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Linkages Between US Firms and Global Markets for IT Products

The US market for IT products is by far the largest in the world. However, the demand for these products is expanding rapidly abroad, particularly in the developing world. There is increased production abroad as well, particularly of IT hardware. And finally there is a dramatic move toward greater spending on software and IT services, particularly in the industrial economies. These patterns of global demand, along with the technological capabilities to increasingly fragment IT production, are what determine decisions by US producers as to which components of final demand to produce and where to locate production.

US multinational IT firms go abroad for cheaper components, particularly hardware components, which they can then recombine with domestic resources to produce competitively priced and higher value-added products for the domestic and global marketplace. In addition, US multinational IT firms go abroad to serve the local marketplace for IT services, in particular. The data show a dramatic pattern of US firms producing software and providing services through affiliates located in the country of sale.

The integration of globalized production and the movement of US IT firms toward producing software and services have implications for prices of IT products in the United States and for investment in IT throughout US industries, with follow-on consequences for sectoral and overall US productivity and growth. This chapter examines the foundations of globalized production. It looks at how the global marketplace is expanding, examines the integration of global production of US multinational IT firms,

considers the role for foreign IT firms in the US marketplace, and identifies the multinational firms that are players in the IT sector.

An Expanding Global Marketplace

Because there are many ways to measure IT and communications networks, it may be hard to accurately assess the growing importance of spending on technology around the world. But there is no question that the global IT and communications marketplaces are large and expanding.

These markets can be measured through production, expenditure, cross-border investment, and trade. However measured, the global markets for information and communications technology products has expanded much faster than global GDP, global merchandise trade, or global foreign direct investment (FDI) flows. As a benchmark, the annual growth of global real GDP averaged around 3 percent from 1993–2004; growth in the volume of trade in goods and services for the period was slightly more than 7 percent, and growth in current dollar FDI averaged 14 percent.[1]

Consider various measures of the global IT and communications markets:

- The value of global shipments of semiconductors, a fundamental input for both computers and communications equipment, quadrupled from about $50 billion in 1990 to about $213 billion in 2004, surpassing the technology-cycle high of $204 billion in 2000 and representing compound annual growth of 11 percent.[2]
- Worldwide spending on IT reached $1.2 trillion in 2003, for the first time surpassing the 2000 level (inflated by Internet/Y2K expenditure) and growing almost 10 percent per year as it emerged from the slowdown after 2001. Communications equipment in 2003 also surpassed its 2000 level for the first time, with global spending totaling roughly $1.2 trillion.[3]
- Global exports of IT goods increased from about 5.6 percent of global exports in 1990 to 9.1 percent in 2003, while the share of communications equipment rose from 1.8 to 3.1 percent.[4]

1. IMF's *World Economic Outlook* database, September 2005, and UNCTAD's *World Investment Report 2005*.

2. See Semiconductor Industry Association, www.sia-online.org/pre_statistics.cfm (accessed March 15, 2006).

3. See WITSA (2004, 23 and 27). Expenditure data exclude spending internal to a company for development and customization.

4. UN ComTrade database, http://unstats.un.org/unsd/comtrade (accessed September 30, 2005). IT goods defined as Standard International Trade Classification (SITC) revision 3 categories 751, 752, 759, and 776, while communications equipment defined at SITC revision 3 category 764.

- Worldwide FDI in electrical and electronic equipment manufacturing almost tripled from 1990 to 2003 to a stock of $279.8 billion, or 9.7 percent of the 2003 inward stocks of FDI in manufacturing (UNCTAD 2005, table A.I.4).
- International merger and acquisition activity in the IT and communications sectors experienced rapid increases in the late 1990s, declined somewhat after 2000, but remained high through 2003 compared to the mid-1990s.

Global Spending on IT and Communications Technology Products

This expenditure can be broken down into spending on IT (hardware, software, and services) and on networked communications-related hardware and transmission services. Although spending on all categories rose in all countries from 1993 to 2003, the composition changed over time and differs in a systematic way across the level of economic development. Appendix 2A examines the case of semiconductors, which highlights many of these trends.

First, consider global spending on IT versus communications. Each of these markets is huge, with spending of about $1.2 trillion in each category. In both markets, the United States accounts for about 45 percent of global spending. However, the patterns of growth through the technology cycle differ somewhat. Global spending on communications exhibits a greater boom and bust than global spending on IT, although for the United States, just the opposite is true. One rationale for the globalization of US producers of IT and communications equipment could be market diversification and the smoothing of the technology cycle (table 2.1).

Second, focus on global spending on IT products—hardware, software, and services. Although the industrial-country markets remain largest and therefore greatly influence global growth rates, there has been an evolution of rapid growth in IT spending from the industrial-country to the developing-country markets. From 1993 to 2003, the share of developing countries (defined here as countries that are not members of the Organization for Economic Cooperation and Development) in global expenditures on IT rose from 5.7 to 9.1 percent.[5] In addition to the shifting expenditure share toward the developing world, it is also apparent that these countries did not experience the "technology bubble." For example, there was a marked decline in the US growth rate of IT expenditure from 7.6 percent annually during the 1990s to only 2 percent during the

5. See WITSA (2002, 29; 2004, 23, 27). The methods of expenditure compilation in the two WITSA publications do not match completely, but for the purposes of this ratio comparison this methodological issue is not significant.

Table 2.1 Large and growing markets for IT

Rank	Country	2003 expenditure (billions of US dollars)	CAGR, 1993–2001 (percent)	CAGR, 2001–03 (percent)
IT spending[a]				
1	United States	472.9	7.6	1.2
2	Japan	136.3	2.8	–2.4
3	Germany	88.0	5.9	13.2
4	United Kingdom	77.0	8.4	7.8
5	France	69.6	6.4	14.5
6	Italy	35.8	29.1	13.1
7	China	30.5	6.2	24.5
8	Canada	29.3	5.9	10.1
9	Brazil	20.1	7.4	24.7
10	Netherlands	18.9	9.3	13.2
11	Australia	17.3	11.6	16.4
12	Korea	15.3	5.5	14.8
17	India	8.4	7.5	34.8
20	Mexico	7.0	18.7	11.9
21	South Africa	6.5	11.7	31.3
23	Taiwan	5.8	7.1	14.1
25	Russia	5.3	1.8	23.0
34	Ireland	2.6	9.2	11.2
35	Malaysia	2.4	12.3	13.1
39	Thailand	1.7	2.7	19.0
World total (70 countries)		1,182.2	6.9	6.5
Communications spending[b]				
1	United States	459.1	4.9	2.1
2	Japan	187.4	14.5	0.6
3	Germany	58.8	2.9	6.2
4	United Kingdom	55.4	9.1	4.3
5	France	43.8	4.9	6.9
6	China	40.4	26.0	4.7
7	Italy	30.0	7.5	5.8
8	South Korea	23.8	8.7	4.3
9	Canada	21.9	6.6	3.4
10	Spain	19.6	5.0	7.9
11	Brazil	18.4	19.0	0.8
13	Netherlands	16.0	7.4	6.5
14	India	15.4	19.6	4.7
16	Mexico	13.3	2.2	1.0
18	Taiwan	12.5	9.3	2.5
20	Russia	10.8	6.5	7.6
22	South Africa	8.8	5.8	8.4

(table continues next page)

Table 2.1 *(continued)*

Rank	Country	2003 expenditure (billions of US dollars)	CAGR, 1993–2001 (percent)	CAGR, 2001–03 (percent)
35	Malaysia	4.9	9.3	4.9
41	Ireland	3.7	12.0	2.1
42	Thailand	3.7	5.4	4.8
World total (70 countries)		1,232.0	8.5	3.1
IT hardware[b]				
1	United States	119.0	6.7	–2
2	Japan	53.2	2.4	–9
3	Germany	32.0	7.5	7
4	China	24.2	29.2	21
5	United Kingdom	23.1	9.2	1
6	France	17.9	5.6	7
7	Italy	12.2	7.6	7
8	Canada	11.0	7.5	10
9	Brazil	10.1	10.2	26
10	Korea	10.1	13.5	10
11	Australia	6.5	5.0	12
13	Netherlands	5.6	9.5	6
14	India	5.0	8.8	35
17	Mexico	4.4	20.1	15
18	Taiwan	3.7	12.5	14
20	Russia	3.1	–2.2	21
27	South Africa	2.8	5.2	27
31	Malaysia	1.5	11.9	9
34	Ireland	1.3	16.6	7
37	Thailand	1.0	6.0	14
World total (70 countries)		402.7	13.4	4
IT services[b]				
1	United States	248.9	11.7	1.7
2	Japan	68.5	7.9	2.5
3	France	38.6	14.8	16.9
4	United Kingdom	38.3	5.3	10.5
5	Germany	37.6	9.7	16.5
6	Italy	16.9	7.9	16.1
7	Canada	13.2	7.7	9.4
8	Netherlands	8.1	10.4	15.9
10	Brazil	7.4	39.2	24.5
11	Australia	7.2	11.0	17.6
15	Korea	3.9	13.2	27.1
17	China	3.3	9.6	53.9
20	India	2.5	10.9	34.9

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Table 2.1 Large and growing markets for IT *(continued)*

Rank	Country	2003 expenditure (billions of US dollars)	CAGR, 1993–2001 (percent)	CAGR, 2001–03 (percent)
21	South Africa	2.4	8.9	34.1
23	Mexico	2.0	19.0	8.0
24	Russia	1.6	7.9	26.9
28	Taiwan	1.2	0.8	13.6
34	Ireland	.8	10.8	15.6
41	Malaysia	.5	10.6	24.2
47	Thailand	.3	–4.0	20.6
World total (70 countries)		554.3	10.2	7.2
IT software[b]				
1	United States	105.0	14.4	3
2	Germany	18.5	7.7	19
3	United Kingdom	15.6	15.3	12
4	Japan	14.6	14.4	4
5	France	13.0	12.6	19
6	Italy	6.6	7.1	18
7	Netherlands	5.2	14.2	17
8	Canada	5.2	14.6	11
9	Australia	3.6	11.7	22
10	China	3.1	18.9	36
14	Brazil	2.5	19.4	21
18	Korea	1.3	48.5	21
19	South Africa	1.3	30.7	35
22	Taiwan	.8	6.2	16
23	India	.8	14.8	35
26	Mexico	.6	6.6	7
28	Russia	.6	19.4	22
31	Ireland	.5	19.3	17
35	Malaysia	.4	14.4	16
38	Thailand	.4	15.9	34
World total (70 countries)		225.2	13.4	10

CAGR = compound annual growth rate

a. Includes IT hardware, services, and software spending but excludes communications and internal spending. For 1993–2001, CAGR also includes office equipment and internal spending, and the world total consists of only 55 countries. China data do not include Hong Kong.

b. For 1993–2001, CAGR also includes internal spending, and the world total consists of only 55 countries. Software spending includes purchased or leased packaged software, as well as outsourced software development. Internal software development and customization are excluded. China data do not include Hong Kong.

Note: Cells may not add up due to rounding.

Source: WITSA (2002, 28–29, 33–34; 2004, 7–12).

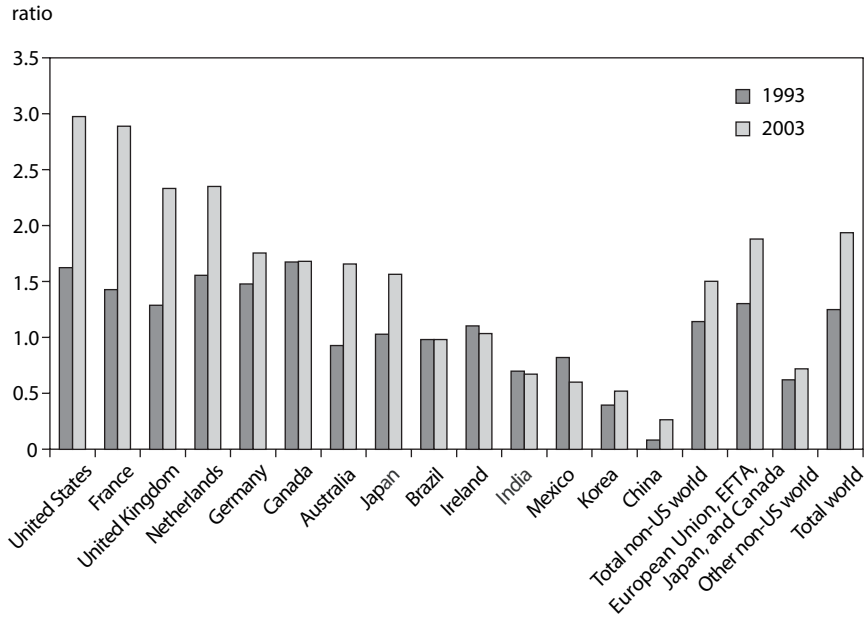
postbubble recovery period (2000–2003). The large weight of the United States and other industrial economies lowered the average annual global growth rate of IT spending from 6.9 percent over 1993–2001 to only 3.7 percent from 2001–03—not much higher than average world GDP growth of 3.1 percent for this recovery period.[6] But, for the developing world, growth in IT spending continued unabated. IT spending in China and India, for example, grew 20 percent or more per year throughout the period, with China at $31 billion (totaling $75 billion including communications spending) rising to become the sixth largest IT market in the world by 2003, ahead of Italy and Canada. From the standpoint of incentives facing US companies, some of these developing-country markets are not only big, they are also growing fast, and more rapidly than industrial-country markets.

