

## U.S.-CHINA R&D LINKAGES: DIRECT INVESTMENT AND INDUSTRIAL ALLIANCES IN THE 1990s

by Francisco Moris

Foreign direct investment (FDI) and research and development (R&D)-related activity by U.S.-owned companies in mainland China (henceforth China) expanded substantially during the 1990s, especially in the information technology sector.<sup>1</sup> U.S. affiliates in China were among the most R&D-intensive overseas affiliates in 2000, making China the eleventh largest host of U.S. R&D expenditures overseas, up from the number 30 spot in 1994. Investment by U.S. companies through majority-owned affiliates grew, while the frequency of new industrial R&D alliances dropped. However, U.S. companies and other organizations still participate in more industrial R&D alliances with Chinese partners than do entities from other investing countries.

During the 1990s China initiated a number of economic and science and technology policies designed to foster economic growth, including steps for attracting foreign investment (OECD 2002; UNCTAD 2001). In the same period, multinational corporations (MNCs) from advanced economies began increasing technology-related activities abroad in a number of emerging markets, including China, to exploit local capabilities, adapt technology for local markets or regulations, and reduce costs and risks through collaboration with international research and development (R&D) partners.

This report analyzes trends in R&D-related FDI and alliance activity by U.S. MNCs in China. It uses FDI data from the U.S. Bureau of Economic Analysis (BEA) and data on industrial alliances from the Joint

<sup>1</sup>FDI is the ownership of productive assets outside the home country by multinational corporations. Data for Hong Kong and Taiwan are not included in this report.

Ventures/Alliances database of Thompson Financial (SDC Platinum). Two major types of FDI data are used in this report: (1) direct investment position and related capital outflows, and (2) operations data (e.g., gross product, employment, R&D expenditures) of affiliates or subsidiaries. Operations data in this report are for majority-owned affiliates of U.S. parent companies.<sup>2</sup>

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*China became the eleventh largest host of U.S. R&D expenditures overseas in 2000, up from the number 30 spot in 1994, after U.S. affiliates in that country more than doubled.*

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Industrial or business alliances involve for-profit partners and may or may not include nonprofit organizations, such as universities or government units. Industrial R&D alliances target research or technology objectives, along with other business goals.<sup>3</sup>

### U.S. Direct Investment and R&D Activities in China

From 1994 to 2001, the direct investment position, or cumulative investments, of U.S. MNCs in China more than quadrupled, from \$2.6 billion to \$10.5 billion (table 1). After adjusting for inflation, cumulative investments grew at an average annual rate of 20.1 percent, about

<sup>2</sup>Majority-owned affiliates of U.S. parent companies are those affiliates in which the combined ownership of all U.S. parents is more than 50 percent.

<sup>3</sup>Data are primarily from English-language news sources and public documents. Agreements involving small firms or less publicized industrial sectors are likely to be underrepresented.



TABLE 1. U.S. foreign direct investment in China: 1994–2001

Year	Direct investment position	Direct investment capital outflows	Gross product (value added)	R&D expenditures	R&D/GP ratio (percent)	Number of affiliates
Billions of current U.S. dollars						
1994	2.557	1.232	0.678	0.007	1.0	172
1995	2.765	0.261	1.092	0.013	1.2	183
1996	3.848	0.933	2.073	0.025	1.2	223
1997	5.150	1.250	3.194	0.035	1.1	274
1998	6.350	1.497	3.004	0.052	1.7	330
1999	7.951	1.947	3.945	0.319	8.1	456
2000	9.861	1.817	5.516	0.506	9.2	454
2001	10.526	1.225	NA	NA	NA	NA

NA = Not available.

GP = Gross product.

NOTES: Data for 2000 and 2001 are preliminary. The U.S. Bureau of Economic Analysis (BEA) defines direct investment as ownership or control of 10 percent or more of the voting securities of a business in another country. Direct investment capital outflows consist of net equity capital outflows, reinvested earnings, and intercompany debt outflows from U.S. parent companies to their foreign affiliates. Direct investment position is a cumulative measure of the financing provided by U.S. parents to their foreign affiliates in the form of equity and debt, recorded at historical cost (net book value). Data for gross product, R&D expenditures, and number of affiliates are for majority-owned affiliates of U.S. parent companies. Majority-owned affiliates of U.S. parent companies are those affiliates in which the combined ownership of all U.S. parents is more than 50 percent.

