

## Research Spotlight

# State-Level R&D by Multinational Companies

## Results From an Interagency Data Link Project

By William J. Zeile

MULTINATIONAL companies—both U.S. and foreign—are major performers of industrial research and development (R&D) in the United States. For U.S. multinational companies, U.S. parent companies play a dominant role in U.S. R&D activity, accounting for about three-quarters of the domestic R&D performed by all U.S. businesses. Through their U.S. affiliates, foreign multinational companies also play a major role: majority-owned U.S. affiliates account for about 15 percent of U.S. industrial R&D, triple their share of production or employment by all U.S. businesses.<sup>1</sup>

Within the United States, industrial R&D activity varies by geographic location. Until now, there was no information on the R&D performance of multinational companies at the state level. This information gap was addressed by an interagency project that linked information from BEA's annual surveys of multinational companies to sample data from the Survey of Industrial Research and Development (SIRD) conducted by the Census Bureau for the National Science Foundation (NSF), resulting in a new set of state-level data on R&D.<sup>2</sup>

This interagency project was initiated and funded by the National Center for Science and Engineering Statistics of the NSF and was implemented under an agreement reached by NSF, the Census Bureau, and BEA. The broader goals of this project were to improve and to enhance the data available on the domestic and international R&D activities of multinational companies. For both U.S. parent companies and majority-owned U.S. affiliates, this project provides new annual data on R&D performance by research type (basic research, applied research, and development), by source

of funds (private versus federal government) and by state.

In this article, matched SIRD data for 2007 from the link project are used to examine patterns in the state distribution of R&D performed by majority-owned U.S. affiliates of foreign companies and by U.S. parent companies. To place these data in context, comparisons are made with universe estimates of total industrial R&D by state from the SIRD sample data.<sup>3</sup> As a caveat, the totals for the matched SIRD data are simple aggregations of sample microdata rather than universe estimates computed by weighting the reported sample to account for nonsample companies; however, for 2007, the R&D total for SIRD sample companies accounts for 95 percent of the universe estimate of total industrial R&D. In addition, at the aggregate level, the quality of the match for 2007 is high: the SIRD sample data for matched affiliates and parents account for 91 percent of BEA's published total for R&D by majority-owned U.S. affiliates and for 95 percent of BEA's published total for R&D by U.S. parent companies. Comparisons with the universe estimates from the SIRD data are made to draw general inferences about the relative importance of U.S.-affiliate and U.S.-parent R&D across states, not to infer precise shares for affiliates or parents in the state R&D totals.

The relative importance of affiliate and parent R&D by state is expressed in terms of a location quotient, a measure frequently used by regional economists to gauge industrial specialization by region. For R&D by majority-owned U.S. affiliates, the location quotient for a given state is the state's share of affiliate R&D divided by the state's share of industrial R&D performed by all U.S. businesses. The quotient shows the states where affiliate R&D is relatively concentrated; if it is greater than 1, it indicates that the state's share of affiliate R&D is larger than its share of total industrial R&D. Alternatively, by rearranging terms in the ratio, the location quotient can also be expressed as the affiliate share of industrial R&D in a given state divided by the affiliate share of industrial R&D nationwide; in this

1. For U.S. parent companies, see table 3 in Kevin B. Barefoot, "U.S. Multinational Companies: Operations of U.S. Parents and Their Foreign Affiliates in 2010," *SURVEY OF CURRENT BUSINESS* 92 (November 2012): 55. For U.S. affiliates, see table 10 in Thomas Anderson, "U.S. Affiliates of Foreign Companies: Operations in 2010," *SURVEY* 92 (August 2012): 223. It should be noted that the shares for U.S. affiliates and U.S. parents are not mutually exclusive, since some U.S. parents companies are also foreign-owned affiliates.

2. Data from the this project were published in NSF, National Center for Science and Engineering Statistics, "Detailed Statistical Tables NSF 12–327," in *International Investment and R&D Data Link: 2004–07* (September 2012); [www.nsf.gov/statistics/nsf12327](http://www.nsf.gov/statistics/nsf12327). For additional information about this interagency project, see [www.nsf.gov/statistics/rdlink](http://www.nsf.gov/statistics/rdlink).

3. The SIRD universe estimates for 2007 are presented in NSF, National Center for Science and Engineering Statistics, "Detailed Statistical Tables NSF 11–3201," in *Research and Development in Industry: 2006–07* (June 2011); [www.nsf.gov/statistics/nsf11301](http://www.nsf.gov/statistics/nsf11301).

second formulation, a location quotient that is greater than 1 indicates that the contribution by affiliates to the state's R&D is proportionately greater than their contribution nationwide. Because the denominator in this second formulation is the same for all states, the location quotient is exactly correlated across states with the value of the numerator, which is the affiliate share of a state's total industrial R&D.

### R&D by U.S. Affiliates

Across the 50 states and the District of Columbia, the new linked data set for 2007 indicates that the amount of R&D performed by majority-owned U.S. affiliates of foreign companies varies widely, ranging from less than \$2 million in South Dakota and the District of Columbia to more than \$5 billion in California (table 1).

In four states—California, New Jersey, Pennsylvania, and Michigan—the dollar value of R&D performed by majority-owned U.S. affiliates is greater than \$2.5 billion, and in an additional six states—Texas, North Carolina, Massachusetts, Connecticut, Illinois, and Ohio—the value of affiliate R&D is greater than \$1 billion (chart 1). Together, these 10 states account for three-fourths of the R&D performed by majority-owned U.S. affiliates.

In most of the other states, the amount of R&D performed by affiliates is much more modest. For 46 states and the District of Columbia, for which data on affiliate R&D are publicly available, the value of affiliate R&D for the median state (Oregon) is \$212 million.<sup>4</sup> For 20 of these 46 states and the District of Columbia, the value of affiliate R&D is less than \$100 million.

Generally, the states with the highest levels of affiliate R&D tend to be the states with the highest levels of industrial R&D for all U.S. businesses; however, the relative importance of affiliate R&D for a state differs substantially among these states. Thus, California is the top-ranking state for affiliate R&D and for R&D by all U.S. businesses; however, the affiliate location quotient for California is only 0.657, indicating that the state's share of affiliate R&D (16 percent) is a third lower than its share of R&D by all U.S. businesses (24 percent). In contrast, the location quotients for New Jersey and Pennsylvania, the states with the second- and third- highest levels of affiliate R&D, are slightly higher than 2, indicating that their shares of total affiliate R&D are each twice as large as their shares of total R&D by all U.S. businesses.