Third, consider global spending patterns on IT goods versus software and services (table 2.1). The US market dominates the global totals, accounting for more than 30 percent of global spending on IT hardware and an even more dominant near 50 percent of global spending for IT services and software. Global expenditure patterns on the different components of the IT package (hardware, services, and software) suggest a trend toward increased spending in the future on IT services and software. This pattern of spending on the various parts of the IT package is exhibited by almost all countries (figure 2.1), with the trend most notable in the industrial countries. But even for many developing countries, spending on IT hardware is now exceeded by spending on software and services that operate on the installed base, as can be seen in the "other non-US world" category in figure 2.1.

The US market, where the penetration of IT into business has been the most pervasive, is not only the largest market but also the "front-runner," that is, the one where software and services as a ratio to IT hardware spending is the highest. Three times as much money is spent (data in nominal dollars) on IT services and software in the United States as on IT hardware, with other large industrialized economies approaching similar multiples. While the demand for hardware is growing fastest in the developing countries, software and services expenditure in those nations has been a bit delayed (albeit exhibiting rapid growth from very modest bases), as these locations wait for hardware and communications infrastructure to be put into place. For developing economies, there is still much to do to create an installed based of IT hardware, so the ratio of services and software to hardware is much lower. In addition, IT software

6. IMF's *World Economic Outlook* database, September 2004, www.imf.org (accessed September 30, 2005). It must be emphasized that these expenditures are denominated in market exchange rate current dollars, so for some countries there may be an exchange rate factor affecting the growth in expenditure in dollars as opposed to the growth rate in local currencies or on a purchasing power parity (PPP) basis.

Figure 2.1 Ratio of software and services to hardware spending, 1993 and 2003



EFTA = European Free Trade Association

Source: WITSA (2002, 32–34; 2004, 8–10).

and especially services must be tailored to local needs, at the very least in the local language and suited to the local business milieu. Going forward, once the hardware penetration rates reach those of the industrial countries, the demand for software and services likely will explode, particularly once domestic and foreign (including US) firms can locate and serve the domestic market.

Behind these ratios the data reveal dramatic growth rates both in IT hardware and in services and software. IT hardware spending in large emerging markets—including China, India, and Mexico, but not Brazil or Russia—posted double-digit growth rates for the post–tech bubble period, even as industrial-country spending slowed. China rose to be the world's fourth largest IT hardware market in 2003, poised to overtake Germany, while Brazil was in the global top 10 for IT hardware market size. In the market for IT services and software as well, growth was at double-digit rates even during the recovery period after the technology bust. In particular, China and India stand out with spending on IT services increasing from small bases by annual average growth rates, respectively, of 37 and 22 percent since 2001. Developing countries have seen continued double-digit growth rates in IT software, albeit from small bases, throughout the period

from 1993 to 2003. An important issue, particularly relevant for emerging markets, is to what extent the spending on IT in these countries is destined for domestic use. It appears to vary considerably across the developing world, with consequences for economic well-being (see chapter 3).

In sum, the United States is still the biggest market overall and has experienced the biggest boom-bust technology cycle. Expenditures on software and services exceed that for IT hardware in the United States, which is also the case for other industrial countries. Growth abroad did not experience the boom and bust, and is growing much more rapidly, although from a smaller base, particularly in developing countries. In those countries, growth is more balanced in that it is quite rapid for all IT categories (hardware, services, and software) as well as for communications equipment. This trend in global markets toward more rapid growth in demand abroad and increasing demand for services and software is the environment in which US firms operate, and it creates the incentives to which they respond in terms of choosing locations for production and sale.

Fragmentation of Global Production Patterns

As global markets have grown, new players in global trade have emerged and trade in IT goods and communications equipment has become less concentrated in a few producers in the industrial countries (tables 2.2a and 2.2b). In terms of concentration of IT exports, the top five countries in global IT exports accounted for 49 percent of global exports in 2004, down from 62 percent in 1990. (The numbers are almost identical for communications equipment.) From 1990 to 2004, the US share shrank from 19 to 11 percent of global IT exports, and Japan's share dropped from 20 to 8 percent. Powerhouse exporters in China, Malaysia, Mexico, Taiwan, and Korea vaulted in the ranks of IT exporters. On the import side for both IT and communications, there has been less change in the top five, but nations have changed within that group. The US share of global imports of IT slipped from the number one ranking at 21 percent to number two (if China and Hong Kong are taken together) at 15 percent. One reason for the new entrants is the Information Technology Agreement (box 2.1).

Comparing country rankings for imports and exports points to the importance of two-way trade in IT and communications products, which is a sign of the globalization of production. For some countries, two-way trade goes along with domestic IT and communications spending, while for others that trade is divorced from domestic spending patterns. The most striking example of the latter situation is Singapore, which is such a small market for IT spending that it does not even appear in table 2.1. But Singapore is a huge importer and exporter of IT goods. Similarly, Malaysia is ranked relatively low in the table on IT hardware spending (table 2.1), even though it is an important two-way trader. On the other hand, Korea is the ninth

Table 2.2a Country ranking and concentration of global IT exports and imports, 1990, 2000, and 2004[a] (percent)

	1990			2000			2004		
Rank	**Country**	**Share of world total**	**Cumulative**	**Country**	**Share of world total**	**Cumulative**	**Country**	**Share of world total**	**Cumulative**
Exports									
1	Japan	20.40	20.40	United States	16.97	16.97	China	14.31	14.31
2	United States	19.28	39.68	Japan	14.05	31.01	United States	11.01	25.32
3	United Kingdom	7.71	47.39	Singapore	9.80	40.81	Singapore	8.72	34.04
4	Former West Germany	7.35	54.74	Korea	6.55	47.36	Japan	7.91	41.95
5	Singapore	6.87	61.61	Taiwan	6.41	53.77	Germany	6.89	48.84
6	Taiwan	5.90	67.51	United Kingdom	5.64	59.41	Taiwan	6.40	55.23
7	France	4.39	71.90	Malaysia	5.56	64.97	Netherlands	5.89	61.13
8	Korea	4.30	76.21	Netherlands	4.71	69.68	Malaysia	5.44	66.56
9	Netherlands	4.20	80.40	Germany	3.66	73.34	Korea	5.17	71.73
10	Italy	3.14	83.54	Ireland	3.38	76.72	United Kingdom	4.08	75.82
11	Malaysia	2.67	86.21	France	3.24	79.95	Mexico	2.77	78.58
12	Ireland	2.58	88.80	Philippines	3.05	83.00	France	2.69	81.28
13	Canada	2.12	90.92	China	3.05	86.06	Ireland	2.36	83.64
14	Hong Kong	1.41	92.33	Thailand	2.14	88.20	Philippines	2.29	85.93
15	Thailand	1.31	93.64	Mexico	1.92	90.12	Canada	1.40	87.33
16	Sweden	0.88	94.52	Canada	1.62	91.74	Italy	1.34	88.67
17	Belgium-Luxembourg	0.74	95.25	Italy	1.50	93.24	Belgium	1.09	89.76
18	Austria	0.67	95.93	Hong Kong	1.12	94.36	Hong Kong	0.87	90.63
19	Spain	0.62	96.54	Belgium	0.70	95.06	Spain	0.79	91.42
20	Switzerland	0.45	96.99	Hungary	0.51	95.57	Hungary	0.78	92.20
21	Mexico	0.32	97.32	Indonesia	0.48	96.05	Czech Republic	0.72	92.92
22	Israel	0.30	97.62	Spain	0.44	96.49	Australia	0.55	93.47
23	Denmark	0.29	97.91	Austria	0.41	96.90	Austria	0.54	94.01
24	China	0.27	98.18	Israel	0.41	97.30	Sweden	0.53	94.54
25	Philippines	0.23	98.41	Sweden	0.38	97.68	Switzerland	0.46	95.00

Imports									
1	United States	20.56	20.56	United States	20.26	20.26	United States	14.79	14.79
2	Former West Germany	9.74	30.30	Japan	6.68	26.93	China	12.47	27.25
3	United Kingdom	8.99	39.29	Singapore	6.66	33.59	Hong Kong	7.61	34.86
4	France	6.54	45.83	Germany	5.92	39.50	Germany	6.47	41.32
5	Italy	4.48	50.31	United Kingdom	5.91	45.41	Singapore	6.20	47.52
6	Singapore	4.47	54.78	Hong Kong	5.44	50.85	Japan	5.77	53.29
7	Netherlands	4.46	59.24	Taiwan	4.80	55.65	Netherlands	5.03	58.32
8	Japan	4.38	63.62	China	4.51	60.16	United Kingdom	4.30	62.63
9	Canada	3.80	67.42	Netherlands	4.33	64.49	Malaysia	4.21	66.83
10	Taiwan	3.64	71.06	Malaysia	4.08	68.57	Taiwan	3.93	70.76
11	Korea	3.22	74.28	Korea	3.97	72.54	Korea	3.47	74.23
12	Hong Kong	3.03	77.31	France	3.47	76.01	France	2.89	77.12
13	Malaysia	2.28	79.58	Canada	2.87	78.88	Mexico	2.84	79.95
14	Spain	2.12	81.70	Mexico	2.76	81.64	Philippines	2.43	82.38
15	Switzerland	1.62	83.32	Ireland	1.89	83.53	Canada	1.76	84.14
16	Sweden	1.59	84.92	Italy	1.75	85.28	Italy	1.58	85.72
17	Belgium-Luxembourg	1.53	86.44	Thailand	1.72	87.00	Ireland	1.54	87.27
18	Australia	1.50	87.94	Philippines	1.41	88.41	Belgium	1.07	88.34
19	Austria	1.28	89.22	Belgium	1.02	89.44	Spain	1.03	89.36
20	Ireland	1.23	90.45	Spain	0.87	90.30	Australia	0.83	90.20
21	Thailand	1.23	91.68	Australia	0.83	91.13	Hungary	0.83	91.03
22	Denmark	0.80	92.48	Switzerland	0.80	91.93	Czech Republic	0.66	91.69
23	China	0.77	93.24	Sweden	0.70	92.63	Sweden	0.66	92.34
24	Finland	0.72	93.97	Brazil	0.66	93.29	Switzerland	0.63	92.98
25	Norway	0.59	94.55	Hungary	0.55	93.84	Brazil	0.54	93.51

a. Information and communications technologies defined as the sum of Standard International Trade Classification (SITC) categories 751, 752, 759, and 776.

Note: Data for Taiwan are from the OECD ITCS database and include all exports as no data for reexports are available; 1991 data are shown for 1990.

Source: UN ComTrade database, SITC, rev. 2. For 1990, 109 reporting countries; for 2000, 163 reporting countries; and for 2004, 123 reporting countries. As all major world trading nations have reported, the differences in number of reporting countries do not materially affect the results. Data show domestic exports only, i.e., reexports have been subtracted.

Table 2.2b Country ranking and concentration of global communications exports and imports, 1990, 2000, and 2004[a]
(percent)

	1990			2000			2004		
Rank	**Country**	**Share of world total**	**Cumulative**	**Country**	**Share of world total**	**Cumulative**	**Country**	**Share of world total**	**Cumulative**
Exports									
1	Japan	26.71	26.71	United States	12.37	12.37	China	17.09	17.09
2	United States	13.92	40.63	United Kingdom	7.98	20.35	Korea	12.05	29.14
3	Former West Germany	7.40	48.04	Japan	7.81	28.16	Germany	8.89	38.03
4	United Kingdom	5.35	53.39	Germany	6.76	34.92	United States	7.02	45.04
5	Taiwan	5.04	58.43	China	5.99	40.91	Japan	6.95	52.00
6	France	4.88	63.31	Sweden	5.64	46.55	United Kingdom	4.25	56.24
7	Sweden	4.27	67.58	France	5.60	52.15	Sweden	4.15	60.39
8	Singapore	4.13	71.70	Canada	5.57	57.72	Mexico	3.88	64.26
9	Korea	3.50	75.20	Mexico	5.49	63.21	France	3.78	68.04
10	Hong Kong	2.87	78.07	Korea	5.09	68.30	Singapore	3.60	71.64
11	Netherlands	2.71	80.79	Finland	4.69	72.99	Finland	3.52	75.17
12	Canada	2.64	83.42	Malaysia	2.90	75.89	Hungary	3.29	78.45
13	Italy	2.44	85.87	Singapore	2.84	78.73	Taiwan	3.08	81.53
14	Malaysia	2.05	87.92	Taiwan	2.61	81.34	Netherlands	2.63	84.16
15	Belgium-Luxembourg	1.75	89.67	Netherlands	2.59	83.93	Malaysia	2.58	86.74
16	Finland	1.54	91.21	Israel	1.94	85.87	Canada	2.18	88.92
17	Denmark	1.11	92.33	Italy	1.86	87.74	Italy	1.75	90.67
18	Switzerland	0.97	93.30	Ireland	1.54	89.28	Israel	1.05	91.72
19	China	0.92	94.22	Belgium	1.53	90.80	Belgium	0.88	92.60
20	Thailand	0.88	95.10	Thailand	1.05	91.85	Denmark	0.85	93.45
21	Israel	0.73	95.83	Denmark	0.89	92.74	Spain	0.72	94.17
22	Austria	0.69	96.53	Indonesia	0.85	93.59	Czech Republic	0.57	94.74
23	Ireland	0.51	97.03	Spain	0.74	94.33	Ireland	0.55	95.29
24	Norway	0.48	97.52	Hungary	0.70	95.02	Austria	0.54	95.82
25	Spain	0.48	97.99	Brazil	0.60	95.62	Brazil	0.48	96.31

