacturing (72%) and computer and peripheral products industries (54%) and also for almost half of the semiconductor and other electronic components industry (48%). Michigan accounted for the majority of R&D performed by automobile manufacturers in the United States (76%). The R&D of the mining, extraction, and support industries, including that of oil and gas companies, was concentrated in Texas, which accounted for 65% of self-funded U.S. R&D performance.

Given the wide disparities in the size of state economies, it is helpful to create an indicator that measures business R&D relative to the size of each state's economy. One such indicator of R&D intensity is defined as the state's self-funded business R&D as a percentage of its gross domestic product (GDP). Overall, the U.S. ratio of business R&D (performed and paid for by the same companies) to GDP was 1.6% in 2011 (table 1). California's business R&D intensity was twice as high (3.4%), indicating that twice as much business R&D was performed in California relative to the size of its economy. Washington, California, Massachusetts, and Michigan had the highest R&D intensities of the top 10 states in 2011—all over 3%. Two of the top 10 states for business R&D in 2011 had R&D intensities substantially below that of the nation as a whole: Texas and New York. These below-average R&D intensities reflect a higher concentration of less R&D-intensive industries within these states: oil and gas extraction in Texas, and financial services in New York.[3]

Concentration of R&D within Metropolitan Areas

R&D Spending

Businesses responding to BRDIS tend to concentrate their self-funded R&D performance in one geographic location. This finding is based on data reported by the subset of all BRDIS respondents with known R&D activity and estimated at the time of sampling to have at least $3 million of R&D performed in the United States (hereafter referred to as *large-R&D companies*).[4] In 2011, a total of 2,931 of these large-R&D companies out of a total 5,037 such companies responded to questions in BRDIS asking for the address of their largest R&D location in the United States and the amount of R&D performed at that location. These responding companies accounted for 69% of all R&D performed in the United States in 2011 that was paid for by the performing companies. Of the large-R&D companies that reported these data, 52% reported performing

TABLE 2. Domestic R&D performed and paid for by the companies, by select industry, by state: 2011

Industry	NAICS code	Total ($millions)	Largest state for industry	Industry R&D performed in largest state	
				Amount ($millions)	Percent
Automobiles, bodies, trailers, and parts	3361–3363	11,737	Michigan	8,869	76
Communications equipment	3342	10,796	California	4,788	44
Computer systems design and related services	5415	11,706	California	3,187	27
Mining, extraction, and support activities	21	2,425	Texas	1,574	65
Navigational, measuring, electromedical, and control instruments	3345	10,643	California	2,694	25
Computer and peripheral products	3341, 3343, 3346	9,370	California	5,075	54
Pharmaceuticals and medicines	3254	41,111	California	10,042	24
Semiconductor and other electronic components	3344	22,855	California	10,860	48
Semiconductor machinery	333295	2,220	California	1,592	72
Software publishers	5112	27,280	California	7,777	29

NAICS = 2002 North American Industry Classification System.

NOTES: Industry classification is based on the dominant business code for domestic R&D performance, where available. For companies that did not report business codes, the classification used for sampling was assigned.

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, and U.S. Census Bureau, Business R&D and Innovation Survey, 2011.

100% of their U.S. R&D at their largest location, and 87% reported performing at least 50% of their U.S. R&D at that location (figure 1).[5]

New questions added to one of the BRDIS forms in 2011 also asked companies for information about their second-largest R&D location. Of the 2,594 large-R&D companies that were asked these questions, 907 reported data about their second-largest location, and 698 reported all their R&D at their largest location; 58% of these companies reported performing all of their U.S. R&D at their two largest locations, and 93% reported performing at least 50% of their U.S. R&D at these two locations (figure 1).

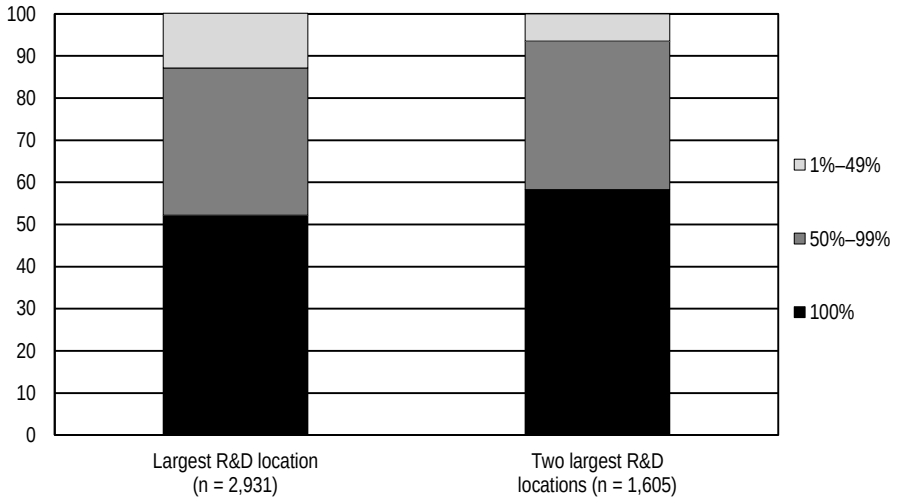
Data reported by large-R&D companies for their largest R&D location further illustrate the regional concentration of business R&D in the United States. The 10 most frequently reported combined statistical areas (CSAs) or metropolitan statistical areas (MSAs) accounted for over half of the 2,931 large-R&D companies reporting their largest R&D location (table 3).[6]

