BEA BRIEFING

# Innovation-Related Services Trade by Multinational Enterprises

## Results from an Interagency Data Link Project

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*This article presents new data on multinational enterprises (MNEs) located in the United States that engage in both research and development (R&D) and international trade in innovation-related services. The data show that these MNEs are more R&D-intensive in terms of employment than MNEs that perform R&D but do not engage in innovation-related services trade. The data also show differences in trade balances in different types of innovation-related services between R&D-performing U.S. parent companies of U.S. MNEs and R&D-performing U.S. affiliates of foreign MNEs.*

MULTINATIONAL ENTERPRISES (MNEs) with a presence in the United States economy—both U.S. parent companies of U.S. MNEs and U.S. affiliates of foreign MNEs—are major contributors to U.S. technological innovation, as evidenced by their research and development (R&D) activity. An earlier article presented results from an interagency project that linked company information from BEA's annual activities of MNE (AMNE) surveys to company-specific information from the Business R&D and Innovation Survey (BRDIS), which is cosponsored by the National Science Foundation (NSF) and the U.S. Census Bureau. Results from that link indicate that in 2010, the share of total U.S. domestic R&D performance accounted for by U.S. parent companies was 71 percent, and the share accounted for by foreign-owned U.S. affiliates was 14 percent.[1]

Given that MNEs are increasingly fragmenting their global production and supply chains (Johnson and Noguera) and extending the geographic scope of their R&D and innovation-related activities (Hall), a commensurate rise might be expected in their cross-border trade in intermediate services.[2] This may be particularly true for trade in services related to R&D and for charges for the use of intellectual property. Information on U.S. trade in services by MNEs for 2008 was obtained earlier from a BEA project that linked company information from its AMNE surveys to transactions data from its surveys of international trade in services.[3]

Building on these separate two-way link projects, a new interagency three-way link project was recently completed involving BRDIS, the AMNE surveys, and the BEA BE–125 quarterly survey of Transactions in Selected Services and Intellectual Property With Foreign Persons. The three-way link results in integrated information for matched U.S. parent companies and majority-owned U.S. affiliates that engage in both R&D and trade in innovation-related services. These services include R&D services, industrial engineering services, and charges for the use of intellectual property, including industrial processes and trademarks.[4] The interagency project aims to improve and enhance the data available on the R&D and innovation activities of MNEs. The project was initiated and funded by the National Center for Science and Engineering Statistics (NCSES) of the NSF and was implemented under an agreement reached by NSF, the Census Bureau, and BEA.

The data project provides new integrated information on the R&D performance, R&D employment, trade in R&D services, and international charges for the use of intellectual property for the subset of MNEs operating in the United States (U.S. parent companies and majority-owned U.S. affiliates) that engage in both R&D and the selected international trade in services covered for 2010.[5] Among the illustrative findings from the project, matched MNEs that report activity

1. See Francisco Moris, "R&D Performance of U.S.-Located Multinational Companies: Results from Multiagency Survey Linking Project," *InfoBriefs* (February 2016). As noted in "Data Notes" in this report, the shares for U.S. parents and U.S. affiliates are not mutually exclusive because some U.S. parent companies are also foreign-owned affiliates.

More information about data link projects is available on BEA's Web site.

2. Robert C. Johnson and Guillermo Noguera, "Accounting for Intermediates: Production Sharing and Trade in Value Added," *Journal of International Economics* 86, no. 2 (March 2012): 224–236, and Bronwyn H. Hall, "The Internationalization of R&D" 2010.

3. See Kevin Barefoot and Jennifer Koncz-Bruner, "A Profile of Exporters and Importers of Services: Evidence From New Linked Data on International Trade in Services and Operations of Multinational Companies," SURVEY OF CURRENT BUSINESS 92 (June 2012).

4. Data from the three-way link on trade in industrial engineering services are not presented in this article because much of the tabular data from the project was suppressed to avoid disclosure of information on individual companies.