Imports

1	United States	21.46	21.46	United States	20.42	20.42	United States	20.54	20.54
2	Former West Germany	7.93	29.40	United Kingdom	7.02	27.44	China	9.27	29.80
3	United Kingdom	6.43	35.82	Hong Kong	6.92	34.36	Hong Kong	9.24	39.04
4	Hong Kong	4.90	40.72	China	5.54	39.90	Germany	7.61	46.65
5	France	4.58	45.31	Germany	4.84	44.74	United Kingdom	6.50	53.15
6	Singapore	4.25	49.56	Japan	4.02	48.76	Japan	3.87	57.02
7	Italy	3.74	53.29	Mexico	3.40	52.16	Italy	3.61	60.63
8	Japan	3.60	56.89	France	3.36	55.53	Singapore	3.47	64.10
9	Canada	3.28	60.16	Canada	3.35	58.88	Mexico	3.46	67.56
10	Netherlands	3.06	63.23	Netherlands	3.09	61.97	France	3.38	70.94
11	China	3.01	66.24	Italy	2.79	64.76	Netherlands	3.26	74.20
12	Spain	2.97	69.21	Korea	2.32	67.07	Canada	2.58	76.78
13	Taiwan	2.10	71.31	Spain	2.27	69.34	Spain	2.43	79.21
14	Korea	1.98	73.29	Singapore	2.19	71.53	Korea	1.98	81.18
15	Malaysia	1.97	75.26	Taiwan	1.87	73.40	Hungary	1.80	82.99
16	Sweden	1.88	77.15	Australia	1.62	75.02	Sweden	1.71	84.69
17	Belgium-Luxembourg	1.65	78.79	Sweden	1.55	76.57	India	1.61	86.31
18	Switzerland	1.62	80.41	Malaysia	1.48	78.04	Malaysia	1.50	87.81
19	Thailand	1.46	81.87	Brazil	1.38	79.42	Australia	1.45	89.26
20	Austria	1.46	83.33	Belgium	1.28	80.70	Taiwan	1.24	90.50
21	Mexico	1.45	84.78	Turkey	1.20	81.90	Belgium	1.07	91.57
22	Australia	1.40	86.17	Ireland	1.03	82.93	Denmark	1.01	92.58
23	Finland	0.91	87.08	Finland	0.97	83.90	Russia	0.99	93.57
24	Indonesia	0.84	87.92	Austria	0.92	84.82	Austria	0.96	94.53
25	Denmark	0.81	88.73	Denmark	0.91	85.73	Finland	0.94	95.47

a. Communications defined as Standard International Trade Classification (SITC) category 764.

Note: Data for Taiwan are from the OECD ITCS database and include all exports, as no data for reexports are available; 1991 data are shown for 1990.

Source: UN ComTrade database, SITC, rev. 2. For 1990, 109 reporting countries, for 2000, 163 reporting countries, and for 2004, 123 reporting countries. As all major world trading nations have reported, the differences in number of reporting countries do not materially affect the results. Data show domestic exports only, i.e., reexports have been subtracted.

Box 2.1 The Information Technology Agreement

The Information Technology Agreement (ITA) was formally concluded at the Singapore Ministerial Conference of the World Trade Organization (WTO) in December 1996.

The ITA is notable for both economic and political economy reasons. It represents a departure from the standard WTO negotiating approach even as it espouses the key WTO principle—most favored nation status. From the perspective of average tariffs, the ITA makes a difference: the average tariff rate on covered products is 3.6 percent for ITA members and 11.2 percent for nonmembers (Bora 2004). Its impact on trade in information technology and communications products has been hard to judge for a number of reasons, but on balance it appears to have enhanced trade in these products, particularly exports for the signatories.

Under the ITA, countries agreed to bring tariffs on trade in covered products in six categories (computers, software, telecom equipment, semiconductors, semiconductor manufacturing equipment, and scientific instruments) to zero by 2000, either immediately or by equally staged tariff reductions in four tranches from July 1997 to January 2000. Provision for extending the final phase to 2005 was agreed to at the initial signing, and some countries did avail themselves of the extensions for some products, including, for example, India, Malaysia, and Indonesia. China joined in 2003, but its implementation schedule has not been derestricted to public view. Brazil, Mexico, and South Africa are among the nonacceding countries. Under WTO auspices, the Committee of Participants on the Expansion of Trade in Information Technology Products was organized upon inception of the agreement. This committee is addressing issues of product classification and nontariff measures, as well as calls to broaden the product coverage under a so-called ITA II.

The runup to and negotiation of the ITA departed in several ways from the more standard approach in a multilateral trade negotiation. First, it was a sectoral agreement that was negotiated in isolation from a multilateral trade round, rather than being part of a single undertaking. The broad outlines of the agreement were broached by the business advisory group and interested country partners—including the United States, Japan, Canada, and Mexico (although the latter has not signed on)—in the context of the 1996 summit year of the Asia Pacific Economic Cooperation (APEC) forum, headed that year by the Philippines. The November 1996 meeting of APEC ministers in Subic Bay provided both explicit tariff-cutting formulas and product coverage for an agreement, as well as the momentum for the actual ITA, which was agreed upon by a set of WTO mem-

(box continues next page)

Box 2.1 *(continued)*

bers at the Singapore Ministerial Conference the following December. Not all WTO members signed on at Singapore, however, and this too is a way in which the ITA differs.

A third way in which the ITA differed from a standard WTO agreement was that one of the provisions of the Declaration on Trade in Information Technology Products—the official term for the agreement made in Singapore—was that the declaration would not come into effect unless participants representing approximately 90 percent of world trade in the covered products notified their acceptance of the ITA by April 1, 1997. At the signing in Singapore, only 29 countries or economic regions accounting for about 83 percent of global trade in IT products acceded to the agreement. These included Australia, Canada, 15 European Community members, Hong Kong, Iceland, Indonesia, Japan, Korea, Norway, Singapore, Switzerland (including Liechtenstein), Taiwan, Turkey, and the United States. However, before the April 1 deadline, 15 more countries or economic entities joined, bringing the coverage of trade up to the required 90 percent, and the declaration came into force. ITA members now account for 95.5 percent of trade.

Has the ITA made a difference for global trade in technology products and for countries that are members? Theory and practical experience tell us that reducing tariffs leads to more trade, and that trade should grow more for the countries that cut tariffs the most. In fact, empirical evidence of the ITA has been difficult to ascertain. First, many of these tariff reductions took place in the context of dramatic increases in global trade in IT products associated with the technology boom up to 2000 and subsequent crash. It is difficult to parse out the changes in trade due to changes in tariffs alone. Second, the product coverage of the ITA does not match the tariff-line classification system. Therefore it is not possible to perfectly assess ITA commitments across countries.

Bijit Bora and Xinpeng Liu (2004) undertake a comprehensive research effort using the very detailed data available and gravity-model analysis. Their results suggest that two trading partners, both ITA members, trade 7 percent more with each other than if neither of them were a WTO (or ITA) member. If two countries are trading partners—the exporter a member of the ITA and the importer not—then the importer imports 6 percent less than if neither of the trading partners were members of the WTO (or ITA). Therefore, a non-ITA WTO member would import about 14 percent more if it joined the ITA.

An alternative econometric approach by the author finds that being a member of the ITA is statistically associated with imports of IT products, controlling for do-

(box continues next page)

Box 2.1 The Information Technology Agreement *(continued)*

mestic expenditures on IT. Keeping in mind that many IT products are intermediates, being a member of the ITA should reduce tariffs on imported intermediates and thereby increase the competitiveness of IT exports. Indeed, econometric evidence suggests that being a member of the ITA may play this role.

To the extent that some WTO members delayed implementation of the ITA, or have not yet acceded to it, they hampered the importation of these products that have such important effects on domestic productivity and growth as well as on trade competitiveness.

Sources: Asia Pacific Economic Cooperation (APEC) Meeting of Ministers Responsible for Trade, Montreal, Canada, May 8–10, 1997; *Call to Action*, APEC's Business Advisory Council Report to the APEC Economic Leaders, 1997; and Introduction: Information Technology Agreement, available at www.wto.org (accessed March 22, 2006).

largest exporter, the eleventh largest importer, and twelfth largest in expenditure on IT hardware, indicative of a more balanced trade and domestic spending pattern. Imbalances in trade patterns also show up in tables 2.2a and 2.2b.

Finally, China and India are both fast-growing markets for IT hardware spending, but their integration with globalized production of IT is quite different. China is the major two-way trader, but India does not appear in the top 25 traders (it is ranked below 40th).

Despite its high rank as an exporter, China may not gain the most from its participation in globalized production. That is, even though China probably is the world's most important production assembly platform for IT and consumer electronics products, it is not necessarily the one with the highest value added on domestic content. China had a very modest trade surplus in technology products of $14 billion in 2003. Chinese domestic value added may account for as little as 15 percent of the value of Chinese technology exports, with the remainder being import content.[7]

India probably is harmed by its lack of participation in global production to the extent that its domestic IT prices exceed the global prices for these products. India, for example, delayed full implementation of the Information Technology Agreement. Some implications of an imbalance between production for exports versus for domestic spending will be addressed in more depth in chapter 3.

7. Technology product trade surplus and domestic value added based on Chinese data inclusive of consumer electronics, office equipment, computers, and communications equipment from Lardy (2005, 132).

Integrating US Firms into the Global Marketplace

Even as the production and use of IT hardware continue to increase and spread around the globe, and even as US producers maintain an importance presence in these products, the key trend in the market is toward production of and demand for IT software and database and network management services.[8] How are US IT firms responding to these trends both in the US market and abroad?[9]

US firms continue to supply the high value-added IT hardware market for both domestic production and production abroad, but increasingly are relinquishing commodity hardware production to imports or to foreign-owned firms in the United States. At the same time, the fragmentation of production, well established for IT hardware, is beginning to take place on the "soft" side of IT, thus increasing domestic and foreign assets, employment, sales, and two-way international trade in components of IT services and software activities.

There are several perspectives from which to analyze the global integration of US IT firms. First, the product perspective: What do these firms sell in the global marketplace, particularly comparing the relative size of hardware versus software and services activities in the global marketplace? Second, the geographical perspective: What does the global production and sales strategy look like for a US multinational IT firm?

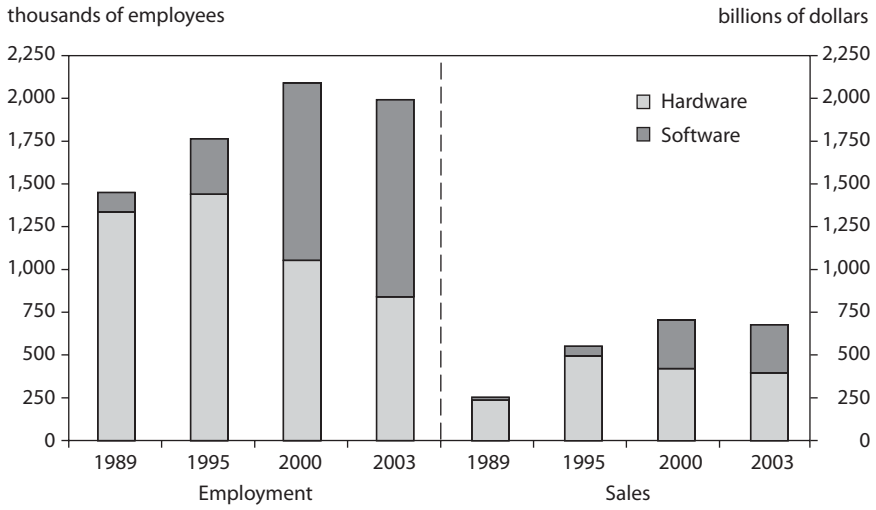
Sales by US Multinational IT Firms in the Global Marketplace

The first perspective on US multinational IT firms is how they produce and sell in the global marketplace. As noted above, global spending on IT totaled more than $1 trillion in 2003, with both the dollar value and rate of growth of global spending on services and software exceeding those for hardware. Recall that table 2.1 showed that the technology bubble was more apparent in spending on IT in the United States, whereas for other countries, particularly developing ones, expenditures on IT products continued to rise rapidly. How have US firms reacted to this trend in product and service type and geographical location of spending in the US and global marketplaces?

8. IT services are a specific subset of what are called information technology–enabled services (ITES). ITES is a much larger set of services that can be digitized and outsourced from the internal operations of the firm to which they are related. These include call centers for financial firms or insurance claim processing. The potential for international trade in these services will be discussed in chapter 4.

9. For a historical perspective, see Mann (1994, 1997).

Figure 2.2 US firms' global sales and employment in hardware and services, by industry of parent, selected years



Source: Bureau of Economic Analysis financial and operating data for US multinational companies.

The US Commerce Department's Bureau of Economic Analysis (BEA) conducts a large annual survey of US multinational IT firms.[10] These data indicate that global sales by these firms—including sales in the US market and sales in foreign markets—rose dramatically during the 1990s, but then stabilized at the 2000 peak until 2003 (last available data). Similarly, the number of employees around the world rose throughout the period before falling from the technology peak in 2000. Most notable is the shift in the composition of global sales and employment from hardware to services and software, following the pattern already observed in global IT spending. US multinationals' global services and software sales now are on par with global hardware sales. US multinationals' employment in hardware has fallen absolutely and global employment in services and software has continued to rise and exceeds global hardware employment (figure 2.2).

In sum, growing global competition in the hardware industry (as seen in new exporters) and growing demand for services and software in

10. The BEA defines US multinational IT firms for data prior to 1999 as those primarily conducting business in US Standard Industrial Classification (SIC) categories 357 (computer and office equipment), 367 (electronic components and accessories), and 737 (computer programming, data processing, and other computer-related services). From 1999 to the most recent data from 2003, the companies are defined as those primarily in North American Industry Classification System (NAICS) categories 3341 (computer and peripheral equipment manufacturing), 3344 (semiconductor and other electronic components manufacturing), 514 (information services and data processing services), and 5414 (computer systems design and related services). See appendix A for elaboration of methodological issues related to classification systems.

global spending have both pushed and pulled US firms toward producing IT services and software and away from producing IT hardware. Services sales and employment increased from less than 10 percent of total global activities of US IT firms in 1989 to 42 percent of sales and 57 percent of employment in 2003.