4. For the other four states, the SIRD totals for R&D performed by majority-owned U.S. affiliates are suppressed to avoid disclosure of information on individual companies.

**Table 1. Research and Development Performed by Matched Majority-Owned U.S. Affiliates by State, 2007**

|                                                                        | Millions of dollars | Percentage of total R&D for all states | Percentage of R&D performed in the state by all U.S. businesses | Location quotient for R&D | Addendum: Location quotient for manufacturing employment |
|------------------------------------------------------------------------|---------------------|----------------------------------------|-----------------------------------------------------------------|---------------------------|----------------------------------------------------------|
| Total <sup>1</sup> .....                                               | 33,738              | 100.0                                  | 12.7                                                            | 1.000                     | 1.000                                                    |
| Alabama.....                                                           | 64                  | 0.2                                    | 3.6                                                             | 0.285                     | 1.227                                                    |
| Alaska.....                                                            | 3                   | (*)                                    | 5.2                                                             | 0.408                     | 1.318                                                    |
| Arizona.....                                                           | 237                 | 0.7                                    | 6.2                                                             | 0.486                     | 0.572                                                    |
| Arkansas.....                                                          | 29                  | 0.1                                    | 8.6                                                             | 0.674                     | 0.934                                                    |
| California.....                                                        | 5,347               | 15.8                                   | 8.3                                                             | 0.657                     | 0.860                                                    |
| Colorado.....                                                          | 513                 | 1.5                                    | 9.8                                                             | 0.774                     | 1.126                                                    |
| Connecticut.....                                                       | 1,583               | 4.7                                    | 16.8                                                            | 1.321                     | 1.101                                                    |
| Delaware.....                                                          | (D)                 | (D)                                    | (D)                                                             | (D)                       | 1.642                                                    |
| District of Columbia.....                                              | 1                   | (*)                                    | 0.3                                                             | 0.021                     | 2.039                                                    |
| Florida.....                                                           | 358                 | 1.1                                    | 7.8                                                             | 0.618                     | 0.808                                                    |
| Georgia.....                                                           | 269                 | 0.8                                    | 9.6                                                             | 0.760                     | 1.031                                                    |
| Hawaii.....                                                            | (D)                 | (D)                                    | (D)                                                             | (D)                       | 0.967                                                    |
| Idaho.....                                                             | 15                  | (*)                                    | 2.1                                                             | 0.163                     | 0.524                                                    |
| Illinois.....                                                          | 1,232               | 3.7                                    | 10.8                                                            | 0.855                     | 0.878                                                    |
| Indiana.....                                                           | 483                 | 1.4                                    | 9.8                                                             | 0.771                     | 1.314                                                    |
| Iowa.....                                                              | 101                 | 0.3                                    | 8.4                                                             | 0.662                     | 0.927                                                    |
| Kansas.....                                                            | 305                 | 0.9                                    | 23.4                                                            | 1.844                     | 1.539                                                    |
| Kentucky.....                                                          | 88                  | 0.3                                    | 9.9                                                             | 0.779                     | 1.724                                                    |
| Louisiana.....                                                         | 43                  | 0.1                                    | 11.5                                                            | 0.909                     | 0.735                                                    |
| Maine.....                                                             | 20                  | 0.1                                    | 7.5                                                             | 0.595                     | 0.864                                                    |
| Maryland.....                                                          | 483                 | 1.4                                    | 13.2                                                            | 1.039                     | 1.334                                                    |
| Massachusetts.....                                                     | 1,797               | 5.3                                    | 9.2                                                             | 0.727                     | 0.921                                                    |
| Michigan.....                                                          | 2,512               | 7.4                                    | 16.0                                                            | 1.258                     | 0.793                                                    |
| Minnesota.....                                                         | 622                 | 1.8                                    | 9.4                                                             | 0.739                     | 0.673                                                    |
| Mississippi.....                                                       | 7                   | (*)                                    | 2.5                                                             | 0.198                     | 0.637                                                    |
| Missouri.....                                                          | 192                 | 0.6                                    | 7.0                                                             | 0.553                     | 0.832                                                    |
| Montana.....                                                           | (D)                 | (D)                                    | (D)                                                             | (D)                       | 0.554                                                    |
| Nebraska.....                                                          | 73                  | 0.2                                    | 14.9                                                            | 1.177                     | 0.984                                                    |
| Nevada.....                                                            | 30                  | 0.1                                    | 5.3                                                             | 0.417                     | 1.000                                                    |
| New Hampshire.....                                                     | (D)                 | (D)                                    | (D)                                                             | (D)                       | 1.753                                                    |
| New Jersey.....                                                        | 4,851               | 14.4                                   | 27.1                                                            | 2.137                     | 1.334                                                    |
| New Mexico.....                                                        | 8                   | (*)                                    | 1.4                                                             | 0.111                     | 0.567                                                    |
| New York.....                                                          | 763                 | 2.3                                    | 7.0                                                             | 0.551                     | 0.851                                                    |
| North Carolina.....                                                    | 1,813               | 5.4                                    | 26.5                                                            | 2.093                     | 1.192                                                    |
| North Dakota.....                                                      | 31                  | 0.1                                    | 24.6                                                            | 1.939                     | 0.734                                                    |
| Ohio.....                                                              | 1,119               | 3.3                                    | 15.4                                                            | 1.214                     | 1.137                                                    |
| Oklahoma.....                                                          | 28                  | 0.1                                    | 5.3                                                             | 0.419                     | (D)                                                      |
| Oregon.....                                                            | 212                 | 0.6                                    | 5.8                                                             | 0.460                     | 0.530                                                    |
| Pennsylvania.....                                                      | 2,804               | 8.3                                    | 27.0                                                            | 2.128                     | 1.002                                                    |
| Rhode Island.....                                                      | 92                  | 0.3                                    | 22.4                                                            | 1.764                     | 0.376                                                    |
| South Carolina.....                                                    | 448                 | 1.3                                    | 31.4                                                            | 2.476                     | 1.965                                                    |
| South Dakota.....                                                      | 1                   | (*)                                    | 0.8                                                             | 0.060                     | 0.455                                                    |
| Tennessee.....                                                         | 235                 | 0.7                                    | 14.3                                                            | 1.131                     | 1.559                                                    |
| Texas.....                                                             | 2,345               | 7.0                                    | 16.9                                                            | 1.331                     | 0.953                                                    |
| Utah.....                                                              | 52                  | 0.2                                    | 2.9                                                             | 0.232                     | 0.788                                                    |
| Vermont.....                                                           | 17                  | 0.1                                    | 4.1                                                             | 0.324                     | 0.557                                                    |
| Virginia.....                                                          | 303                 | 0.9                                    | 6.3                                                             | 0.493                     | 1.145                                                    |
| Washington.....                                                        | 527                 | 1.6                                    | 4.2                                                             | 0.327                     | 0.641                                                    |
| West Virginia.....                                                     | 18                  | 0.1                                    | 7.7                                                             | 0.609                     | 1.596                                                    |
| Wisconsin.....                                                         | 194                 | 0.6                                    | 5.7                                                             | 0.448                     | 0.540                                                    |
| Wyoming.....                                                           | 5                   | (*)                                    | 13.5                                                            | 1.065                     | 1.623                                                    |
| Addenda: Summary statistics for 46 states and the District of Columbia |                     |                                        |                                                                 |                           |                                                          |
| Mean.....                                                              | 687                 | 2.0                                    | 10.8                                                            | 0.851                     | .....                                                    |
| Median.....                                                            | 212                 | 0.6                                    | 8.6                                                             | 0.674                     | .....                                                    |
| Standard deviation.....                                                | 1,182               | 3.5                                    | 7.8                                                             | 0.611                     | .....                                                    |