The 2,931 large-R&D companies performed an estimated $106 billion of R&D at their primary R&D location alone. The R&D reported at the primary R&D location provides lower-bound estimates for business R&D performed in major metropolitan areas. The 24 areas listed in table 3 were each home to the primary R&D location of at least 24 large-R&D companies (2,136 companies in total). Together, these 24 areas account for over three-quarters of the R&D performed by large-R&D companies at their primary location.

The three areas where the largest amount of R&D was performed by large-R&D companies at their primary R&D location were the San Jose-San Francisco-Oakland, Seattle-Tacoma, and Los Angeles-Long Beach CSAs. The largest R&D industries represented in these areas vary, with San Jose-San Francisco-Oakland dominated by computer and electronic products manufacturers and Seattle-Tacoma-Olympia dominated by information technology and aerospace companies. Although the Los Angeles-Long Beach CSA is home to many large-R&D companies, no single industry accounts for a disproportionately large share of its R&D performance.

FIGURE 1. Large-R&D companies, by share of U.S. R&D reported at largest R&D locations: 2011

Percent



NOTE: Data are for companies with known R&D activity and an estimated measure of size of at least $3 million of R&D performed in the United States that reported their largest R&D location (Forms BRDI-1 and BRDI1-A) and their two largest R&D locations (Form BRDI-1).

SOURCE: National Science Foundation, National Center for Science and Engineering Statistics, and U.S. Census Bureau, Business R&D and Innovation Survey, 2011.

R&D Locations

The San Jose-San Francisco-Oakland CSA, home to Silicon Valley, not only was the site with the highest level of R&D performance among large-R&D companies, but it also was the most commonly reported primary R&D location. The Boston-Worcester-Providence, Los Angeles-Long Beach, and New York-Newark CSAs were the next most commonly reported areas. Like Los Angeles, the Boston CSA is not dominated by a single company or industry in terms of R&D. The New York-Newark CSA is dominated by pharmaceutical and chemicals companies. A characteristic common to all of these CSAs, however, is that they are each home to multiple world-renowned research universities. These universities, along with large preexisting companies, may foster the creation of new R&D-performing companies in their locales through technology transfer programs and the training and education of future company employees.

Perhaps not coincidentally, those areas reported most frequently as the sites of companies' largest R&D location were also among the largest in terms of U.S. utility patents (also known as *patents for invention*) granted in 2011 based on the residence of inventors (table 3). The areas listed in table 3 were home to the first-named inventors of 73% of all utility patents granted in 2011 with U.S.-located inventors.[7]

TABLE 3. Business R&D performed and paid for by large-R&D companies at their largest R&D location and utility patents, by area: 2011

Area	Companies reporting largest R&D location (*n*)	R&D performance at largest location ($millions)	Utility patents originating from location (*n*)
All areas	2,931	106,440	108,592
Atlanta-Athens-Clarke County-Sandy Springs, GA CSA	60	989	1,758
Austin-Round Rock, TX MSA	24	2,159	2,460
Boston-Worcester-Providence MA-RI-NH CSA	230	4,524	5,989
Chicago-Naperville, IL-IN-WI CSA	103	4,090	3,073
Cleveland-Akron-Canton, OH CSA	30	535	1,289
Dallas-Fort Worth, TX CSA	47	621	2,249
Denver-Aurora, CO CSA	46	565	1,531
Detroit-Warren-Ann Arbor, MI CSA	98	7,360	2,972
Houston-The Woodlands, TX CSA	49	1,432	2,182
Los Angeles-Long Beach, CA CSA	214	8,797	6,065
Milwaukee-Racine-Waukesha, WI CSA	34	538	708
Minneapolis-St. Paul, MN-WI CSA	88	1,824	3,183
New York-Newark, NY-NJ-CT-PA CSA	209	8,154	8,996
Philadelphia-Reading-Camden, PA-NJ-DE-MD CSA	70	3,605	2,169
Phoenix-Mesa-Scottsdale, AZ MSA	31	1,061	1,364
Pittsburgh-New Castle-Weirton, PA-OH-WV CSA	35	413	732
Portland-Vancouver-Salem, OR-WA MSA	43	815	2,038
Raleigh-Durham-Chapel Hill, NC CSA	33	879	1,732
Salt Lake City-Provo-Orem, UT CSA	34	403	974
San Diego-Carlsbad, CA MSA	91	3,804	3,293
San Jose-San Francisco-Oakland, CA CSA	380	23,346	17,596
Seattle-Tacoma-Olympia, WA CSA	76	10,496	4,208
St. Louis-St. Charles-Farmington, MO-IL CSA	30	423	620
Washington-Baltimore-Arlington, DC-MD-VA-WV CSA	81	1,679	2,503
All other geographic areas reported as largest location	795	17,928	28,908

CSA = combined statistical area; MSA = metropolitan statistical area.