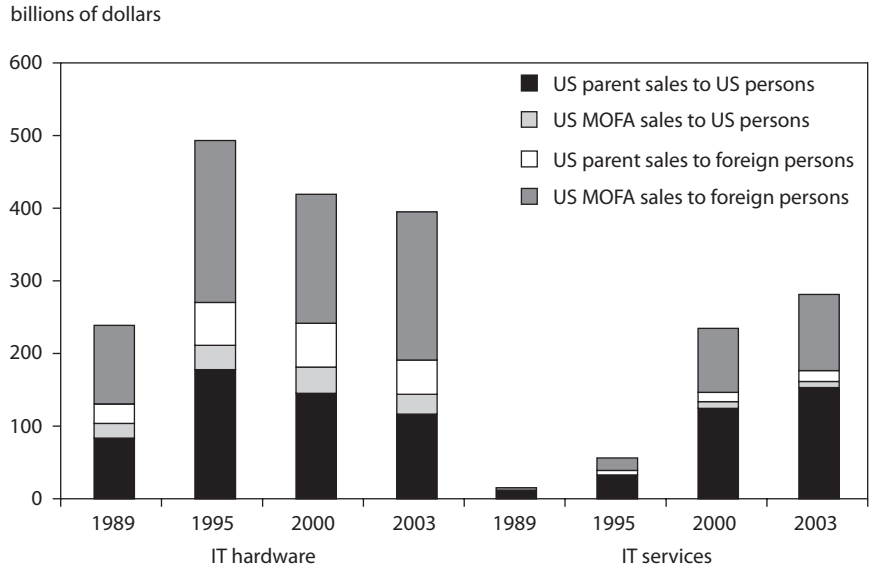
How US Multinationals Meet Domestic and Foreign Demand

The second perspective on the operation of US multinationals considers the importance of the US marketplace. The data on global IT expenditure show that the US marketplace has been by far the largest in the world, accounting for 32 percent of total expenditure on IT hardware and 48 percent of global spending on IT services and software (WITSA 2004, 24–26). Considering just US-parent multinational firms, how important is the US market to them? Does the US market dominate for them as much as it dominates in terms of global spending?

The US (i.e., domestic) share of US-parent firms' global IT hardware sales declined from 35 percent in 1989 to just below 30 percent in 2003 (figure 2.3). US multinationals' sales of IT services in the United States as a share of their total global IT services sales fell dramatically over this period from nearly 100 percent to around 55 percent by 2003. So the US market represents about the same share of hardware sales for US multinationals as the United States accounts for in the global marketplace for IT hardware spending. For services (including software), the domestic share of US multinationals' global sales is a bit higher than the US share in global spending on IT services. In sum, data indicate that the US market continues to be an important part of US IT firms' business strategy, but that to an increasing extent US firms are expanding sales abroad because that is where the fastest growth is. The trend in the US marketplace and for US multinationals is a microcosm of what is happening in the global marketplace. Moreover, the rapid expansion of US firms' IT services abroad is consistent with the US "frontrunner" status.

A third perspective on the operation of US multinationals analyzes the trends in terms of how US firms can meet domestic and global market demand. US multinationals can meet US domestic demand in two ways: through domestic production, or by importing from affiliates located abroad (known as majority-owned foreign affiliates, or MOFAs). The multinationals can serve the foreign market by exporting US-based production or by producing abroad at MOFAs and selling to that market or to third markets. What do the data show in terms of how US multinationals serve the domestic and foreign markets? It may be surprising to learn that the picture is one of stability: the multinationals show neither a reduction in export share to meet global demand nor much of an increase in import share to meet US domestic demand. To the extent that global production and out-

Figure 2.3 US multinational companies' sales in US and global markets, by industry of parent, selected years



MOFA = majority-owned foreign affiliate

Source: Bureau of Economic Analysis financial and operating data for US multinational companies.

sourcing abroad of parts of the production process are an important feature of the business strategy of US multinationals, these data indicate that a stable global production strategy has been in place for some time (figure 2.3).

The data are more complete for US multinationals that produce IT hardware. Consider first the decision to produce in the United States and export versus producing abroad and selling from that affiliate to the foreign market. In IT hardware, the share of foreign demand met by exporting IT hardware—using US parent sales to foreign "persons" as a proxy for US exports—has been about 30 percent of total foreign sales (sum of US parent sales to foreign persons and US MOFA sales to foreign persons in figure 2.3). With regard to the decision to produce IT hardware abroad and import or to sell in the US market from domestic production facilities, the share of US domestic sales met by foreign affiliates of the US parent (that is, imports) has been stable at roughly 15 percent. So the foreign market is a more important destination for US domestic production facilities than is the US domestic market for the foreign production affiliates of US multinationals.

This stability in the shares of exports and imports of US multinationals belies a significant change in to whom the US multinational sells abroad (to an affiliate or a direct sale to an unrelated foreign buyer), or how US demand is met (from a US affiliate or from an unrelated foreign firm).

These changes will be addressed in the next two sections, first by examining the globally integrated production platform of US multinationals and the cost drivers of that platform, and second by looking at foreign firms' participation in the US market. The bottom line is that foreign firms—that is, those with no ownership relationship to US multinationals—are playing an increasingly important role in the US marketplace as producers in the United States, and particularly in terms of selling into the United States from abroad (that is, as the source of imports of IT hardware). This is consistent with the pattern already noted, that US multinational IT companies are reducing their emphasis on producing IT hardware so as to shift into IT software and services.

The picture is murkier for IT services. The share of foreign demand met by sales from US parent companies (that is, exports) was about 20 percent.[11] The data indicate that more than 90 percent of US domestic demand has been met through domestic sales by the US parent, and that that share has risen. These data therefore do not show an increase in the share of US IT services demand through imports of IT services by affiliates of US multinationals (so-called offshoring or offshore outsourcing).[12] The limited data cannot establish whether US IT multinationals' services increasingly rely on third-party providers rather than on affiliated firms, as was the case for US IT hardware multinationals and for which there is some evidence from the international trade data. Looking forward, technological changes that support further fragmentation of the production process of services and software, as well as remote purchase and sale, certainly will increase the two-way trade in services. It remains to be seen to what extent that trade will be at "arm's length" or between related parties of a US multinational, and whether it will be in surplus or deficit on an overall or affiliated international trade basis. These issues will be discussed further in chapter 4.

Integrated Global Production Platform of US Multinational IT Firms

This section drills down into the structure of globalized production by US multinational IT firms. US IT hardware firms have well-established global production networks with cross-border flows of intermediate products to

11. See appendix A for more detail on the way in which data are collected on multinational companies—"industry of parent versus industry of affiliate." The main classification issue is whether to consider affiliates by their own industry sector or by the industry sector of the parent firm. For affiliates of computer hardware companies whose primary line of business is wholesale trade (rather than hardware production), the distinction can be quite significant. On the other hand, whereas the dollar value of sales is different with the alternative classification, the shares and trends are generally the same.

12. Recall, however, that the data only cover the IT services industry and hence would not include, for example, a US airline offshoring its back-office transactions to India.

Table 2.3 Sales by US IT hardware majority-owned foreign affiliates, by destination and industry of parent, selected years (percent)

	Sales to	1989	1995	2000	2003
1	Parent	15	12	14	11
2	Other local foreign affiliates	4	2	3	1
3	Foreign affiliates in other foreign countries	16	26	25	20
4	Unaffiliated US persons	0	1	3	1
5	Unaffiliated local persons	61	53	40	57
6	Unaffiliated persons in other foreign countries	3	6	15	11

Source: Bureau of Economic Analysis, US Direct Investment Abroad: Financial and Operating Data for US Multinational Companies (table III.F.9), www.bea.gov (accessed September 30, 2005).

serve their markets both in the United States and abroad. In contrast, US IT services firms have used a strategy based on production and sale in the same market—domestic production sites for domestic sales and foreign production sites for foreign sales. In the future, fragmentation and globalized production of software and services may well yield integrated global production for services and software similar to the one used for IT hardware. However, as that fragmentation process is just beginning, current data reveal little. Hence, this section will focus primarily on the evolving integrated and globalized production platform for IT hardware and its implications for companies' assets and employment.

Because the global production network for IT hardware has been in place for some time, it makes sense to look at it in more detail (table 2.3). The global production networks for IT hardware start with the 30 percent or so of US production that is sold abroad (exported), of which 75 percent goes to affiliates, according to 2003 data.

Benchmark year surveys indicate that 84 percent of the sales (exports) from the parent go to the affiliates for "further manufacturing," that is, it represents intermediate products entering the integrated global production network. So about 20 percent of total sales by the US parent go to affiliates for "further manufacturing." Therefore, a minority of US parent total sales, but the vast bulk of exports of these US IT hardware firms, is slated for further manufacturing. What happens to these intermediate products once they arrive at the foreign affiliate?

More than half of the affiliate production is sold in the same country (line 5 in table 2.3). About a third goes to other affiliates—some back to the US parent, but relatively more to other affiliates in other countries. Even as affiliates' sales have climbed dramatically, the relative distribution of sales has not moved significantly over the period shown in table 2.3, indicating that this integrated global production network for US IT hardware developed well before that. Over this time period as well, the US content (that is, the export percentage value) in the final sales of affiliates

has held relatively constant at about 25 percent.[13] On the other hand, there is some evidence that affiliate operations are being consolidated in fewer foreign locations, perhaps to maximize economies of scale at the most technologically advanced or lowest-cost locations.[14] (Line 6 in table 2.3 notes the rising share of sales to unaffiliated persons in other foreign countries.)

Since the US-produced content of affiliate operations has remained stable, increased production and sales abroad should yield a complementary increase in US exports. That is, if the consolidation of production in some affiliates yields more cost-effective production that is passed on to lower prices, then these lower prices would tend to increase global sales, and US exports to the integrated global production network also should increase. In fact, the trade data just for US multinationals does reveal this response.[15]

Costs and Technology: Drivers of the Integrated Global Production Network

In a world with a growing number of competitors, cost-efficient production and the use of cutting-edge technology are the keys to maintaining and increasing market presence. How have US multinationals responded? For IT hardware, aggregate data show that US firms have significantly reduced average labor costs by locating production facilities abroad. But labor cost is not the only issue—increased capital intensity in IT hardware production, regardless of ownership or location, is also a factor. For IT services, labor costs in affiliates abroad are about the same as in the United States. Employment abroad appears driven not by cost differentials but by the need to be in the market where the service is delivered.

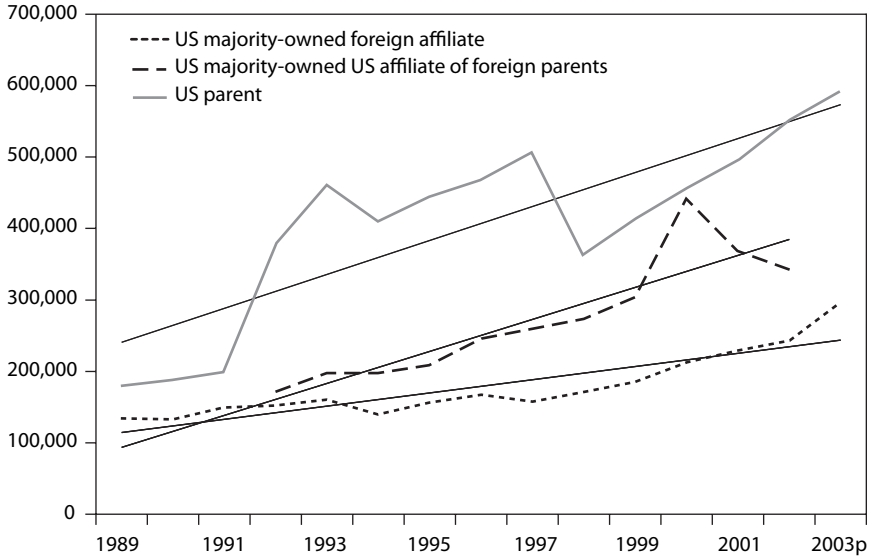
For IT hardware, cost savings and technology drive the structure of global production. Integrated global production of IT hardware goes hand-in-hand with cost differentials and changes in capital intensity. First, trends in the capital intensity of IT hardware firms suggest that technological change is an important factor driving employment in the production structure. An increase in capital intensity in production facilities is widely observed at US-located facilities of different ownership. While the increase in capital intensity is less intense in US-owned facilities in low-wage locations, it is still apparent (figure 2.4).

13. This figure is derived from detailed data on destination of parent and MOFA sales: US parent sales to affiliates divided by MOFA sales (excluding sales back to parent or unaffiliated US buyers).

14. Insufficient publicly available geographic detail makes it impossible to determine in which countries these facilities are located.