\* Less than 0.05 percent.

D Suppressed to avoid disclosure of data of individual companies.

1. Excludes data for U.S. affiliates and all U.S. businesses that are undistributed by state. For matched majority-owned U.S. affiliates, the R&D total including the amount undistributed by state is \$37,323 million.

NOTES. In this table, the dollar figures for R&D are unweighted sample data totals from the Survey of Industrial Research and Development (SIRD) for matched majority-owned U.S. affiliates of foreign companies. The data on R&D by all U.S. businesses used to construct the affiliate share of R&D and the R&D location quotient are SIRD universe estimates published in National Science Foundation, *Research and Development in Industry: 2006-07*.

The location quotient for manufacturing employment was constructed using state-level data on manufacturing employment by majority-owned U.S. affiliates from BEA's 2007 Benchmark Survey of Foreign Direct Investment in the United States and from data on manufacturing employment of all U.S. businesses from BEA's Regional Economic Information System.

In terms of the value of affiliate R&D, the top 10 states also all rank among the top 12 states for R&D performed by all U.S. businesses; however, for many of these states, the two rankings are widely divergent. For example, Massachusetts, the state with the second-largest amount of industrial R&D, ranks seventh in R&D by affiliates. Pennsylvania, the state with the third-largest level of affiliate R&D, ranks ninth in industrial R&D, and North Carolina, the sixth-largest state for affiliate R&D, ranks twelfth in industrial R&D. The two rankings are closer for New Jersey, which ranks second in terms of R&D performed by affiliates and third in terms of R&D performed by all U.S. businesses.

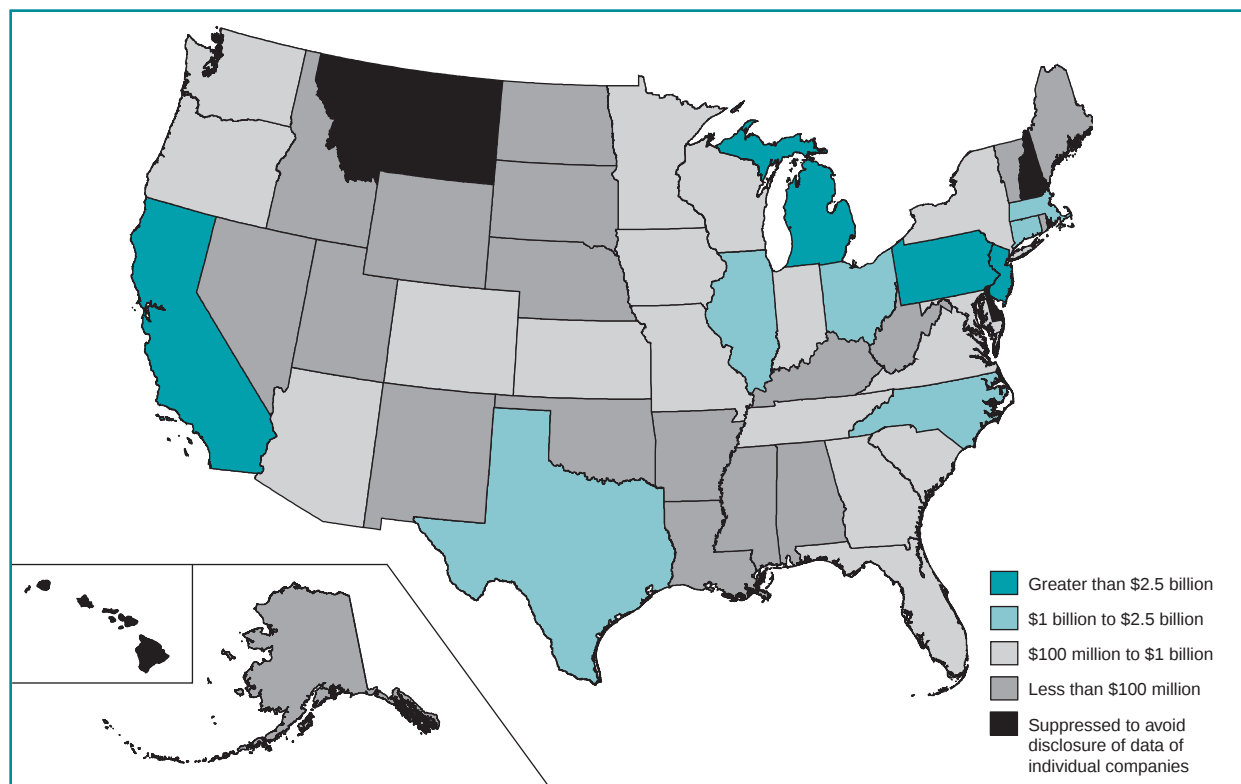
Majority-owned U.S. affiliates account for more than a quarter of the SIRD estimated universe total for industrial R&D in four states: South Carolina, New Jersey, Pennsylvania, and North Carolina. In each of these states, the location quotient for affiliate R&D is equal to 2 or more, which indicates that the affiliate share of industrial R&D in the state is at least twice as high as the affiliate share of industrial R&D nationwide. In an additional seven states—North Dakota,

Kansas, Rhode Island, Texas, Connecticut, Michigan, and Ohio—the location quotient is higher than 1.2 (chart 2).