SOURCE: U.S. Bureau of Economic Analysis, Survey of U.S. Direct Investment Abroad, Washington, DC, annual series. Available at [www.bea.gov/bea/di/di1usdop.htm](http://www.bea.gov/bea/di/di1usdop.htm).

twice the average inflation-adjusted annual growth rate of total overseas investments by U.S. companies during the same period. U.S. investments in China appear to be highly targeted: in 2001 China represented 7.6 percent of the global U.S. FDI position in electronic and other electrical equipment but only 0.9 percent of global U.S. investments in all industries (BEA 2003).

Investment growth by U.S. companies in China was fueled by annual capital investment flows exceeding one billion dollars for most years since 1994 (table 1). The number of majority-owned, U.S.-owned affiliates in China reached 454 in 2000, more than double the number in 1994, representing just over 2 percent of all majority-owned U.S. affiliates overseas.

In 2000 these affiliates had a gross product (value added) of \$5.5 billion, sales of \$26.0 billion, and employed 240,400 workers (BEA 2003). The largest industry in terms of gross product was computer and electronic products at \$2.0 billion, about 5 percent of the \$41.9 billion in U.S.-owned overseas gross product by this industry. This level of activity made China the eighth-largest worldwide location for U.S.-owned computer and electronic products subsidiaries in 2000 and the third largest in the Asia-Pacific region after Singapore (\$5.6 billion) and Japan (\$3.0 billion). The

second largest sector of U.S.-owned gross product in China was chemicals manufacturing, with \$899 million.

Even though China's R&D spending relative to gross domestic product was below 1 percent during the 1990s, reaching 1 percent only in 2000,<sup>4</sup> a substantial number of MNCs from advanced economies have established R&D or technical centers in China in recent years, either as stand-alone facilities or integrated with manufacturing or services operations. These facilities support activities in the country or in the Asia-Pacific region through a combination of wholly owned subsidiaries, joint ventures, and contractual agreements in key industrial sectors, such as telecommunications, electronics, chemicals, and auto manufacturing. U.S. companies with major R&D activities or facilities in China include DuPont, Ford, General Electric, General Motors, IBM, Intel, Lucent Technologies, Microsoft, Motorola, and Rohm and Haas.<sup>5</sup>

Majority-owned affiliates of U.S. parent companies in China performed \$506 million in R&D spending in 2000,

<sup>4</sup>By comparison, the average ratio of R&D relative to gross domestic product for all Organisation for Economic Co-operation and Development (OECD) countries for the same period exceeded two percent from 1991 to 2000 (OECD 2002, table 9.1, figure 9.3).

<sup>5</sup>Source: Individual company Web sites. Accessed September 2003.

compared with only \$7 million as recently as 1994 (table 1). The level of R&D expenditures by U.S.-owned companies in China in 2000 represented 2.6 percent of total overseas R&D by U.S. companies, compared with less than one-half of 1 percent earlier in the decade. The vigorous investment activity over the late 1990s propelled China as a location of U.S.-owned R&D spending from a rank of 30 in 1994 to 11 in 2000. Furthermore, U.S. affiliates in China invest relatively more in R&D compared with U.S. affiliates in other countries, as measured by the ratio of R&D spending to gross product. In 2000 this ratio was 9.2 percent for U.S. affiliates in China, compared with 3.3 percent for the aggregate of U.S. affiliates in all host countries.

In 2000, R&D spending by U.S. affiliates in China was concentrated in the manufacturing sector (\$491 million);<sup>6</sup> another \$15 million in R&D spending was performed in the professional, scientific, and technical services industry, which includes computer system designs and R&D services.