15. See chapter 4 for a discussion on intrafirm trade.

Figure 2.4 Trends in capital intensity in IT hardware, 1989–2003
(total assets in US dollar terms per employee)

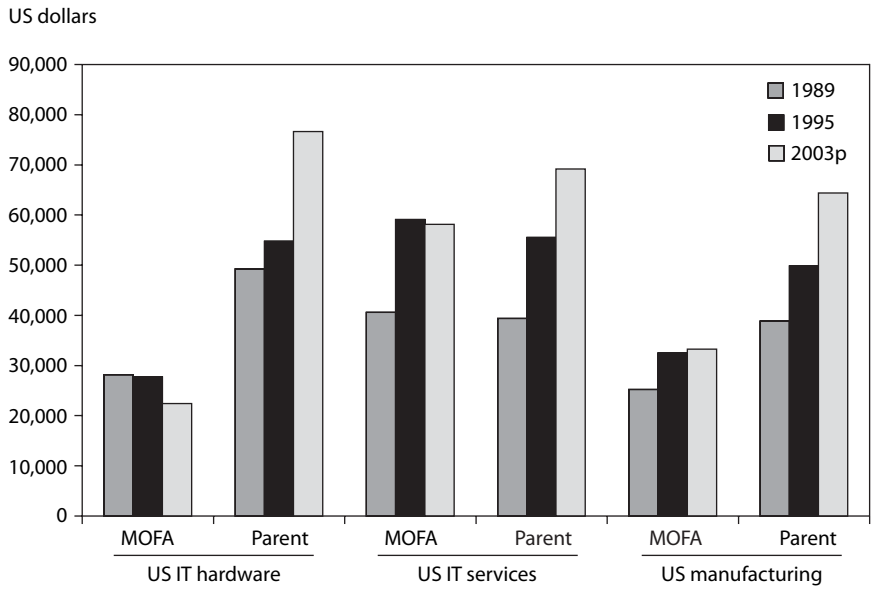


Source: Bureau of Economic Analysis financial and operating data for US multinational companies.

Even with the overall increase in capital intensity, wage-cost differentials are substantial, and do influence the location of production as well as the decision to produce at all (figure 2.5). In 1989, average wages at US IT hardware facilities were 1.8 times greater than average wages at US affiliates. By 2003, the cost differential was 3.4. (Both the starting and the ending wage differentials are larger than for manufacturing as a whole, although the trend in increasing wage differentials is the same for both IT and manufacturing and slowed after 2000.) Over this period, average wages at US IT hardware facilities increased about 43 percent, while average wages at affiliate operations dropped about 20 percent. The widening gap between wages at the affiliates and those at domestic production locations suggests a geographical shift of production to low-wage locations. But this wage pattern also implies a widening differentiation in what workers do and the skills they have at the foreign versus domestic locations. The highest skills and highest wages are paid to workers in US production facilities.

Pulling together the earlier discussion of the operations of US firms and the (limited) geographic detail regarding the location of US facilities suggests several trends. First, operations by US IT hardware companies in what are generally considered "low-wage" countries (in US dollar terms) increased in the 1990s. However, a substantial portion of the adjustment

Figure 2.5 Average total annual compensation for US majority-owned foreign affiliates (MOFAs) and US parents, by industry, selected years



p = preliminary

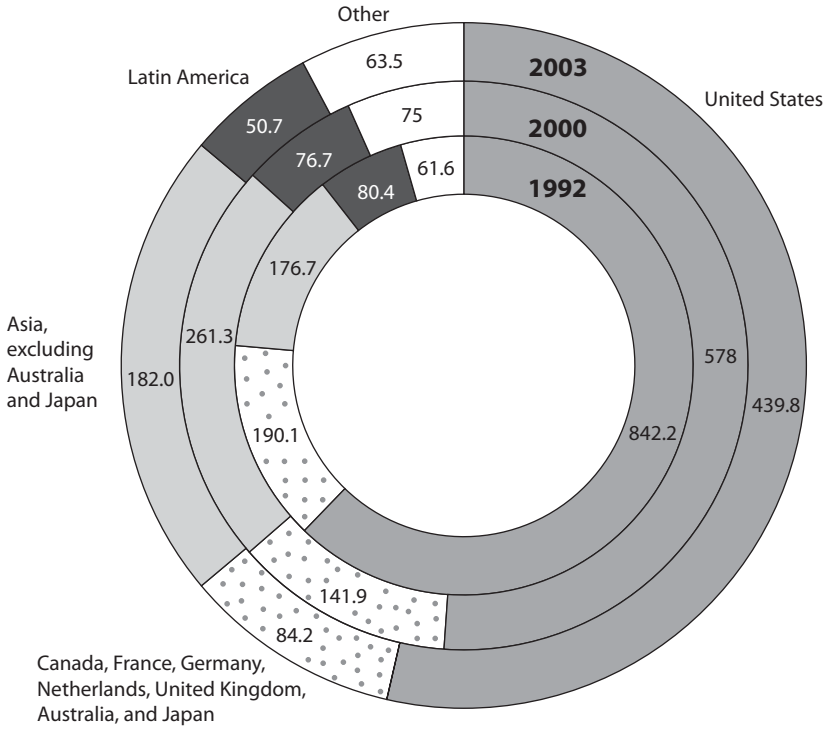
Source: Bureau of Economic Analysis financial and operating data for US multinational companies.

came from high-cost affiliates outside the United States, which is confirmed by data on global employment. Whereas employment by US multinational ITs in the United States dropped 48 percent from 1992 to 2003, employment in affiliates in other industrial countries with similarly high wages fell even more (56 percent) over the same period (figure 2.6). Moreover, the increase in capital intensity at all plants means that even as employment fell at US and other high-wage locations, these workers were not replaced one-for-one with low-wage workers.

The timing of changes in employment location and in capital intensity is an important indicator of what products continue to be produced in the United States. The more significant change in capital intensity in IT hardware came in the first half of the 1990s, while more dramatic growth in wages occurred in the second half of that decade. (This is not the pattern observed for manufacturing as a whole.) The increasing wage premium in the second half of the 1990s for skilled workers at US-based IT hardware facilities is consistent with these plants producing the highest-value IT hardware for US and global markets.

IT services present a different picture of how technology and local market demand drive the location of production. How do costs, technology,

Figure 2.6 Regional employment by US multinational IT hardware companies, 1992, 2000, and 2003 (thousands of employees)

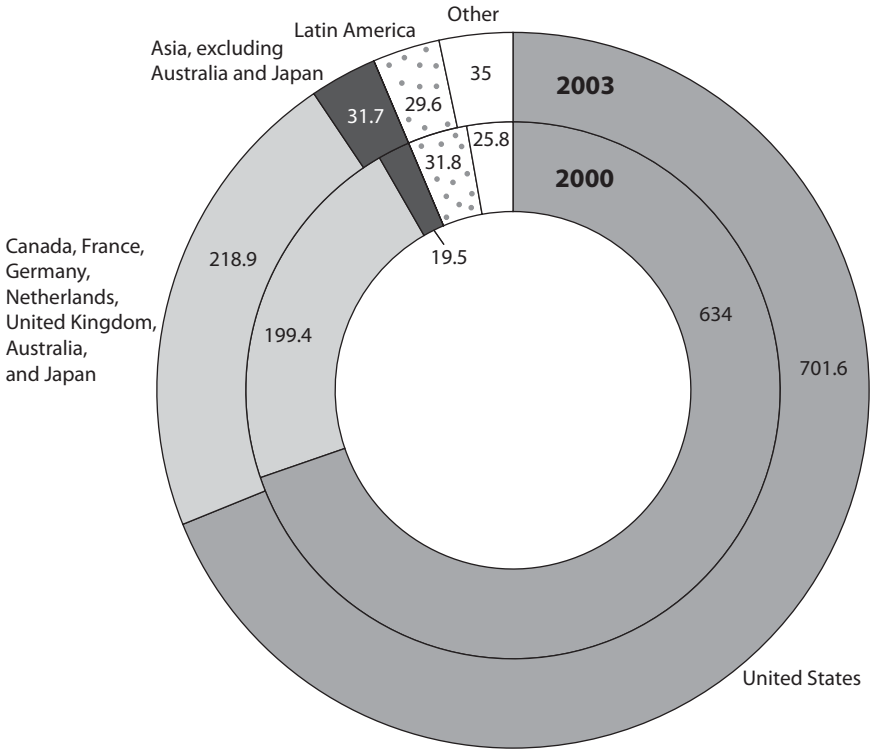


Source: Bureau of Economic Analysis financial and operating data for US multinational companies.

and localization affect IT services in the global marketplace? First, as discussed, the global demand for IT services, while growing quickly, is not yet as diversified in production or in demand around the world as it is for hardware. The services market is better developed in the advanced industrial economies, where there is a more significant installed base of IT hardware and higher spending on IT services and software.

Second, the dramatic increase in average wages at US IT services multinationals from 1989 to 2003 was greater than the increase in average wages in US IT hardware firms. The average wage is much higher for services affiliates abroad than in hardware affiliates abroad (figure 2.5). This suggests that the services produced and the skills necessary at both US and foreign locations have increased, and that the markets in which the services are delivered are similar in terms of wage costs. Employment data in figure 2.7 confirm these observations. US IT services affiliates tend to be located in other advanced industrial economies. Because labor costs in the industrial economies more closely mirror US labor costs, there is

Figure 2.7 Regional employment by US multinational IT services companies, 2000 and 2003 (thousands of employees)



Source: Bureau of Economic Analysis financial and operating data for US multinational companies.

less of a cost advantage to creating a globally integrated production network for services. These data, along with the data on IT spending, are consistent with the observation that services tend to be produced and sold in the same market.

On the other hand, the fragmentation of the production process for services to lower-wage locations may be starting to show in the data. From a very small base of 45,000 employees, employment in developing countries outside Latin America rose nearly 50 percent between 2000 and 2003. But with only 67,000 employed there, developing countries outside Latin America account for only 7 percent of total global employment. While this may represent the early stage of the fragmentation and globalization of the production of IT services and software, overall employment in affiliates abroad increased some 39,000 (about 14 percent) during 2000–2003, and employment in the United States by the parent firms increased by 68,000 (11 percent) over the same period—a much higher absolute number of em-

ployees than in the low-wage locations abroad. So even as fragmentation and globalization of IT services have increased, the expansion into lower-wage locations is well outweighed by expansion in hiring at home and in other industrial-country markets with similar wage structures. This pattern of expanding sales and employment is consistent with the investment and price elasticities discussed earlier.

In sum, the trend of the integrated global production platform looks different for IT hardware versus software and services. IT hardware employment in the United States and high-wage countries has fallen dramatically, but has only been partially replaced by low-wage labor. Increased capital intensity has also played a role in the domestic employment trends, and the wages earned at home have increased, commensurate with the higher valued-added production that remains in the United States. IT services and software employment and wages have increased dramatically in the United States, even as there have been modest increases in employment in both high- and low-wage affiliates abroad.

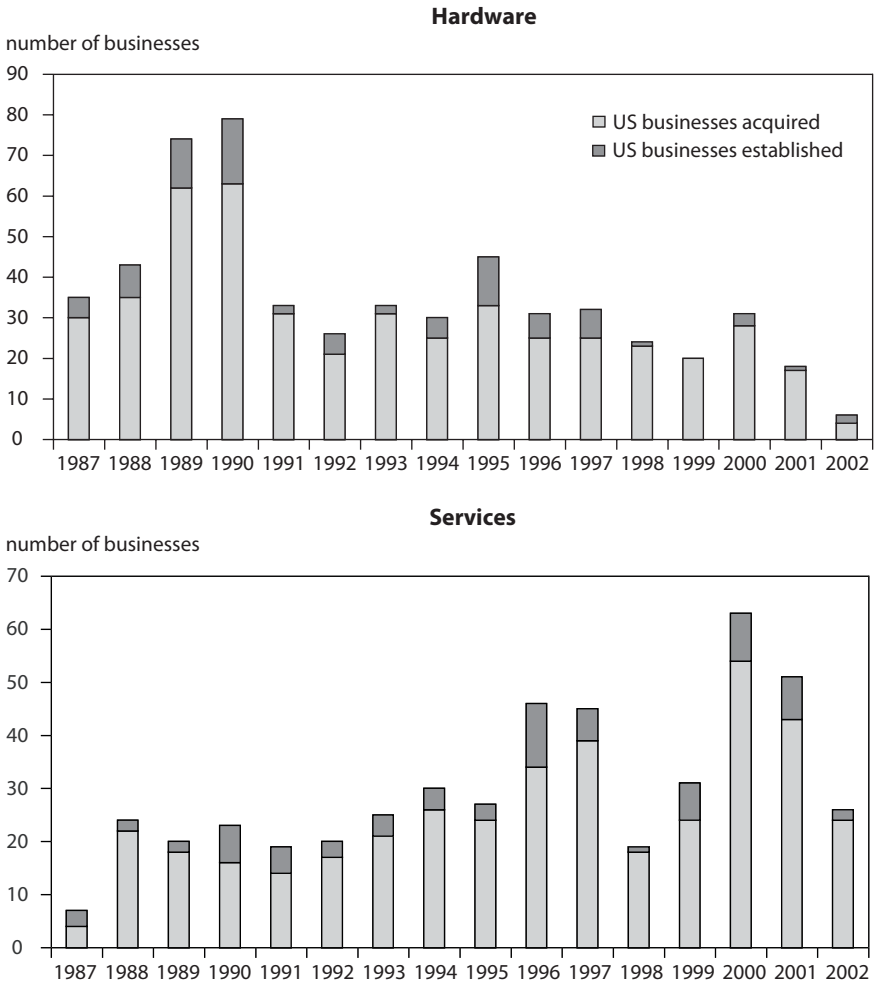
Foreign-Owned IT and Communications Firms in the US Marketplace

US multinational IT firms are not the only players in the US marketplace. Foreign firms with no ownership affiliation with US firms are playing an increasingly important role in the US marketplace. Foreign firms can participate in the United States through new "greenfield" direct investment—i.e., by establishing new plants and facilities. But the data suggest that what is taking place even more is mergers and acquisitions. That is, when US firms sell US-located assets that no longer fit with their business strategy, foreign firms purchase some of those assets, hire some of the employees, and continue to serve the US market. "Contract" firms such as electronics manufacturing services are important examples. Does this ownership transformation affect the US IT marketplace, US firms, or US workers?