### Affiliate industry detail

A common characteristic of several of the states with a high location quotient is a high concentration of R&D activity in the chemicals industry (mainly pharmaceuticals), an industry in which affiliate production and R&D are relatively prominent nationwide. Universe estimates from the SIRD data for 2007 indicate that chemicals manufacturing accounts for more than half of all industrial R&D in New Jersey, Connecticut, and Pennsylvania and for slightly more than a quarter of industrial R&D in North Carolina. New Jersey, which has the second-largest location quotient (2.137), historically has attracted a large amount of foreign direct investment in the pharmaceutical industry partly because of its access to shipping ports, its proximity to New York financial centers, and its ample sites for industrial development. Most of these factors also apply to Connecticut and Pennsylvania. In contrast, the chemicals industry accounts for less than a fifth of

**Chart 1. R&D by Majority-Owned U.S. Affiliates by State, 2007**



U.S. Bureau of Economic Analysis

industrial R&D in Massachusetts and California, two major R&D-performing states for which the affiliate share of R&D is relatively low; in both of these states, the computer and electronics manufacturing industry accounts for a much larger share of industrial R&D (45 percent in Massachusetts and 32 percent in California). Generally, across the 45 states for which data are publicly available, the share of industrial R&D accounted for by U.S. affiliates and the share of industrial R&D performed in the chemicals industry are significantly and positively correlated.<sup>5</sup>

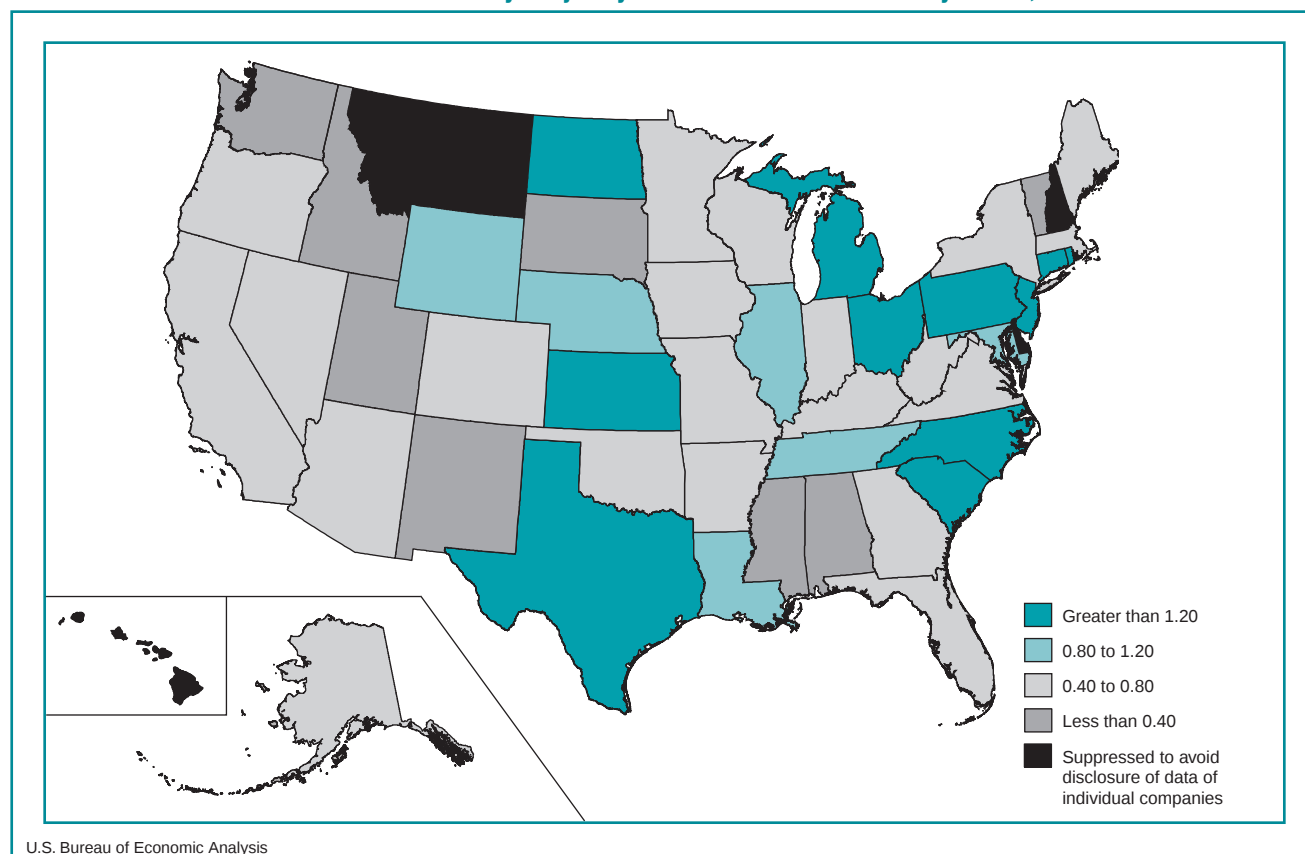
As gauged by the location quotient, the R&D of matched majority-owned U.S. affiliates is relatively concentrated in a small number of states; for most states, the affiliate location quotient is well below 1. Among the 46 states and the District of Columbia, for which data on affiliate R&D are publicly available, the median state (Arkansas) has a location quotient of

0.674, which indicates that the state's share of R&D by affiliates is 33 percent lower than its share of R&D by all U.S. businesses. For eight states and the District of Columbia, the location quotient is less than 0.4. One of these states is Washington, which ranks as the sixth-largest state for industrial R&D by all U.S. businesses; however, almost all of the other states rank in the bottom half in terms of industrial R&D.