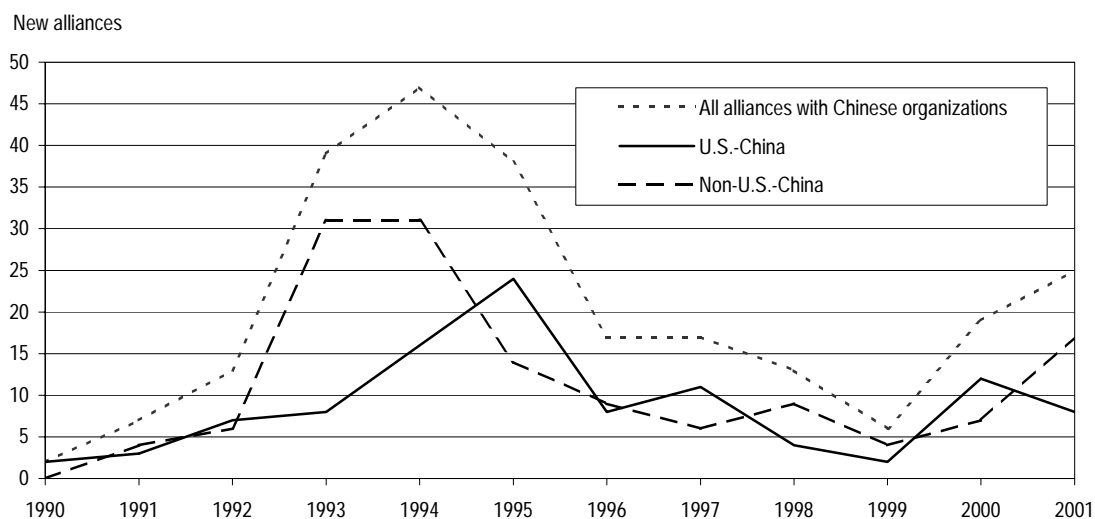
### Trends in U.S.-China Industrial R&D Alliances

Industrial R&D alliances are separate business organizations that collaborate to achieve specific research or

technology development objectives. Some include non-profit partners, such as universities or government agencies. An alliance can be organized as a legally distinct business entity (joint venture or equity-based alliance) or as a short-term contractual or nonequity alliance. Joint ventures are a common entry vehicle for foreign investors in emerging markets, such as China. Contractual alliances focus on shorter-term projects and are more likely to have nonprofit members. China has encouraged collaboration in scientific research as a policy goal since 1985 and reaffirmed this policy in 1995 (IDRC 1997).

According to the Thomson Financial Joint Ventures/Alliances database, U.S. and Chinese-owned companies and other organizations formed 105 new business alliances with a large R&D component (U.S.-China R&D alliances) from 1990 to 2001. The highest annual frequency of partnerships was reached in the mid-1990s (figure 1). A slowdown after this peak coincided with an increase in majority-owned affiliates of U.S. companies in China (table 1) and may reflect a shift to wholly owned R&D facilities by companies with an established presence in the country.<sup>7</sup> Still, U.S. entities formed more business R&D alliances than did other

FIGURE 1. Industrial R&D alliances with Chinese-owned private and public organizations: 1990–2001



SOURCE: Thomson Financial Joint Ventures/Alliances database.

<sup>6</sup>No further details for the manufacturing sector were available due to disclosure limitations.

<sup>7</sup>For a discussion of policy changes in China in the late 1990s and their effects on foreign technology investments in that country see Walsh (2003:79, 89).

countries' organizations in China from 1990 to 2001. Over the same period, Japan had the second largest number of R&D partnerships with Chinese organizations (26), followed by Germany (15), the United Kingdom (14), Singapore (12), and Canada (11).

### Alliance Location and Partners

Ninety percent (94 of 105) of U.S.-China R&D alliances had activities in China. Of these, 79 had activities exclusively in China, 12 had activities in both the United States and China, and 3 had activities in China and elsewhere. The other 11 partnerships performed activities either exclusively in the United States or in other locations outside China, including Singapore and South Korea. Information on the location of alliances within China was not available for many entries of the database; however, most of the identified sites were in Beijing and Shanghai. Other cities hosting several R&D alliances were Tianjin, Guangzhou, and Shenzhen.

Eighty-one percent of the alliances had two members and the rest had either three or four members. A sizable proportion, at least 19 percent, had Chinese public or nonprofit participants, such as universities, R&D institutes, or government ministries. All but six of these partnerships were exclusively between U.S. and Chinese organizations. Likewise, most R&D alliances involving Chinese organizations and companies from Japan, Germany, the United Kingdom, Canada, and Singapore were organized as bilateral partnerships. This pattern is consistent with activities performed jointly with domestic companies aimed at adapting products or technologies to local markets and regulations—a common objective at early stages of foreign-based R&D activities.

### Organizational Forms

Although U.S.-China R&D alliances were equally divided between joint ventures and contractual alliances over the 12-year period from 1990–2001, most have been structured as contractual or nonequity alliances since 1996 (table 2). This increasing preference toward nonequity alliances matches overall trends in worldwide alliances by companies from advanced economies (NSF/SRS forthcoming). The trend toward nonequity arrangements in U.S.-China R&D alliances appears to be stronger in nonmanufacturing alliances.