Mergers and Acquisitions in the IT and Communications Sectors

Data on assets and employment of IT multinationals operating in the United States—including multinationals of both US and foreign ownership—reveal one way that foreign firms can participate in the US marketplace, namely through merger and acquisition activity among US and foreign owners of IT hardware firms. Aggregated data from the BEA on the IT sector alone show the total value of assets owned in the United States by US-parent multinationals and the value of assets owned in the United States by foreign-parent multinationals above a cut-off value of assets.

Figure 2.8 Acquisition and establishment of US IT companies by foreigners, 1987–2002



Notes: Threshold for inclusion in these data is 10 percent foreign ownership. Key is the same for both figures.

Source: Bureau of Economic Analysis, Foreign Direct Investment in the United States: Financial and Operating Data for US Affiliates of Foreign Multinational Companies, www.bea.gov (accessed September 30, 2005).

Changes in these two values may not be directly due to merger and acquisition deals. But to the extent that greenfield direct investment is unimportant, merger and acquisition is what is going on. A second source of data on mergers and acquisitions, from the Organization for Economic Cooperation and Development (OECD), which incorporates both IT and

Box 2.2 Adapting to change and seeking markets: IBM versus Bull

Two trends characterize the global IT marketplace: the large shift from hardware toward software and IT services, and the rising importance of foreign demand for IT products. With such a massive market shift, it is noteworthy that IBM has remained the world's biggest IT company. IBM has accomplished this by meeting the market as it has shifted, that is, by trending toward IT services and by going abroad. By seeking the growing markets, the firm has maintained its leadership position.

IBM's services revenues grew from 9 to 48 percent of total revenues from 1991 to 2004, while hardware revenues declined from 57 percent to less than a third of the total. Meanwhile, the share of software revenues in IBM's total has remained fairly stable at about 15 percent. Throughout the 1990s, IBM sought new markets outside the United States for its new services products and has maintained a roughly one-third/two-thirds US/non-US geographic revenue distribution from 1991 to 2004. IBM—the company that invented the personal computer—is now an IT services and software company more than it is an IT hardware company.[1] Indeed, with the sale in December 2004 of its personal computing division to the Chinese company Lenovo (while becoming that company's preferred IT services provider), IBM continued in 2005 the trend away from hardware toward IT services.[2]

Why did IBM move toward services? Was it forced by declining profitability to abandon hardware? Has it grown profitably by providing IT services? Through the 1990s, IBM's gross margins in hardware were significantly higher than in IT services. By 1999, however, gross margins on the two product groups converged, with a decline in hardware margins and a rise in IT services margins.[3] The fact that IBM's IT services margins improved as the company moved into this sector points

(box continues next page)

communications, is built on a deal-by-deal basis, but there are fewer details on employment and asset value. Finally, Thomson VentureXpert details the cross-border flows of venture financing, a subset of the total cross-border financial activities. It makes sense to take a look at these three data sources.

On the matter of new establishments versus acquisitions, figure 2.8 shows two trends. First, in both hardware and services, new establishments are far less important than are foreign acquisitions of US assets. Second, the time series of data on foreign acquisitions of US assets corroborate the evolution away from hardware and toward services.

According to the BEA, US parent companies in the IT sector reduced assets by almost 30 percent (from $363 billion to $259 billion) between 1995

Box 2.2 *(continued)*

to the likely "pull" from opportunities for profitable growth in IT services. And, consistent with the aggregated sector data presented in the main text, the declining hardware margin is consistent with a "push" out of the increasingly competitive marketplace. IBM's story shows the importance of adapting to change.

What happens in the competitive global IT markets to companies that do not adapt to change and market signals? The French computer company Bull was created through the nationalization of the French computer industry in 1982 as a "national computer champion." Bull has attempted to establish itself as an important player in the high-value server market as well as in the market for specialized computer engineering services. In contrast to IBM's restructuring and redirection to support profitability in new market segments and locations, Bull's strategy has been financed by subsidies, including €517 million in December 2004.[4] In 2002, Bull lost €548 million on revenues of €1,514 million and has barely broken even since. By 2004, Bull was still shrinking, with revenues of only slightly over €1 billion and 7,500 employees.[5] Bull demonstrates that simply financing IT companies does not yield global players.

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1. This change also has significant data classification implications. See appendix 2B.
2. See IBM press release, "Lenovo Completes Acquisition of IBM's Personal Computing Division," May 1, 2005.
3. Only gross margins are available by company segment, and therefore these data do not account for selling, general and administrative, research and development, interest, tax, and other expenses. They are consequently indicative only of the net profitability of each segment.
4. European Commission press release IP/04/1424, December 1, 2004.
5. See Bull S.A. annual reports for 2003 and 2004, Paris, www.bull.com (accessed March 15, 2006).

and 2003. The expression "reduced assets" is important, as these data aggregate both company exits as well as mark-to-market valuation of company assets. (Unfortunately, the data do not distinguish between these two fundamentally different economic outcomes.) One can infer that some companies either exited the industry, diversified out of it (such as IBM, as discussed in box 2.2), or were taken over by rivals, since the number of US IT parent companies declined by roughly the same 23 percent from 1995 to 2003. The reduction in US IT hardware assets occurred at a time when foreign competition via imports to the US market heated up and the market for IT services started to emerge, both of which tended to push the leading US businesses away from producing IT hardware, particularly standardized hardware, in the United States.

Foreign investment in the United States behaved quite differently during the 1995–2000 technology boom and bust that followed. During the boom, foreign investment in US IT hardware firms increased from $14 billion to $46 billion. Even as US hardware firms reduced assets, the reported value of assets owned by foreigners increased by an amount equal to about 40 percent of the decline in the value of the assets sold by US owners. After the bust (2002), foreign-owned assets declined, but this could be due to fewer survey respondents, as well as to lower stock market value of those assets.

Data on specific merger and acquisition activity trend in broadly similar ways to the BEA aggregated data.[16] Against the backdrop of the overall technology boom and bust, the United States as a target for global mergers and acquisitions stands out for having even higher volatility than the global market as a whole. For the United States as a target country, about $2 billion in 1995 in foreign-source mergers and acquisitions rose to $103 billion in 1999, before falling back to about $11 billion in 2003 (table 2.4).[17]

Target countries outside the OECD in 2002 and 2003 had mergers and acquisitions comparable in magnitude to those of the United States, which may indicate the increasing attractiveness of IT and communications assets in low-wage but increasingly high-skill countries, such as India and China.

From these data it is not possible to tell whether US bidders increasingly target non-OECD markets. On the other hand, data from Thomson VentureXpert on venture capital investments and buyouts in the IT sector (discussed in more detail in chapter 6) indicate that between 1999 and 2005 (November 11) about 30 percent of the venture finance abroad went to non-OECD countries (totaling about $33 million), of which 25 percent went to China, 12 percent each went to India and Israel, 8 percent to Hong Kong, and 3 percent to Taiwan. Notably over the period, the share of overseas finance to the China, Hong Kong, and Taiwan production areas shifted dramatically to China, with in fact no deals recorded in Taiwan and Hong Kong in 2005.

16. Most of the preceding discussion has used the narrower definition of IT that excludes communications companies. Here we use the broader definition of IT and communications, in part because of limitations of the source data that do not allow us to break out the strict communications companies. Differences in merger and acquisition activity where the sector of communications appears to be most relevant are addressed in the text.

17. The fact that the European Union has a perhaps surprisingly large share of the "targets" is an indication of the ongoing gradual integration and cross-border consolidation of the EU telecommunications sector following the liberalization of the sector in Europe during the 1990s. The increase over 1999–2001 may also be due to the restructuring of telecommunications firms in the European Union. Developed countries other than those in Europe and not including the United States did not have significant foreign investment in their IT and communications sectors during this period.

Table 2.4 IT and communications sector cross-border mergers and acquisitions, by country, 1995–2003

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	Total, 1995–2003
By target country										
United States										
Billions of dollars	2.1	11.9	11.3	27.7	103.2	57.6	77.6	13.3	10.8	315.6
Percent	8	25	13	19	33	10	33	13	13	
European Union[a]										
Billions of dollars	16.9	27.7	47.7	125.6	301.1	79.8	49.2	n.a.	n.a.	n.a.
Percent	62	57	53	40	52	34	48	0	0	
United Kingdom										
Billions of dollars	6.7	3.0	3.0	5.6	67.5	104.4	25.1	5.5	6.0	226.7
Percent	25	6	3	4	22	18	11	5	7	
Germany										
Billions of dollars	1.0	14.2	2.0	3.4	6.7	97.2	22.5	6.8	13.3	167.1
Percent	4	29	2	2	2	17	10	7	16	
France										
Billions of dollars	1.0	1.0	13.3	9.3	6.5	8.2	11.9	1.8	5.7	58.9
Italy										
Billions of dollars	1.9	2.0	11.4	2.2	9.4	6.4	.4	1.7	1.1	36.6
Canada										
Billions of dollars	2.0	.3	.4	2.0	13.5	75.6	5.4	2.3	2.0	103.5
Japan										
Billions of dollars	.3	.7	.6	18.4	17.8	15.0	13.2	.65	7.0	73.7
Percent	1	2	1	13	6	3	6	1	9	
Australia										
Billions of dollars	2.5	.5	12.0	.7	14.7	1.9	9.1	1.3	1.2	43.9

(table continues next page)

Table 2.4 IT and communications sector cross-border mergers and acquisitions, by country, 1995–2003 *(continued)*

Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	Total, 1995–2003
Korea										
Billions of dollars	n.a.	n.a.	n.a.	2.3	1.5	3.0	7.7	9.9	.6	25.0
Total OECD										
Billions of dollars	24.0	41.3	73.8	108.3	278.5	490.0	203.1	79.6	67.8	1,366.0
Percent share of world total	89	85	82	75	89	84	87	78	83	
Total non-OECD										
Billions of dollars	3.1	6.9	15.3	34.6	31.2	86.4	27.8	19.6	10.6	235.4
Percent share of world total	11	14	17	24	10	15	12	19	13	
Unspecified (billions of dollars)[b]	.04	.3	.8	1.4	2.2	5.9	2.7	3.1	2.9	19.3
Total world	27.2	48.4	89.9	144.3	311.9	582.3	233.6	102.3	81.3	1,621.1
By country of bidder										
United States										
Billions of dollars	7.7	4.1	12.0	21.3	33.1	57.1	35.0	16.6	11.8	198.9
Percent	28	9	13	15	11	10	15	16	15	
European Union[a]										
Billions of dollars	6.9	11.4	23.4	45.1	169.6	245.2	116.0	34.3	21.4	673.3
Percent	25	24	26	31	54	42	50	33	26	
United Kingdom										
Billions of dollars	1.7	6.8	7.1	7.6	76.4	57.3	40.3	5.2	8.9	211.3
Percent	6	14	8	5	24	10	17	5	11	
Germany										
Billions of dollars	3.1	.8	3.6	1.8	59.2	22.1	41.3	4.4	.1	136.4
Percent	12	2	4	1	19	4	18	4	0	
France										
Billions of dollars	.2	.3	3.1	9.5	13.3	78.3	8.9	8.2	9.3	131.1

Italy										
Billions of dollars	.1	.7	2.8	8.5	5.8	10.5	3.8	.5	.8	33.2
Canada										
Billions of dollars	.9	4.1	.9	23.8	3.0	26.5	5.3	.6	1.7	67.0
Japan										
Billions of dollars	1.1	1.9	1.4	1.5	1.5	12.9	12.4	2.3	.1	35.0
Percent	4	4	2	1	0	2	5	2	0	
Australia										
Billions of dollars	.4	.4	3.1	.8	2.4	.7	13.6	1.5	8.0	31.3
Korea										
Billions of dollars	1.2	.3	.2	.3	.2	n.a.	.2	.2	.9	1.8
Total OECD										
Billions of dollars	18.4	22.6	41.4	92.8	215.4	347.7	184.2	57.2	44.7	1,024.6
Percent share of world total	68	47	46	64	69	60	79	56	55	
Percent share of world specified total	97	93	93	91	90	86	93	81	91	
Total non-OECD										
Billions of dollars	.5	1.7	3.3	9.0	24.9	57.7	14.3	13.2	4.6	129.1
Percent share of world total	2	4	4	6	8	10	6	13	6	
Unspecified[b]										
Billions of dollars	8.2	24.0	45.1	42.5	71.6	176.9	35.0	32.0	32.0	467.2
Percent share of world total	30	50	50	29	23	30	15	31	39	
Total world	27.2	48.4	89.8	144.3	311.9	582.3	233.6	102.3	81.3	1,621.1

n.a. = not available

a. Includes the 19 members of the European Union that are also members of the Organization for Economic Cooperation and Development (OECD), excluding Latvia, Estonia, Lithuania, Malta, Cyprus, and Slovenia.

b. Unspecified refers to cases where there is no individual specified country bidder.

Source: OECD (2004a, annex table C.2.9, 2.10).

Global Mergers and Acquisitions

It is often assumed that an increase in global production of any kind of product is associated with new investment in a production facility in that country. However, direct investment through mergers and acquisitions is another way to create a global production platform without necessarily adding to global productive capacity.

Table 2.4 lists cross-border merger and acquisition activity in the IT and communications sectors for the world's major economies. Not surprisingly, the main international acquirers of IT and communications assets are found among the OECD countries.[18] More surprising perhaps is that US companies account for a relatively small share of acquirers, about 15 to 20 percent of the total, which is significantly below the roughly 50 percent share of US equity markets in global market capitalization and the roughly 50 percent US share in global expenditure on IT goods and services (table 2.1). This may reflect a US strategy of organic international growth through direct investment in newly created foreign-owned subsidiaries. Or it may mean that leading US IT firms have found relatively few inviting takeover targets outside the United States. Or it may be, as explained in box 2.3, that US and European IT and communications companies have different approaches to global expansion. European companies appear to rely more on large foreign acquisitions to enter a telecommunications market, whereas US companies have focused on buying smaller, but numerous, foreign technology companies. The large Asian economies have been virtually absent from the international merger and acquisition stage.