Industry-level SIRD data from the link project indicate that 78 percent of the R&D performed by matched majority-owned U.S. affiliates is in manufacturing, which suggests that the R&D of affiliates is relatively concentrated in states where the affiliates have a prominent manufacturing presence. The relative prominence of affiliate manufacturing activity across states can be gauged by a location quotient for manufacturing employment—the affiliate share of manufacturing employment in a given state divided by the affiliate share of manufacturing employment nationwide—constructed from state-level data for majority-owned U.S. affiliates from BEA's 2007 Benchmark Survey of Foreign Direct Investment in the United States. The location quotient for affiliate manufacturing

5. The coefficient of correlation is 0.373, significant at the 5-percent level. The omitted states in the sample are the four states in table 1 for which the affiliate share of industrial R&D is suppressed and the two states (Alaska and West Virginia) for which R&D in the chemicals industry is suppressed in the SIRD data.

**Chart 2. Location Quotients for R&D by Majority-Owned U.S. Affiliates by State, 2007**



employment is more than 1 in 10 of the 15 states for which the affiliate R&D location quotient exceeds unity, including the four states with the highest location quotients for affiliate R&D (South Carolina, New Jersey, Pennsylvania, and North Carolina) (table 1). Across the 46 states for which data on each measure are publicly available, the two location quotients are positively and significantly correlated with each other (the coefficient of correlation is 0.317); however, the relation is mild, owing to a weak relation between the two measures among states with very little industrial R&D. For states with substantial R&D activity, the location quotient for affiliate R&D is much more strongly correlated with the location quotient for affiliate manufacturing employment.<sup>6</sup>

### R&D by U.S. Parent Companies

For U.S. parent companies of foreign affiliates, SIRD data for 2007 indicate that the value of R&D performed in the United States ranges across states from \$8 million in Wyoming to \$43 billion in California (table 2).

In 10 states—California, Massachusetts, Michigan, New Jersey, Washington, Texas, Illinois, Pennsylvania, Connecticut, and New York—the value of R&D performed by U.S. parents is greater than \$5 billion (chart 3). Together, these 10 states account for 73 percent of the R&D performed by U.S. parents nationwide. California alone accounts for 23.6 percent of total R&D by matched U.S. parents for all states, a share that closely matches its 24 percent share of total industrial R&D performed by all U.S. businesses.

The top 10 states for matched U.S. parent companies all rank among the top 10 states for industrial R&D performed by all U.S. businesses; moreover, for the 10 states, the two rankings are either identical or similar. Generally, the state rankings for R&D performed by matched U.S. parents and by all U.S. businesses are closely correlated across all 50 states and the District of Columbia (the coefficient of correlation between the two rankings is 0.993).

For all states combined, the share of the universe total for industrial R&D accounted for by U.S. parents is