TABLE 2. U.S.-China industrial R&D alliances by organizational form, industry sector, and selected industry: 1990–2001

Alliance category	1990–2001	1990–1995	1996–2001
Total industrial R&D alliances	105	60	45
Organizational form			
Joint ventures	53	41	12
Contractual alliances	52	19	33
Industry sector			
Manufacturing	46	35	11
Services	45	16	29
Trade/finance	6	4	2
Telecommunications	5	4	1
Primary resources <sup>1</sup>	3	1	2
Selected industry			
R&D services	25	1	24
Computer programming, data processing services	17	14	3
Pharmaceuticals	10	5	5
Instruments	8	8	0
Motor vehicles	6	3	3
Communications equipment	5	5	0
Computer manufacturing	4	4	0

<sup>1</sup> Agricultural products and oil and gas extraction.

NOTE: Data are the sum of new annual industrial R&D alliances involving at least one U.S. and one Chinese company or organization over the indicated years.

SOURCE: Thomson Financial Joint Ventures/Alliances database.

### Industrial Sectors and Activities

About 75 percent of U.S.-China R&D alliances between 1990 and 2001 were classified in seven industries: R&D services, computer programming and data processing services, pharmaceuticals, instruments, motor vehicles, communications equipment, and computer manufacturing (table 2).<sup>8</sup> In the late 1990s, the distribution of these alliances shifted from manufacturing to service industries. Two-thirds of the alliances in the services sector (29 of 45) were formed in 1996–2001, whereas only one-fourth of alliances in the manufacturing sector (11 of 46) were formed during the same period.

Alliances classified primarily in services, however, included manufacturing companies with complementary activities. For example, all but 4 of the 17 R&D alliances in computer programming and data processing

<sup>8</sup> Industry classifications are from the Standard Industrial Classification System (SIC).

services between 1990 and 2001 (table 2) involved computers, electronic components, or communications equipment manufacturers. Likewise, two-thirds of the alliances in R&D services were effectively information technology (IT) alliances, bringing together IT equipment manufacturers with specialized services companies. About one-fourth of R&D-services alliances involved pharmaceutical companies, most of which were established in 2000 or 2001.

A different profile of these partnerships is obtained by examining their major activities, regardless of industrial classification (table 3). About 30 percent performed only R&D. The rest combined R&D and other activities, such as marketing, manufacturing, technology transfer, and specialized services. R&D-only alliances were more frequent in the second half of the 1990s, whereas alliances combining R&D with marketing, manufacturing, or technology transfer were more frequent in the early 1990s.

### Conclusion

Activities by U.S. MNCs in China expanded substantially during the 1990s using two different investment modes: direct investment and nonequity business alliances. As part of this investment drive, U.S. affiliates in China became among the most R&D-intensive overseas affiliates in 2000.

The frequency of new U.S.-China industrial R&D alliances, especially equity alliances, declined after the

TABLE 3. U.S.-China industrial R&D alliances by type of activity: 1990–2001

Alliance activity	1990–2001	1990–1995	1996–2001
Total industrial R&D alliances	105	60	45
R&D and marketing	34	25	9
R&D only	31	11	20
R&D and manufacturing	29	21	8
R&D and technology transfer	19	18	1
R&D and specialized services <sup>1</sup>	13	4	9

<sup>1</sup> Specialized services include consulting, telecommunications, and educational services.

NOTE: Data are the sum of new annual industrial R&D alliances involving at least one U.S. and one Chinese company or organization over the indicated years. Details by alliance activity exceed total industrial R&D alliances because some R&D alliances conduct more than two major activities.

SOURCE: Thomson Financial Joint Ventures/Alliances database.

mid-1990s in contrast with an increase in U.S. majority-owned affiliates and R&D expenditures in China. U.S.-owned entities, however, still represent the largest block of foreign-based participants in these alliances among all investing countries in China. R&D alliances in the service industries—especially in the IT sector—are likely complementing a growing technology-intensive manufacturing base by U.S. MNCs in China.

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- For more information, contact
- Francisco Moris  
 Research and Development Statistics Program  
 Division of Science Resources Statistics  
 National Science Foundation  
 4201 Wilson Boulevard, Suite 965  
 Arlington, VA 22230  
 fmoris@nsf.gov



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