5. For the data year 2010 covered in the link project, trade in R&D services was collected as "research, development, and testing services." Trade in these services is currently reported as "trade in research and development services" on line 46 (exports) and line 114 (imports) of table 2.1 in the international transactions accounts.

on all three research-related surveys are more R&D intensive in their employment than other U.S.-located R&D performing companies and MNEs that perform U.S. R&D but do not engage in innovation-related services trade. Matched U.S. parent companies that report on all three surveys account for dominant shares of total U.S. trade connected with both charges for the use of intellectual property and R&D services.

## Results for U.S. Parent Companies

U.S. parent companies that engage in both domestic R&D and international trade in innovation-related services were responsible for $162.9 billion in domestic U.S. R&D performance in 2010 (table 1).[6] Their R&D performance accounted for 58 percent of the total $279.0 billion in domestic R&D performed by all U.S.-located companies and for 83 percent of the total $197.2 billion in domestic R&D by R&D-performing U.S. parent companies identified in the two-way link. About 80 percent of the domestic R&D performance of U.S. parent companies in the three-way link was by parent companies classified in manufacturing.[7]

The domestic R&D labor force of U.S. parent companies in the three-way link was approximately 602,000 employees. These employees accounted for 43 percent of the domestic R&D employment of all R&D-performing U.S. companies and for 76 percent of the domestic R&D employment of R&D-performing U.S. parent companies identified in the two-way link. For U.S. parent companies in the three-way link, their domestic R&D employment accounted for 8.5 percent of their total domestic employment, which is higher than both the 7.6 percent R&D-employment share for all R&D-performing companies located in the United States and the 6.9 percent R&D-employment share for R&D-performing U.S. parent companies identified in the two-way link.

U.S. parent companies in the three-way link accounted for dominant shares of both U.S. exports and U.S. imports of R&D services. Their share of imports was 84 percent, substantially higher than their 63 percent share of exports (table 2). Imports of R&D services by the matched U.S. parent companies, which totaled $18.5 billion, exceeded their exports of R&D

6. In table 1, the figures on R&D and employment for matched companies in the three-way link include companies whose trade in innovation-related services consisted solely of trade in industrial engineering services. The trade data for this service category are not presented in the other tables because of suppressions to avoid disclosure of information on individual companies.

7. A forthcoming NSF *InfoBrief* (to be released on the NSF Web site) will discuss additional BRDIS information based on the three-way link.

**Table 1. R&D Performance and Employment of All R&D-Performing U.S. Companies and for Matched Companies in Two-Way and Three-Way Links, 2010**

| | Millions of dollars | Thousands | Percentage of all-companies total | | Addendum: R&D employment as a percentage of total employment |
|---|---|---|---|---|---|
| | Domestic R&D performance | Domestic R&D employment | Domestic R&D performance | Domestic R&D employment | |
| All U.S.-located companies that perform R&D (BRDIS estimates) | 278,977 | 1,412 | 100.0 | 100.0 | 7.6 |
| U.S. parent companies that perform R&D (two-way link) | 197,163 | 788 | 70.7 | 55.8 | 6.9 |
| U.S. parent companies that perform R&D and engage in services trade (three-way link) | 162,902 | 602 | 58.4 | 42.6 | 8.5 |
| Majority-owned U.S. affiliates that perform R&D (two-way link) | 39,700 | 155 | 14.2 | 11.0 | 7.3 |
| Majority-owned U.S. affiliates that perform R&D and engage in services trade (three-way link) | 31,973 | 116 | 11.5 | 8.2 | 9.0 |

Notes. Data for all U.S.-located companies are from the full 2010 BRDIS. Three-way link refers to BRDIS-USDIA-trade in services link and BRDIS-FDIUS-trade in services link.For an illustration of two-way and three-way links, see chart 1. R&D services for 2010 include transactions in testing services.
Data for matched U.S. parent companies and matched majority-owned U.S. affiliates (U.S.-located foreign-owned companies) should not be summed to attempt a U.S. aggregate related to MNEs because some U.S. parent companies of foreign affiliates are themselves owned by a foreign parent company. Linked data are not weighted. Detail may not add to total because of rounding.
Sources: National Science Foundation, National Center for Science and Engineering Indicators, U.S. Bureau of Economic Analysis, and U.S. Census Bureau R&D Data Link Project 2008–2010.