**Table 2. Research and Development Performed by Matched U.S. Parent Companies by State, 2007**

|                                                                        | Millions of dollars | Percentage of total R&D for all states | Percentage of R&D performed in the state by all U.S. businesses | Location quotient |
|------------------------------------------------------------------------|---------------------|----------------------------------------|-----------------------------------------------------------------|-------------------|
| Total <sup>1</sup> .....                                               | 184,117             | 100.0                                  | 69.2                                                            | 1.000             |
| Alabama .....                                                          | 991                 | 0.5                                    | 56.0                                                            | 0.808             |
| Alaska .....                                                           | 10                  | (*)                                    | 17.2                                                            | 0.249             |
| Arizona .....                                                          | 2,764               | 1.5                                    | 71.9                                                            | 1.038             |
| Arkansas .....                                                         | 162                 | 0.1                                    | 47.8                                                            | 0.690             |
| California .....                                                       | 43,453              | 23.6                                   | 67.7                                                            | 0.978             |
| Colorado .....                                                         | 3,800               | 2.1                                    | 72.8                                                            | 1.051             |
| Connecticut .....                                                      | 7,212               | 3.9                                    | 76.4                                                            | 1.103             |
| Delaware .....                                                         | 858                 | 0.5                                    | 58.3                                                            | 0.842             |
| District of Columbia .....                                             | 189                 | 0.1                                    | 49.9                                                            | 0.720             |
| Florida .....                                                          | 2,817               | 1.5                                    | 61.7                                                            | 0.890             |
| Georgia .....                                                          | 1,451               | 0.8                                    | 52.0                                                            | 0.752             |
| Hawaii .....                                                           | 100                 | 0.1                                    | 45.9                                                            | 0.663             |
| Idaho .....                                                            | 543                 | 0.3                                    | 74.8                                                            | 1.080             |
| Illinois .....                                                         | 8,291               | 4.5                                    | 73.0                                                            | 1.054             |
| Indiana .....                                                          | 3,943               | 2.1                                    | 79.8                                                            | 1.153             |
| Iowa .....                                                             | 810                 | 0.4                                    | 67.4                                                            | 0.973             |
| Kansas .....                                                           | 792                 | 0.4                                    | 60.7                                                            | 0.877             |
| Kentucky .....                                                         | 599                 | 0.3                                    | 67.3                                                            | 0.972             |
| Louisiana .....                                                        | 144                 | 0.1                                    | 38.6                                                            | 0.558             |
| Maine .....                                                            | 123                 | 0.1                                    | 46.4                                                            | 0.670             |
| Maryland .....                                                         | 1,264               | 0.7                                    | 34.5                                                            | 0.498             |
| Massachusetts .....                                                    | 13,939              | 7.6                                    | 71.5                                                            | 1.033             |
| Michigan .....                                                         | 13,193              | 7.2                                    | 83.8                                                            | 1.211             |
| Minnesota .....                                                        | 4,615               | 2.5                                    | 69.5                                                            | 1.004             |
| Mississippi .....                                                      | 126                 | 0.1                                    | 45.2                                                            | 0.652             |
| Missouri .....                                                         | 1,717               | 0.9                                    | 62.8                                                            | 0.906             |
| Montana .....                                                          | 27                  | (*)                                    | 20.1                                                            | 0.291             |
| Nebraska .....                                                         | 268                 | 0.1                                    | 54.8                                                            | 0.792             |
| Nevada .....                                                           | 229                 | 0.1                                    | 40.4                                                            | 0.583             |
| New Hampshire .....                                                    | 1,376               | 0.7                                    | 75.9                                                            | 1.096             |
| New Jersey .....                                                       | 12,746              | 6.9                                    | 71.2                                                            | 1.029             |
| New Mexico .....                                                       | 287                 | 0.2                                    | 50.5                                                            | 0.730             |
| New York .....                                                         | 6,833               | 3.7                                    | 62.6                                                            | 0.904             |
| North Carolina .....                                                   | 4,536               | 2.5                                    | 66.4                                                            | 0.959             |
| North Dakota .....                                                     | 71                  | (*)                                    | 56.3                                                            | 0.814             |
| Ohio .....                                                             | 4,573               | 2.5                                    | 62.9                                                            | 0.909             |
| Oklahoma .....                                                         | 285                 | 0.2                                    | 54.1                                                            | 0.781             |
| Oregon .....                                                           | 2,795               | 1.5                                    | 77.0                                                            | 1.112             |
| Pennsylvania .....                                                     | 7,943               | 4.3                                    | 76.5                                                            | 1.104             |
| Rhode Island .....                                                     | 255                 | 0.1                                    | 62.0                                                            | 0.896             |
| South Carolina .....                                                   | 923                 | 0.5                                    | 64.7                                                            | 0.935             |
| South Dakota .....                                                     | 20                  | (*)                                    | 15.2                                                            | 0.219             |
| Tennessee .....                                                        | 852                 | 0.5                                    | 52.0                                                            | 0.751             |
| Texas .....                                                            | 10,016              | 5.4                                    | 72.1                                                            | 1.042             |
| Utah .....                                                             | 606                 | 0.3                                    | 34.4                                                            | 0.496             |
| Vermont .....                                                          | 306                 | 0.2                                    | 74.1                                                            | 1.070             |
| Virginia .....                                                         | 2,663               | 1.4                                    | 55.0                                                            | 0.795             |
| Washington .....                                                       | 10,413              | 5.7                                    | 82.1                                                            | 1.185             |
| West Virginia .....                                                    | 123                 | 0.1                                    | 52.8                                                            | 0.762             |
| Wisconsin .....                                                        | 2,057               | 1.1                                    | 60.3                                                            | 0.871             |
| Wyoming .....                                                          | 8                   | (*)                                    | 21.6                                                            | 0.312             |
| Addenda: Summary statistics for 50 states and the District of Columbia |                     |                                        |                                                                 |                   |
| Mean .....                                                             | 3,610               | 1.9                                    | 58.2                                                            | 0.814             |
| Median .....                                                           | 923                 | 0.5                                    | 61.7                                                            | 0.863             |
| Standard deviation .....                                               | 6,835               | 3.6                                    | 16.9                                                            | 0.237             |

\* Less than 0.05 percent.

1. Excludes data for U.S. parents and all U.S. businesses that are undistributed by state. For matched U.S. parent companies, the R&D total including the amount undistributed by state is \$192,410 million.

Notes. In this table, the dollar figures for R&D are unweighted sample data totals from the Survey of Industrial Research and Development (SIRD) for matched U.S. parent companies. The data on R&D by all U.S. businesses used to construct the parent share of R&D and the location quotient are SIRD universe estimates published in National Science Foundation, *Research and Development in Industry: 2006-07*.

6. Specifically, for the subsample of 29 states for which the total value of industrial R&D in 2007 is greater than \$1 billion, the coefficient of correlation between the location quotient for affiliate R&D and the location quotient for affiliate manufacturing employment is 0.654. In contrast, for the subsample of 17 states for which the total value of industrial R&D is less than \$1 billion, the coefficient of correlation between the two location quotients is -0.091.

69.2 percent. In 16 states, U.S. parents' share of industrial R&D is higher than their nationwide share, as indicated by a location quotient higher than 1. The median location quotient for U.S.-parent R&D is 0.863, considerably higher than the median for R&D by majority-owned U.S. affiliates (0.674); however, in contrast to U.S. affiliates, there is no state for which the location quotient for U.S. parents exceeds 1.3.

As indicated by the standard deviation statistics in the addenda rows to tables 1 and 2, the location quotient for U.S. parents varies much less across states than the location quotient for U.S. affiliates. In 18 states, the location quotient for R&D by U.S. parent companies lies in a narrow range between 0.9 and 1.1, which indicates that the state's share of R&D by U.S. parents is within 10 percent of its share for all U.S. businesses R&D (chart 4). (In contrast, among the 47 states for which data on U.S.-affiliate R&D are publicly available, only three states have an affiliate location quotient between 0.9 and 1.1.) Only one state (Michigan) has a location quotient for U.S. parents that exceeds 1.2. In 20 states, the location quotient is less than 0.8; for these states, the share of R&D by parents