The Role for "Contract" Manufacturers of IT Hardware

Global IT hardware producers face three realities: IT product prices continue to decline through exponentially increasing processing power; the infrastructure costs of building production facilities continue to rise exponentially; and product cycles are shortening. In this business environment, cutting costs is imperative, but at the same time companies must in-

18. The relatively large share of all merger and acquisition activity listed in table 2.4 as unspecified might warrant some caution in making such a statement. However, this uncertainty comes from the original source of the data (Dealogic) and is caused by financial disclosure rules and the fact that "bidders" are often existing (international) shareholders. There is no reason to believe that the OECD share among the "unspecified" is less than the OECD share of the world specified total, i.e., 83 percent or above. Another cause of concern with respect to overinterpreting these data lies in the risk that "one-off events," such as the international purchases of countries' auctioned 3-G licenses in 2000, are included in the aggregate numbers. This may serve to particularly inflate the European data.

Box 2.3 Mergers and acquisitions: Build it or buy it

US and European information technology and communications companies, particularly large telecommunications firms, appear to pursue very different globalization strategies. US IT and communications firms are generally much more likely either to buy smaller foreign companies and integrate them into their global business and leverage the technology acquired. Such was the case of Hewlett-Packard's purchase of the Dutch company Indigo N.V., as described in box 6.1, or through the global business strategy of IBM (box 2.2).

European IT and communications companies, on the other hand, have tended to buy their way into new markets through acquisitions of, in many cases, large foreign companies. This strategy is exemplified by Deutsche Telecom's $22.5 billion takeover of the US carrier VoiceStream in 2001, or Vodafone's $62 billion acquisition of the US carrier AirTouch in 1999 and $183 billion acquisition of the German carrier Mannesmann in 2000.

It is premature, however, to jump to conclude that the United States "builds" and Europe "buys." First, most of the European "mega-deals" occurred at the height of the boom in the late 1990s, when executive "animal spirits" were certainly stirred by rocketing share prices. Second, much cross-border consolidation took place within the European Union as telecommunications markets were rapidly liberalized, and purchases of large market shares may have been necessary in order to compete with dominant, formerly state-owned incumbents. Third, similar consolidation in telecommunications has subsequently occurred (indeed, it is still in progress) in the US market—with the obvious difference that none of these deals has been "international." Last but perhaps most important for the US IT companies operating within the broader definition of IT and communications, many large US firms have for decades been building an extensive overseas subsidiary network, in part as a reaction to domestic regulations in those markets. In this respect, the US firms' international growth strategy operates as a "first mover" relative to their European competitors, so the Europeans may therefore have fewer strategic options for growth other than through large acquisitions.

crease research and development budgets in order to stay at the technological frontier.

An increasingly popular cost-cutting strategy adopted by US IT hardware producers is to turn to contract manufacturers, in which selected parts of or even the entire IT hardware manufacturing process is outsourced by the name-brand firm to specialized electronics manufacturing services (EMS) companies, such as Flextronics International or Solectron. The EMS industry experienced very rapid market growth throughout the

1990s, expanding to an estimated $115 billion in 2000, before experiencing a postbubble contraction. In 2004, the EMS industry nearly reached the levels seen in 2000, but has gone through a considerable consolidation, with the top 50 companies in the industry now accounting for as much as $94 billion of the total market.[19] Industry observers are predicting continued rapid growth and a world market of $245 billion by 2008 (Electronic Trend Publications 2004).

By outsourcing to an unaffiliated EMS company, US IT hardware manufacturers with household names can reduce overall production costs through lower capital investment requirements, improved inventory management and purchasing power (by tapping into the EMS firms' economies of scale), and access to advanced EMS manufacturing facilities strategically located in low-cost countries. In particular, manufacturing of high-volume "commoditized" products (those with well-established engineering technologies and standards) can be outsourced and produced in low-cost countries, which improves the price competitiveness of the overall product that carries the brand name of the US multinationals. Hence, EMS outsourcing can complement the US IT hardware companies' own global supply network of foreign affiliates. The relative importance of the multinationals' own global production network and their reliance on outsourcing to an EMS global production network are seen in the data on international trade—a point to which we will return.

Despite its aggressive search for cost reductions and tax incentives as a competitive parameter, the EMS industry maintains a strong production presence in the United States (table 2.5).[20] Two of the top five EMS companies in 2004 were incorporated in the United States[21] and all of the top five EMS companies had the United States as their number one global sales and asset location. However, consistent with all the data thus far presented on global spending and US multinationals' production, a shift

19. *Manufacturing Market Insider* press release, "Annual MMI Top 50 EMS Producer Rankings, 2004," available at www.mfgmkt.com (accessed April 27, 2005).

20. According to the Flextronics International Ltd., 2002 10-K filing (p. 13): "We have structured our operations in a manner designed to maximize income in countries where . . . tax incentives have been extended to encourage foreign investment; or . . . income tax rates are low. We base our tax position upon the anticipated nature and conduct of our business and upon our understanding of the tax laws of the various countries in which we have assets or conduct activities." Available at www.sec.gov (accessed September 30, 2005).

According to the Solectron, Inc., 2002 Annual Report (p. 25): "In general, the effective income tax rate is largely a function of the balance between income from domestic and international operations. Our international operations, taken as a whole, have been taxed at a lower rate than those in the United States, primarily due to tax holidays granted to several of our overseas sites in Malaysia, Singapore, and China."

21. *Manufacturing Market Insider* newsletter, March 2004 and March 2005.

of production locations and assets to Asia from 2000 to 2004 is clearly visible for the top EMS firms as well. Asian sales by the top five EMS companies also rose dramatically, indicating that assets and production follow the markets in this highly competitive industry. Consistent with the other data presented, the growth of EMS facilities in China has been rapid, but this growth has not come solely at the expense of production in the United States. Rather, other developed countries—notably in Western Europe—show declines in EMS production facilities. The US share of sales and assets generally is a little lower for the major EMS companies than for the US IT hardware multinationals covered in the BEA survey data.[22]

What else do EMS firms offer that might underpin their continued strong US presence but also a global location strategy? EMS firms provide both large and smaller US IT companies with accelerated time-to-market and time-to-volume production at their manufacturing facilities. Furthermore, as EMS companies offer more fully integrated product processes, including design, engineering, manufacturing, and postmanufacturing services, adjacency to customers and markets becomes an increasingly important asset, as logistics management and integral production cooperation with name-brand companies form a crucial part of EMS competitiveness. So there is strong incentive for EMS firms to locate in their biggest market, even as they also locate abroad to serve those markets too.

In sum, while outsourcing to contract manufacturers plainly means that parts of the global supply chain will be concentrated in low-cost countries, especially China, it is equally evident that high value-added operations tend to stay in the United States, complementing and facilitating the growth of existing US IT hardware firms. In other words, just because production of IT hardware is outsourced to an EMS company does not automatically mean that is also offshored to China or another low-wage country. When a US IT firm ceases production at a facility in the United States, it may not mean that jobs are lost in lockstep. In some cases, the facility and jobs will change owners and be redeployed, thus contributing to the cost competitiveness of US production overall.

What lessons does the EMS industry offer regarding the nascent globalization of the IT software and services sector? First, even for IT hardware production, where globalized production networks are well developed and have been in place for decades, adjacency and local knowledge matter in choosing a production location, although not necessarily a corporate ownership structure or nationality. Second, assets and production location move with the locus of market demand. Maintaining strong demand in the United States for IT investment throughout the economy is

22. The US share generally aligns with the US share of the world IT hardware spending. In 2003, the United States accounted for 32 percent ($119 billion) of world IT hardware spending. See WITSA (2004).

Table 2.5 ***Manufacturing Market Insider's*** **top five electronics manufacturing service companies**

Company (country of incorporation)	**2004 sales** (billions of dollars)	**Global locations, owned and leased**		**Regional sales and asset distribution** (percent)	
		2000	**2004**	**2000**	**2004**
Flextronics (Singapore)	14.5 (fiscal year ending March 31, 2004)	Number of locations: United States (21), Sweden (8), China (5), Austria (3), Hungary (3), Scotland (2), Finland (2), Ireland (2), Malaysia (2), Germany (2), Mexico (2), Italy, Brazil, France, Taiwan, Thailand, Switzerland	500,000–2.5mn square feet facilities: Brazil, China, Hungary, Mexico, and Poland 50,000–500,000 square feet facilities: Austria, Brazil, China, Denmark, Finland, France, Germany, Hungary, India, Israel, Italy, Japan, Malaysia, Mexico, Netherlands, Norway, Singapore, Sweden, Switzerland, Taiwan, Thailand, United States	Net sales: Americas (40) Asia (16) Europe (44) Long-lived assets: Americas (34) Asia (28) Europe (39)	Net sales: Americas (14) Asia (45) Europe (41) Long-lived assets: Americas (25) Asia (43) Europe (32)
Sanmina-SCI (United States)	12.2 (fiscal year ending August 31, 2004)	Number of locations: United States (31), Canada (2), Sweden (2), Finland (2), Malaysia (2), China (2), France, Ireland, Mexico	Percent of global square footage: Australia >(1), Brazil (2), Canada (3), China (8), Finland, (3), France (4), Germany (4), Hungary (7), Indonesia >(1), Ireland (1), Israel (2), Japan >(1), Malaysia (2), Mexico (12), Singapore (1), Spain (2), Sweden (2), Thailand (1), UK (7), United States (38)	Net sales: United States (81) International (19) Long-lived assets: United States (86) International (14)	Net sales: United States (27) International (73) Long-lived assets: United States (42) International (58)
Solectron (United States)	11.6 (fiscal year ending October 2, 2004)	Percent of global square footage: Brazil (4), Canada (3), Mexico (9), France (5), Germany (2),	Percent of global square footage: Australia (1), Belgium (1), Brazil (2), Canada (8), China (10), France (3), Germany (1),	Net sales: United States (59) Europe (24) Other (17)	Net sales: United States (28) Other Americas (16) Europe (14)

		Ireland (1), Romania (2), UK (6), Sweden (2), Australia (2), China (3) India >(1), Japan >(1), Malaysia (8), United States (52)	Hungary (2), Netherlands (2), Romania (4), Sweden (2), Turkey >(1), India >(1), Indonesia (1), Japan (5), Malaysia (9), Singapore (3), Taiwan >(1), Mexico (6), UK (2), United States (37)	Long-lived assets: United States (48) Europe (35) Other (17)	China (16) Other Asia-Pacific (26) Long-lived assets: United States (30) Other Americas (20) Europe (15) Asia-Pacific (35)
Celestica (Canada)	8.8 (fiscal year ending December 31, 2004)	Percent of global square footage: Brazil (3), Mexico (6), Canada (17), UK (12), Italy (16), Ireland (4), Czech Republic (3), China (7), Thailand (6), Malaysia (1), United States (26)	Percent of global square footage: Philippines (1), Thailand (5), Japan (5), Singapore (3), Malaysia (8), Indonesia >(1), China (13), Brazil (1), Mexico (9), Spain (6), Czech Republic (3), France (3), Italy (6), Ireland (1), UK, (2), Canada (11), United States (23)	Net sales: Americas (61) Europe (28) Asia (11) Long-lived assets: Americas (54) Europe (34) Asia (14)	Net sales 2003: Americas (44) Europe (20) Asia (36) Long-lived assets, 2003: Americas (38) Europe (32) Asia (30)
Foxconn (Taiwan)	8.5 (fiscal year ending December 31, 2004)	Number of locations: United States (5), China (2), Taiwan, Japan, Scotland, Ireland	n.a.	n.a.	n.a.

n.a. = not available

Note: The company operations listed in this table are captured by the aggregate data material used for this book in the following manner: (1) US companies: US-located operations are part of the US parent, while foreign operations constitute US majority-owned foreign affiliates. (2) Foreign companies: foreign-located operations are not covered in the aggregate data material, while US-located operations constitute US majority-owned US affiliates of foreign parents. Table is incomplete due to changes in the format of company filings. Due to rounding, percentages may not add up to 100. *Manufacturing Market Insider* 2005 rankings show the same five companies on top ranked Flextronics, Foxconn, Sanmina-SCI, Solectron, and Celestica.

Sources: Company 2000, 2004 10-K filings; Celestica Inc. 2000, 2004 20-F filings; company annual reports; Taiwan Stock Exchange; *Manufacturing Market Insider* March 2004.

an important way of ensuring continued domestic IT production and jobs, and this will be of increasing importance as the demand for IT services and software pervades the US economy.

The Rise of the Global IT and Communications Company

While it is important to focus on IT markets from the perspective of nations, and in particular on differences in trends among countries, so too is it important to examine who the companies are that actually supply these markets and develop much of the new technology. Given the rapid globalization of the IT industry, with many multinational companies located in dozens of different countries, a company-based analysis of the global IT market may yield valuable information about the performance of US multinationals in global IT markets. Such an analysis is an essential addition to the picture of the global marketplace that emerges from using data based on the country as the unit of analysis.

According to the OECD, the world's top 250 technology and communications companies in 2003 made their home in 25 different nations, 18 of which are OECD members.[23] The companies had revenues that year totaling almost $2.5 trillion, and they employed nearly 10 million people. More than half of the 250 firms were American, although this dominance is somewhat less pronounced when looking at revenues and numbers of employees, where US companies account for somewhat less than 40 percent of the total. The EU-25 and Japan account for significantly smaller shares of the number of top technology and communications companies, while both make up approximately a quarter of the top 250 in terms of revenues and employment. Among non-OECD countries, whereas China was the top IT exporter (table 2.1), only three Chinese technology companies are on the top 250 list of IT firms.