**Table 2. U.S. Trade in Selected Services for All U.S. Companies and for Matched Companies in Three-Way Links by Type of Service, 2010**

| | Millions of dollars | | | Percent | | |
|---|---|---|---|---|---|---|
| | All U.S. companies | Matched U.S. parents | Matched U.S. affiliates | All U.S. companies | Matched U.S. parents | Matched U.S. affiliates |
| Exports: | | | | | | |
| Charges for the use of intellectual property | 107,521 | 93,003 | 7,672 | 100.0 | 86.5 | 7.1 |
| *Of which:* | | | | | | |
| Industrial processes | 36,333 | 33,818 | 4,185 | 100.0 | 93.1 | 11.5 |
| Trademarks | 14,340 | 10,930 | 360 | 100.0 | 76.2 | 2.5 |
| Research and development services | 22,446 | 14,231 | 7,018 | 100.0 | 63.4 | 31.3 |
| Imports: | | | | | | |
| Charges for the use of intellectual property | 32,551 | 20,394 | 15,219 | 100.0 | 62.7 | 46.8 |
| *Of which:* | | | | | | |
| Industrial processes | 18,847 | 13,499 | 9,880 | 100.0 | 71.6 | 52.4 |
| Trademarks | 4,524 | 2,103 | 3,111 | 100.0 | 46.5 | 68.8 |
| Research and development services | 22,170 | 18,517 | 2,358 | 100.0 | 83.5 | 10.6 |

Notes. Data for all U.S. companies are from BEA's survey of transactions in selected services and intellectual property with foreign persons."Three-way links" refers to BRDIS-USDIA-services trade link and BRDIS-FDIUS-services trade link. For an illustration of two-way vs. three-way links, see Figure 1. R&D services for 2010 include transactions in testing services. Data for matched U.S. parent companies and matched majority-owned U.S. affiliates (U.S.-located foreign-owned companies) should not be summed to attempt a U.S. aggregate related to MNEs because some U.S. parent companies of foreign affiliates are themselves owned by a foreign parent company. Linked data are not weighted. Detail may not add to total because of rounding.
Sources: National Science Foundation, National Center for Science and Engineering Indicators, U.S. Bureau of Economic Analysis, and U.S. Census Bureau, R&D Data Link Project 2008–2010.

services of $14.2 billion, in contrast to the positive U.S. trade balance in R&D services for all companies in 2010. Trade in R&D services, however, is only one of the channels through which U.S. parents can deliver their innovation-related services to foreigners. As will be shown later, parents had a large positive balance on their trade in other services.

Slightly more than half of the imports of R&D services by the linked U.S. parent companies were by parent companies in manufacturing, and another 40 percent were by those in information (table 3). Exports of R&D services by the matched U.S. parent companies were predominantly by manufacturing companies; these companies accounted for slightly more than 80 percent of these exports. This share is comparable with manufacturing's share of the domestic R&D performance of parent companies. For both exports and imports, trade in R&D services by the matched U.S. parent companies was predominantly with their foreign affiliates.

U.S. parents' trade in R&D services reflects both services performed by one unit of the MNE for another and allocated expenses related to the firm's R&D. Imports of R&D services by U.S. parents are likely to reflect reimbursement of foreign affiliates for their R&D expenses, cost-sharing arrangements for the development of new technology by affiliates, or payments for services provided to the parent. A substantial amount of R&D is conducted by foreign affiliates of U.S. MNEs to meet local tastes or to benefit from proximity to new sources of knowledge or talent.[8]

In contrast to their negative balance in R&D services, U.S. parent companies matched in the three-way link had a large positive balance in charges for the use of intellectual property in 2010. The linked U.S. parents' receipts (exports) of $93.0 billion exceeded their payments (imports) of $20.4 billion by more than fourfold (table 2). Matched U.S. parents accounted for 86 percent of U.S. receipts for the use of intellectual property abroad, a share substantially above their 63 percent share of U.S. payments for the use of foreign intellectual property.