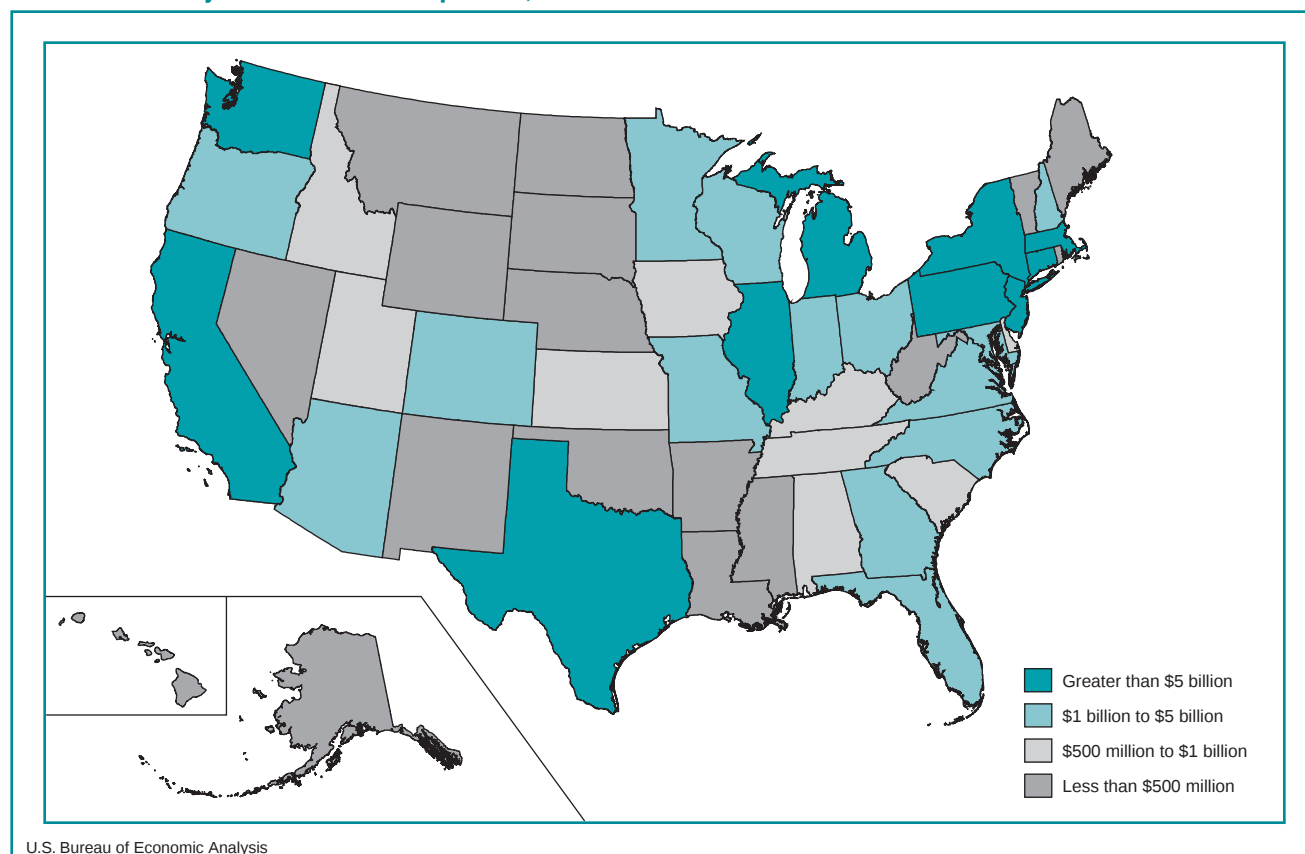
is more than 20 percent lower than its share of R&D by all U.S. businesses.

Most of the 20 states for which the location quotient of U.S. parents is less than 0.8 are states with relatively little industrial R&D, including 11 of the 12 states that rank in the bottom quartile in terms of R&D performed by all U.S. businesses. In addition, many of these 20 states (including those with substantial R&D activity) are states in which a relatively large share of industrial R&D is performed outside of manufacturing, particularly in the professional, scientific, and technical services industry.

### Parent industry detail

Nationwide, U.S. parent companies account for 78 percent of universe total for R&D (as estimated by SIRD) performed in manufacturing, but they account for only 42 percent of the total for R&D performed in professional, scientific, and technical services. Consistent with these aggregate differences, the state-level share of industrial R&D accounted for by U.S. parents is positively correlated across states with the share accounted for by manufacturing businesses and

**Chart 3. R&D by U.S. Parent Companies, 2007**



negatively correlated with the share accounted for by businesses in professional, scientific, and technical services.<sup>7</sup> In the latter sector, the correlation is driven largely by a significant negative correlation between the U.S. parent share of industrial R&D and the share accounted for by scientific research and development services, an industry for which the parent share of for-profit-company R&D nationwide is only 29 percent.<sup>8</sup> Many of the companies in this industry are small, recently established biotechnology firms that perform drug discovery and other research services for pharmaceutical companies or for the federal government. Because these companies tend to be either in the development stage or to receive their revenue from domestic contract services, they usually do not have affil-

iates in foreign countries. For the other major industry in this sector in terms of R&D performance—computer systems design and related services—the correlation between the U.S. parent share of industrial R&D and the industry share of industrial R&D is not significant.