NOTES: R&D data are for companies known to have performed at least $3 million of R&D in prior years that reported their largest R&D location. Only geographic areas where at least 24 companies report their largest location are listed. Utility patent counts by region are based on the residence locations of the first-named inventors that may differ from the location of their inventive activity; for example, the location of their place of business. Counts include patents assigned to businesses as well as to individuals and other organizations.

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, and U.S. Census Bureau, Business R&D and Innovation Survey, 2011. Utility patent data are from the U.S. Patent and Trademark Office.

Business R&D Paid for by Others

BRDIS estimates of business R&D that is not paid for by the performing company itself but by others—such as customers, partners, or grant-giving organizations—show that this R&D is also geographically concentrated, though these estimates are less precise than those for self-funded business R&D. Companies performed $31 billion of R&D in the United States in 2011 that was funded by the federal government, of which $24 billion can be attributed by BRDIS to a specific state. The five largest states in terms of federally funded business R&D (California, New York, Virginia, Florida, and Maryland) accounted for 60% of the federal-funded business R&D that could be attributed by BRDIS to a specific state. Companies performed $24 billion of R&D in the United States in 2011 that was paid for by other nonfederal organizations, of which $22 billion can be attributed by BRDIS to a specific state. The five largest states by this measure (California, Massachusetts, New Jersey, Texas, and Michigan) accounted for 47% of the business R&D paid for by other nonfederal organizations that could be attributed by BRDIS to a specific state.

Data Sources and Limitations

The sample for BRDIS was selected to represent all for-profit companies with five or more domestic employees, publicly or privately held, with an emphasis on those that perform or fund R&D. The survey also captured information on companies whether or not they perform or fund R&D. For 2011, a total of 43,108 companies were sampled

for BRDIS, representing 1,964,757 companies in the population. Statistics from the survey are subject to both sampling and nonsampling errors.

In 2011, 3% of self-funded U.S. business R&D performed by the companies, 14% of U.S. business R&D paid for by the federal government and performed by companies, and 9% of U.S. R&D paid for by nonfederal organizations other than the performing companies could not be assigned to a specific state location. Therefore, state R&D data provided here are lower-bound estimates. Data for the state of Missouri, which are withheld to avoid disclosing operations of individual companies, are also included in this undistributed R&D. State and industry rankings are based on point estimates and do not take into account the variance of the survey sample. Data presented here for metropolitan areas are from a subset of companies in the survey sample (companies known to have performed $3 million or more of R&D in the United States in any of the four years preceding 2011) and therefore are lower-bound estimates of the total business R&D in these areas.

BRDIS estimates of federally funded business R&D had an imputation rate of 60% in 2011. Some estimates of federally funded business R&D for specific states have imputation rates exceeding 60%.

For this InfoBrief, estimates for R&D at companies' largest locations represent only the amounts for companies responding to the item. No estimation has been made to correct for item nonresponse or for R&D performed at these locations as nonprimary locations. Further, the totals reported here for largest R&D locations do not include R&D performed by these companies that is paid for by others.

Detailed tables for the 2011 BRDIS are forthcoming and will be available at http://www.nsf.gov/statistics/industry/. Individual tables may be available in advance of publication of the full report. For questions related to BRDIS, please contact Raymond Wolfe.

Notes

1. Raymond Wolfe, Research and Development Statistics Program, National Center for Science and Engineering Statistics, National Science Foundation, 4201 Wilson Boulevard, Suite 965, Arlington, VA 22230 (rwolfe@nsf.gov; 703-292-7789). Brandon Shackelford is the owner of Twin Ravens Consulting, Austin, TX.

2. R&D reported on Form BRDI-1 that is not allocated to a specific state and R&D reported on Form BRDI-1A by multiestablishment companies are reported as *undistributed* in BRDIS data tables. This InfoBrief does not include this undistributed amount when calculating state shares of total U.S. R&D.

3. Industry concentration was determined based on data from the U.S. Census Bureau 2007 Economic Census.

4. Based on the likelihood of these companies having R&D, these large-R&D companies were selected with certainty for the 2011 BRDIS sample with sample weights equal to 1. These companies account for the vast majority of R&D performed by businesses in the United States.

5. This concentration is less pronounced among the very largest R&D performers, but most of these companies still report performing the majority of their U.S. R&D at their primary location.

6. CSAs are delineated by the Office of Management and Budget as aggregates of adjacent metropolitan or micropolitan statistical areas that are linked by commuting ties (http://www.census.gov/population/www/metroareas/metrodef.html). Some large MSAs—such as San Diego, CA; Portland, OR; and Austin, TX—are not part of a defined CSA. For the purpose of this InfoBrief, these MSAs are treated as equivalent to a CSA.

7. Location data available on patent filings (residence of inventors) may not represent the location where inventive activity took place, as in cases where the inventors commute long distances to their places of work or where large CSAs are densely concentrated (as in the Northeastern United States). BRDIS collects aggregate patent data from companies but does so with no location detail.

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