About a third of the total receipts of matched U.S. parents for charges for the use of their intellectual property consisted of charges for industrial processes, and another ninth consisted of charges for trademarks. The remaining receipts consisted of charges for computer software, franchise fees, audiovisual and related products (including movies and television programming, books and sound recordings, and broadcasting and recording of live events), and other intellectual property.[9] The matched U.S. parents accounted for 93 percent of total U.S. receipts for industrial processes

8. See, for example, Walter Kuemmerle, "The Drivers of Foreign Direct Investment into Research and Development: An Empirical Investigation," *Journal of International Business Studies* 30, no. 1 (First Quarter of 1999): 1–24 and Heather Berry and Aseem Kaul, "Global Sourcing and Foreign Knowledge Seeking: A Formal Model and Empirical Analysis," forthcoming in *Management Science*.

9. Detail on these other subcategories of charges for the use of intellectual property was not tabulated for the data from the three-way links.

**Table 3. U.S. Trade in Selected Services for Matched U.S. Parent Companies in Three-Way Link by Type of Service and Industry of Parent, 2010**

(Millions of dollars)

| | All industries | Manufacturing | Information | Professional, scientific, and technical services | Other industries |
|---|---|---|---|---|---|
| Exports: | | | | | |
| Charges for the use of intellectual property | 93,003 | 43,773 | 44,991 | 551 | 3,688 |
| *Of which:* | | | | | |
| Industrial processes | 33,818 | 29,414 | 3,611 | 116 | 677 |
| Trademarks | 10,930 | 9,536 | 1,114 | 109 | 172 |
| Research and development services | 14,231 | 11,697 | 1,048 | 1,181 | 305 |
| Imports: | | | | | |
| Charges for the use of intellectual property | 20,394 | 15,899 | 4,183 | 112 | 200 |
| *Of which:* | | | | | |
| Industrial processes | 13,499 | 13,019 | 393 | 37 | 51 |
| Trademarks | 2,103 | 1,776 | 193 | 9 | 125 |
| Research and development services | 18,517 | 10,426 | 7,243 | 771 | 77 |

NOTES. "Three-way link" refers to BRDIS-USDIA-services trade link. For an illustration of two-way vs. three-way links, see Figure 1. R&D services for 2010 include transactions in testing services. Data are not weighted. Detail may not add to total because of rounding. Industry classification is based on BRDIS according to dominant business code for domestic R&D performance where available. For companies that did not report business codes, classification used for BRDIS was assigned.

Sources: National Science Foundation, National Center for Science and Engineering Indicators, U.S. Bureau of Economic Analysis, and U.S. Census Bureau, R&D Data Link Project 2008–2010.

and for 76 percent of total U.S. receipts for trademarks.

Almost all of the matched parent receipts for charges for the use of intellectual property were accounted for by parents in the manufacturing and information industries (table 3). The share for the information industry was about the same as the share for manufacturing, each just under 50 percent. Matched parents in manufacturing alone accounted for 87 percent of the receipts for both industrial processes and trademarks in the three-way link.

Charges for industrial processes accounted for two-thirds of the payments (imports) for charges for the use of intellectual property by matched U.S. parent companies (table 2). Charges for trademarks accounted for 10 percent. Matched U.S. parents accounted for a dominant share (72 percent) of total U.S. payments for industrial processes, but they accounted for less than half of U.S. payments for trademarks.

About three-fourths of the payments for charges for the use of intellectual property by matched parent companies was by parent companies in manufacturing, and an additional fifth was by parents classified in the information industry (table 3). Parents in manufacturing accounted for almost all of the linked-parent payments for industrial processes and for more than 80 percent of the linked-parent payments for trademarks.

## Results for U.S. Affiliates

Majority-owned U.S. affiliates that engage in both R&D and trade in services performed $32.0 billion in domestic U.S. R&D in 2010. They accounted for 12 percent of the domestic R&D performance of all U.S.-located companies and 81 percent of domestic R&D performance of majority-owned U.S. affiliates that perform R&D identified in the two-way link (table 1). Affiliates in manufacturing conducted almost 90 percent of the domestic R&D performance of affiliates in the three-way link.

The domestic R&D labor force of majority-owned U.S. affiliates in the three-way link was approximately 116,000 employees. These employees accounted for 8 percent of the domestic R&D employment of all R&D-performing U.S. companies and for 75 percent of the domestic R&D employment of matched R&D-performing U.S. affiliates in the two-way link. For U.S. affiliates in the three-way link, their R&D employment accounted for 9.0 percent of their total domestic employment, which is higher than both the 7.6 percent R&D-employment share for all R&D-performing U.S. companies and the 7.3 percent share for R&D-performing U.S. affiliates identified in the two-way link.