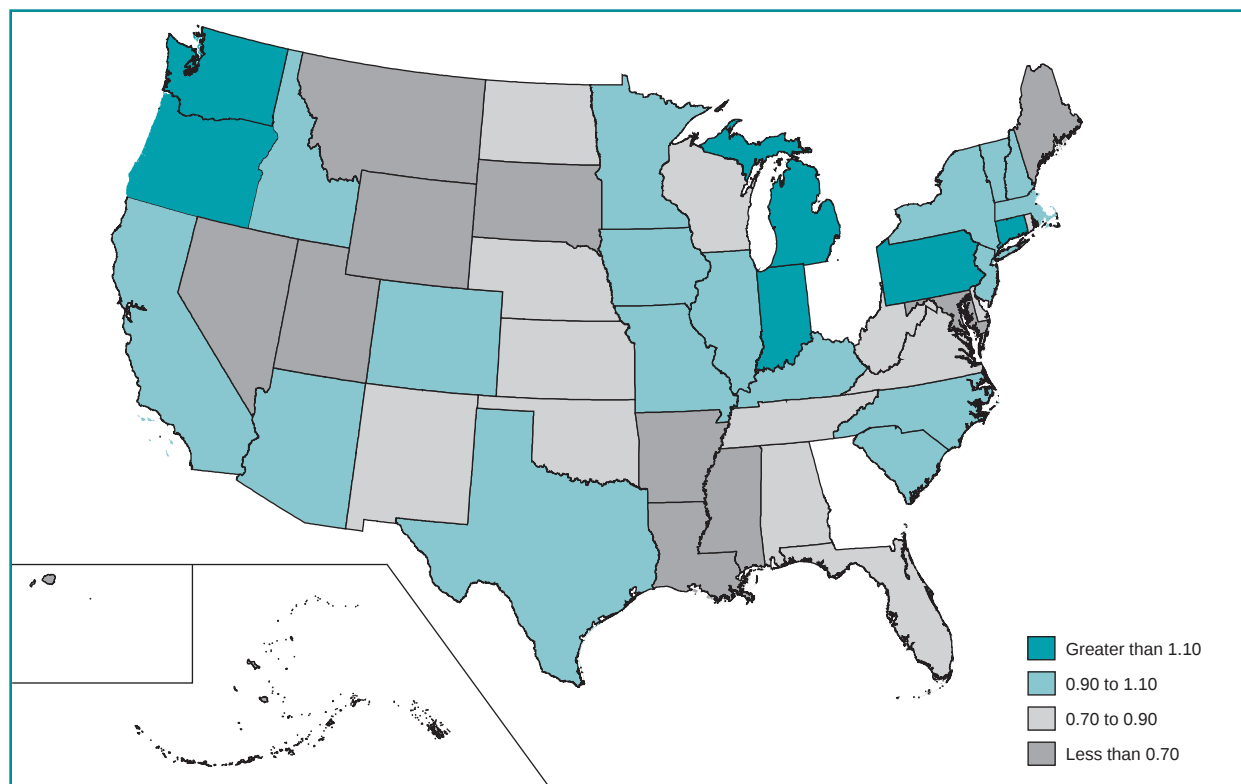
### Conclusion and Future Work

The matched SIRD data from the interagency link project provide new insight on the state distribution of R&D performance by U.S. and foreign multinational companies. For both majority-owned U.S. affiliates of foreign companies and U.S. parent companies of foreign affiliates, the state distribution of R&D is concentrated: about three-quarters of the R&D is performed in 10 states. Majority-owned U.S. affiliates account for relatively high shares of industrial R&D in states with relatively large concentrations of R&D in the chemical industry and in other high-R&D states where affiliates have a relatively large manufacturing presence. For U.S. parent companies, the distribution of R&D across states more closely mirrors that of all U.S. businesses; however, the R&D of parents is relatively less

7. Across the 50 states and the District of Columbia, the coefficient of correlation between the U.S. parent share of industrial R&D and the share of industrial R&D accounted for by professional, scientific, and technical services is  $-0.523$ , significant at the 1 percent confidence level. For the sample of 44 states and the District of Columbia for which data on manufacturing industry R&D are publicly available, the coefficient of correlation between the U.S. parent share of industrial R&D and the share of industrial R&D accounted for by manufacturing is  $0.619$ , also significant at the 1 percent level.

8. The coefficient of correlation is  $-0.490$ .

**Chart 4. Location Quotients for R&D by U.S. Parent Companies, 2007**



U.S. Bureau of Economic Analysis

concentrated in states with little industrial R&D and in other states in which a proportionately large share of industrial R&D is performed in nonmanufacturing industries.

The results presented in this article are based on linked data for 2007, the last year covered by SIRD. For 2008 forward, the SIRD has been succeeded by the Business R&D and Innovation Survey (BRDIS), which collects additional detail on innovation activities and sources of funding for company R&D, including new

details on funding by state.<sup>9</sup> A project linking data from BEA's surveys of multinational companies to BRDIS data for 2008–2010 is in progress. Results from this project promise to provide further insight into the R&D activities of U.S. multinational companies and foreign-owned U.S. affiliates.

9. See NSF, National Center for Science and Engineering Statistics, "NSF Announces New Business R&D and Innovation Survey," news release NSF 09–304 (November 2008) at [www.nsf.gov/statistics/infbrief/nsf09304](http://www.nsf.gov/statistics/infbrief/nsf09304).

### Data Link Project

The R&D data presented in this article were obtained by linking company-specific information from the Survey of Industrial Research and Development (SIRD) conducted by the Census Bureau for the National Science Foundation with information on majority-owned U.S. affiliates of foreign companies from BEA's 2007 Benchmark Survey of Foreign Direct Investment in the United States (FDIUS) and with information on U.S. parent companies from BEA's 2007 Annual Survey of U.S. Direct Investment Abroad (USDIA). The data link was conceived by the National Science Foundation, which also provided funding for the project.

A U.S. affiliate is a business enterprise in which there is foreign direct investment—that is, a single foreign company or other person owns or controls, directly or indirectly, 10 percent or more of the voting securities of an incorporated U.S. business enterprise or an equivalent interest in an unincorporated U.S. business enterprise. A majority-owned U.S. affiliate is a U.S. affiliate that is owned more than 50 percent by foreign direct investors.

A U.S. parent company is a company, resident in the United States, that owns or controls 10 percent or more of the voting securities, or the equivalent, of a foreign business enterprise.

SIRD is a nationally representative sample of all for-profit companies with five or more employees, publicly or privately held, that performed R&D in the 50 states and the District of Columbia. The reporting unit is the company, defined as a business organization of one or more establishments under common ownership or control.

The linked data resulted from matching SIRD to BEA's surveys of FDIUS and USDIA for 2007. The link between data from SIRD and data from the two BEA surveys was

performed in two basic steps. The first step was a computer match of company identification codes from BEA files to codes for the corresponding companies in the Census Bureau's Business Register, a database covering all U.S. businesses with paid employees. The second step was to link BEA identification codes to identification codes in the Census Bureau's Business Register and the SIRD. Additional steps were required to verify company matches and related cross-survey data.

In contrast to the SIRD universe estimates for total U.S. R&D activity, which are computed by weighting the reported SIRD sample to account for nonsample companies, the data from the link project are not weighted. The matched data presented in this article were obtained from simple aggregations of sample microdata, cover only matched companies, and do not represent the universe of all R&D-performing parent companies or U.S. affiliates. In addition, the matched data reflect updates and adjustments to correct for data discrepancies across surveys.<sup>1</sup>

Nationwide in 2007, the unweighted aggregations of the SIRD sample data for matched affiliates and parents accounted for 91 percent of BEA's published total for R&D by majority-owned U.S. affiliates and 95 percent of BEA's published total for R&D by U.S. parent companies. The R&D total for SIRD sample companies in 2007 (\$255.8 billion) accounted for 95 percent of the universe estimate of total industrial R&D in the 2007 SIRD publication (\$269.3 billion).

1. Some of the reasons for data discrepancies in matched companies across surveys were reporting errors and differences in company consolidation or composition. Some discrepancies occurred among matched records that had imputed data items in one of the linked surveys. In such cases, available reported data were used in lieu of imputed data for purposes of the link.