In contrast to the linked U.S. parent companies, majority-owned U.S. affiliates in the three-way link had a large positive balance in R&D services. Their exports were $7.0 billion and accounted for 31 percent of total U.S. exports of R&D services. Their imports were $2.4 billion and accounted for 11 percent of total U.S. imports of R&D services (table 2). Three-fourths of their exports of R&D services were by affiliates in manufacturing, and another fifth were by affiliates in professional, scientific, and technical services (table 4). More than 90 percent of their imports of R&D services were by affiliates classified in manufacturing. Foreign MNEs often find the United States to be an attractive location for their R&D activities because of the access to new sources of knowledge, a supply of skilled labor, and opportunities for collaboration through proximity to

**Table 4. U.S. Trade in Selected Services for Matched U.S. Affiliates in Three-Way Link by Type of Service and Industry of Affiliate, 2010**

(Millions of dollars)

| | All industries | Manufacturing | Information | Professional, scientific, and technical services | Other industries |
|---|---|---|---|---|---|
| Exports: | | | | | |
| Charges for the use of intellectual property | 7,672 | 6,350 | 1,031 | 185 | 106 |
| *Of which:* | | | | | |
| Industrial processes | 4,185 | 3,363 | 716 | 24 | 82 |
| Trademarks | 360 | 310 | 20 | 26 | 4 |
| Research and development services | 7,018 | 5,438 | 54 | 1,317 | 209 |
| Imports: | | | | | |
| Charges for the use of intellectual property | 15,219 | 12,714 | 2,191 | 111 | 202 |
| *Of which:* | | | | | |
| Industrial processes | 9,880 | 9,506 | 203 | 61 | 110 |
| Trademarks | 3,111 | 3,017 | 3 | 11 | 80 |
| Research and development services | 2,358 | 2,213 | 29 | 87 | 29 |

Notes. "Three-way link" refers to BRDIS-FDIUS-services trade link. For an illustration of two-way vs. three-way links, see Figure 1. R&D services for 2010 include transactions in testing services. Data are not weighted. Detail may not add to total because of rounding. Industry classification is based on BRDIS according to dominant business code for domestic R&D performance where available. For companies that did not report business codes, classification used for BRDIS was assigned.

Sources: National Science Foundation, National Center for Science and Engineering Indicators, U.S. Bureau of Economic Analysis, and U.S. Census Bureau, R&D Data Link Project 2008–2010.

leading universities and clusters of industrial research activity.[10]

In trade connected with charges for the use of intellectual property, the matched U.S. affiliates ran a negative trade balance. Their payments (imports) of $15.2 billion were twice as large as their receipts (exports) of $7.7 billion (table 2). Their payments accounted for almost half of all U.S. payments for the use of intellectual property, while their receipts accounted for only 7 percent of all U.S. receipts for the use of intellectual property.

About two-thirds of the payments by matched U.S. affiliates for the use of intellectual property consisted of charges to the affiliates for industrial processes, and another 20 percent consisted of charges for trademarks. Matched affiliates in the three-way link accounted for slightly more than half of total U.S. payments for the use of industrial processes and for about 70 percent of U.S. payments for the use of trademarks. For both industrial processes and trademarks, almost all of the payments by matched affiliates were charges to affiliates classified in manufacturing (table 4).

Slightly more than half of the receipts by matched affiliates for the use of intellectual property consisted of charges for industrial processes; charges for trademarks accounted for only 5 percent of the receipts. Affiliates in manufacturing accounted for about 80 percent of the receipts by matched affiliates for industrial processes; affiliates classified in the information industry accounted for most of the remaining receipts. Manufacturing affiliates also accounted for more than 85 percent of the receipts by matched affiliates for trademarks.

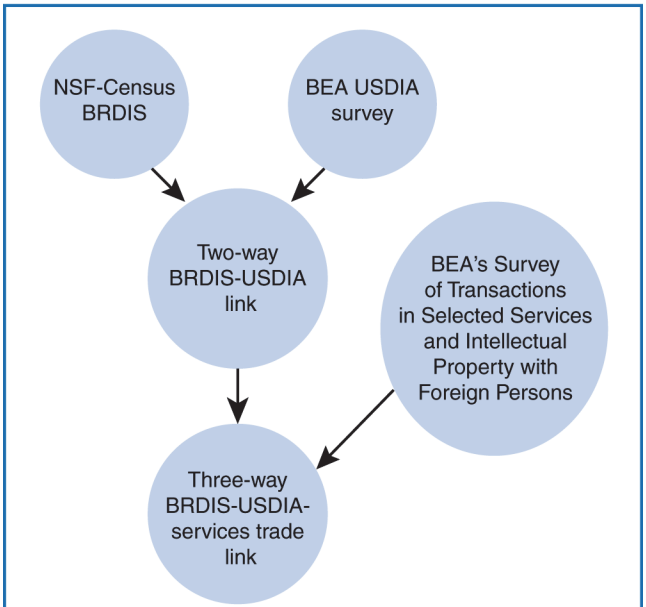
10. See Berry and Kaul.

### Methodology for the Data Link Project

The Business R&D and Innovation Survey (BRDIS) was linked with each of the two activities of MNE surveys from the Bureau of Economic Analysis—the survey of U.S. direct investment abroad (USDIA) and the survey of foreign direct investment in the United States (FDIUS). The master files from each of these two-way links (BRDIS-USDIA and BRDIS-FDIUS) for 2010 were then separately linked via common company identifications with microdata for the sum of the four quarters of 2010 from the BEA Survey of Transactions in Selected Services and Intellectual Property With Foreign Persons, resulting in three-way links for each of the MNE subsets covered in this article (U.S. MNE parent companies and majority-owned U.S. affiliates of foreign MNEs). Validity checks of matches and selected cross-survey data were performed using, for example, information from previous two-way links.

Linked data shown in this article are based on unweighted aggregates. See chart 1 for an illustration of the three-way link for matching U.S. MNE parent companies using BEA's USDIA survey. Similar steps were performed to complete the three-way link for majority-owned U.S. affiliates of foreign MNEs using 2010 data from BEA's FDIUS survey, BEA's services trade survey, and BRDIS.

**Chart 1. The 'Three-Way Link' (BRDIS-USDIA-Services Trade) for U.S. MNE Parent Companies**




BRIDS Business R&D Innovation Survey
MNE Multinational enterprise
NSF National Science Foundation
USDIA U.S. direct investment abroad

National Science Foundation and U.S. Bureau of Economic Analysis

## Conclusion

In 2010, domestic R&D employment as a share of total domestic employment was higher for MNEs in the United States that engaged in both R&D and international trade in innovation-related services than for MNEs that perform U.S. R&D but do not engage in U.S. innovation-related trade in services. U.S. MNE parent companies in the three-way link accounted for dominant shares of U.S. exports and imports of services connected with both charges for the use of intellectual property and R&D services. Further, matched U.S. MNE parent companies had a large positive balance in charges for the use of intellectual property, but they had a negative balance in trade in R&D services. In contrast, the linked U.S. affiliates had a negative balance in trade connected with charges for the use of intellectual property but a positive balance in trade in R&D services.

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At the U.S. Census Bureau, Richard Hough, Assistant Chief for R&D and Special Surveys of the Economic Reimbursable Surveys Division, and Michael Flaherty, Chief of the Research, Development, and Innovation Surveys Branch, directed the Census Bureau's portion of the project.

Jeffrey P. Kellner of the Census Bureau Research, Development, and Innovation Surveys Branch and Francisco Moris (NSF) performed the three-way microdata links and reviewed linked data and tabulations.

At the U.S. Bureau of Economic Analysis, Raymond Mataloni Jr., Assistant Chief for Research and Analysis of the Balance of Payments Division (BPD), directed the agency's portion of the project. Fritz Mayhew of the Merchandise Trade Branch of BPD prepared the BE–125 data files to be transferred to the Census Bureau for linking. Daniel Powell of the Operations Systems and Analysis Branch of the Direct Investment Division performed the disclosure analysis on the tabulations.