An alternative source of information about companies is a composite ranking by *BusinessWeek* magazine based on several different parameters for classification and ranking. (The challenges and risks involved in making such classifications and rankings are discussed in appendix 2B.)

Table 2.6 shows a snapshot ranking of global firms in IT hardware and IT services and software sectors. The table confirms what other data show: US IT hardware companies no longer dominate the global IT hardware market, but they do dominate the software, services, and Internet global market. In corporate rankings of the fastest-growing IT services,

23. These figures draw on data from OECD (2004a, annex A). These data incorporate both IT and communications. For the purposes of these data, companies primarily belonging in the following Standard Industrial Classification (SIC) categories are included; 4813, 3663, 3577, 3669, 3661, 8711, 3511, 3651, 3674, 3861, 3571, 3621, 3572, 7373, 5045, 8742, 7374, 7379, 7372, and 4899. See appendix 2B for additional detail.

Table 2.6 Top 25 global IT services/software/Internet and hardware companies, 2004–05

Rank	Firm	Country	Sector	Revenues, 2004–05 (millions of US dollars)	Profits, 2004–05 (millions of US dollars)
IT services/software/Internet companies					
1	IBM	United States	IT services	97,026	8,252
2	Microsoft	United States	Software	38,919	11,224
3	Accenture	US (Bermuda)	IT services	16,145	800
4	CSC	United States	IT services	14,768	519
5	Oracle	United States	Software	10,997	2,852
6	First Data	United States	IT services	10,235	1,762
7	SAP	Germany	Software	9,675	1,682
8	Atos Origin	France	IT services	6,594	13
9	Yahoo!	United States	Internet	3,991	943
10	Google	United States	Internet	3,794	704
11	Fiserv	United States	IT services	3,794	439
12	SunGard Data Systems	United States	IT services	3,662	458
13	Symantec	United States	Software	2,583	536
14	Tata Consulting Services	India	IT services	2,168	503
15	Wipro	India	IT services	1,865	363
16	Adobe Systems	United States	Software	1,716	479
17	Infosys Technologies	India	IT services	1,592	419
18	CACI International	United States	IT services	1,552	83
19	Activision	United States	Software	1,406	138
20	Verisign	United States	Internet	1,338	226
21	Anteon International	United States	IT services	1,330	67
22	Autodesk	United States	Software	1,292	255
23	SRA International	United States	IT services	822	54
24	Satyam Computer Services	India	IT services	794	154
25	Cognizant Technology Solutions	United States	IT services	649	112
Total				238,703	33,036
IT hardware companies					
1	Hewlett-Packard	United States	Computers and peripherals	76,828	2,979
2	Samsung Electronics	Korea	Computers and peripherals	71,585	9,423
3	Dell	United States	Computers and peripherals	51,051	3,246
4	Intel	United States	Semiconductors	35,552	7,964
5	LG Electronics	Korea	Computers and peripherals	33,773	1,405
6	Canon	Japan	Computers and peripherals	33,698	3,376
7	Hon Hai Precision Industries	Taiwan	Computers and peripherals	16,237	892
8	Texas Instruments	United States	Semiconductors	12,616	1,905
9	Apple Computer	United States	Computers and peripherals	11,097	752
10	EMC	United States	Computers and peripherals	8,601	1,001
11	Applied Materials	United States	Semiconductors	8,081	1,489

(table continues next page)

Table 2.6 Top 25 global IT services/software/Internet and hardware companies, 2004–05 *(continued)*

Rank	Firm	Country	Sector	Revenues, 2004–05 (millions of US dollars)	Profits, 2004–05 (millions of US dollars)
12	Taiwan Semiconductor Manufacturing	Taiwan	Semiconductors	7,730	2,748
13	Asutek Computers	Taiwan	Computers and peripherals	7,496	453
14	Compal Electronics	Taiwan	Computers and peripherals	6,889	197
15	Acer	Taiwan	Computers and peripherals	6,746	210
16	Seagate Technology	US (Cayman Islands)	Computers and peripherals	6,710	394
17	Lite-on Technology	Taiwan	Computers and peripherals	6,432	227
18	NCR	United States	Computers and peripherals	6,037	325
19	Nikon	Japan	Semiconductors	5,945	225
20	Tokyo Electron	Japan	Semiconductors	5,919	251
21	BenQ	Taiwan	Computers and peripherals	5,239	228
22	Nidec	Japan	Computers and peripherals	4,524	312
23	TPV Technology	Hong Kong (Bermuda)	Computers and peripherals	3,738	108
24	Chi Mei Opto-electronics	Taiwan	Computers and peripherals	3,535	515
25	Western Digital	United States	Computers and peripherals	3,447	187
Total				439,507	40,813

Notes: Companies selected by *BusinessWeek* must be publicly traded, nonmonopolistic, have a minimum of $300 million in revenues, and not have a stock that has declined more than 75 percent in the last year. They are selected based on return on equity, shareholder return, revenue growth, and revenues. Revenues and profits are for the latest available 12-month period. To ensure continuity over time, the top companies from the 2004 rankings not included in 2005 have been added to each ranking with 2004 data (CSC and Hewlett-Packard).

Sources: Information Technology 100, 2004, *BusinessWeek,* June 21, 2004; Information Technology 100, 2005, *BusinessWeek,* June 20, 2005.

software, and Internet sectors, 19 of the top 25 companies are American (with Accenture classified as a US company), while four are Indian, and only two European. While Indian IT services companies have certainly proven highly competitive in recent years and saw revenue increases of up to 30 percent in 2004–05, table 2.6 indicates that they still have some way to go to become truly global in scale.

In IT hardware, whereas the United States is still well represented among the top 25 (10 companies), the US position is far less dominant compared with the IT services, software, and Internet ranking. The United States is nearly equaled by Taiwan, which places eight companies in the ranking, with the remainder coming from Japan (four), Korea (two), and Hong Kong (one). Notably, not a single European IT hardware company makes the top 25. The data confirm the rise of Taiwanese (not Chinese)

companies as subcontractors and producers of IT hardware for other manufacturers.

What with the rise of global producers of IT hardware products, the increase in global supply, even with increased global demand, puts downward pressure on IT hardware prices, as will be quantified in the next chapter. In moving away from this global competition, US firms have focused on the more rapidly expanding marketplace of services and software. But table 2.6 also shows that this is also the more lucrative marketplace: the profit margin of the combined top 25 IT services, software, and Internet companies is significantly above that of IT hardware companies (14 percent versus 9 percent). So it would appear that greater benefits accrue to US firms from dominating the fast-growing IT services, software, and Internet sector, rather than the increasingly commoditized IT hardware sector.[24]

In sum, the global IT marketplace has become broad-based across industrial and developing countries. Growth rates of spending, production, trade, and investment are very rapid around the world. New producers, exporters, and multinationals have emerged. Even as the United States remains the largest market, it is no longer the most important global exporter. The relative importance of the hardware versus the software and services markets appears somewhat different depending on the level of GDP per capita. There is overall a trend toward increased spending on IT software and services, portending the globalization of those markets and products too.

24. Rates of return will be particularly volatile in highly cyclical sectors, such as IT hardware. Yet the corresponding numbers from *BusinessWeek's* top 100 ranking of IT firms for 2004 show the same significantly higher profit margin in IT services, software, and Internet sectors, with 11 percent versus only 6 percent for the IT hardware sector.

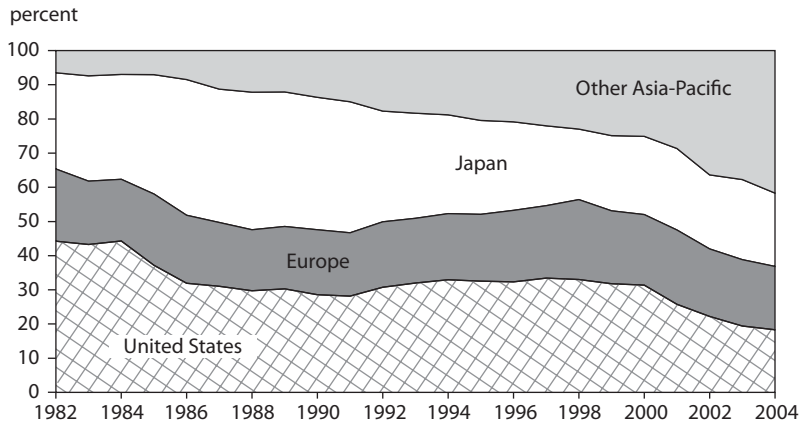
Appendix 2A
The Shifting Global Market for Semiconductors

The Asia-Pacific region is now the dominant location for immediate demand for semiconductors—one of the fundamental products of the IT and communications industries—but the United States continues to lead in supplying the global marketplace for chips.

As a receiver of shipments, the American market held stable at about one-third of global shipments through 2000, but then dropped precipitously following the dot-com bust to account for about 18 percent of global end use in 2004. Japan's demand continued to decline as that economy remained sluggish. In contrast, the Asia-Pacific share in global demand increased from about 15 percent in 1990 to 20 percent in 1995 and to 42 percent in 2004 (figure 2A.1).

On the other hand, as suppliers of semiconductors, the United States reaches all markets, and is particularly capable in penetrating new markets. American suppliers held their market share through the 1990s, and in 2004 still supplied 60 percent of the American marketplace for chips and about 50 percent of the markets in Europe and the Asia-Pacific region (excluding Japan) (table 2A.1).[25] US exports of semiconductors exceeded imports by an increasing margin through the 1990s, which shows the increasing competitiveness of the highest-technology semiconductors in the global marketplace.

Figure 2A.1 Shares of world semiconductor market, 1982–2004



Source: Semiconductor Industry Association, www.sia-online.org/pre_statistics.cfm.

25. Semiconductor Industry Association industry statistics on world market shares, available at www.sia-online.org/pre_statistics.cfm (accessed September 30, 2006).

Table 2A.1 World semiconductor market supply and demand, 1982–2004 (percent)

Supplying region	Demanding region					Total value (millions of US dollars)
	Americas	Europe	Japan	Asia-Pacific	Total demand	
1982						
Americas	88.7	54.6	10.1	42.3	56.7	8,030
Japan	10.4	7.1	89.9	25.4	32.5	4,603
Other	0.9	38.3	0.0	32.3	10.8	1,529
1991						
Americas	69.9	45.2	12.5	42.7	39.2	21,193
Japan	19.7	14.7	86.1	33.9	46.4	25,086
Other	10.4	40.2	1.5	23.3	14.4	7,785
1999						
Americas	71.2	57.0	21.1	47.8	51.4	76,781
Japan	11.7	12.2	71.5	27.1	28.5	42,573
Other	17.1	30.8	7.4	25.1	20.1	30,025
2001						
Americas	72.5	54.6	22.8	53.1	51.2	71,149
Japan	11.1	14.3	70.3	18.6	28.1	39,049
Other	16.4	31.1	6.9	28.3	20.7	28,765
2004						
Americas	59.9	49.5	22.8	52.0	46.7	100,123
Japan	12.9	12.5	68.7	17.0	25.6	55,174
Other	27.2	38.0	8.5	31.0	26.8	57,730

Source: Semiconductor Industry Association, www.sia-online.org/pre_statistics.cfm.

Appendix 2B
How to Classify and Rank the Top Technology Companies

The immediate issue when one attempts to compile a meaningful list of the world's top technology companies, as seen in tables 2B.1 and 2.6, is the choice of ranking parameter. At least four such parameters spring to mind, each with separate implications and problems:

- *Current revenues:* Generally the most widely used indicator, this gives an intuitive reflection of the size of the company in the ranking.
- *Market capitalization:* This parameter should (in theory) reflect the present value of future earnings and hence be an indicator of the future of the company rather than its present size. Furthermore, there may be significant distortions imposed on cross-country comparisons arising from the capital market structure of the home country, which may be different from that of the United States. Companies may traditionally be more reliant on bank loans than on issuing equity capital, or frequently may not be listed at all.
- *Profit margin:* This parameter says something about the success of the firm, an issue again of intuitive importance when attempting to identify the top companies. However, this type of data can be both difficult to obtain (and ambiguous to interpret), and may fluctuate highly over time, making robust ranking difficult.
- *Number of employees and plants:* This parameter measures the physical size of the company, which is frequently of political importance when assessing companies. Yet, with the development of automated, advanced production techniques in IT and communications, as well as the adoption of global supply chains, where much of the manufacturing of inputs is done by geographically distant subcontractors, a ranking based on this type of data may not reflect the true size of the company in the marketplace, and could indeed likely be inversely proportional to corporate profitability parameters.

Hence, current revenue is a frequently used parameter, especially when ranking companies within a given industries. Unfortunately, when applied to the IT and communications industries, the current revenue parameter raises several conceptual issues. First, such segmentation of IT companies into subsector categories carries a methodological risk, because many of the world's large technology companies today have business operations in both subsectors of IT.[26]

26. For instance, IBM is a large IT services provider, but retains a very substantial IT hardware business as well. Other firms, especially Asian companies of the conglomerate type such as Samsung or LG, manufacture not just IT hardware but also significant amounts of consumer electronics, creating a similar type of issue.

Table 2B.1 Top 50 information technology and communications firms
(millions of current US dollars and number employed)

Rank	Company	Country	Industry	Revenue, 2003	Employees, 2002	R&D, 2002	Market cap, 2003
IT firms							
1	IBM	United States	IT equipment	86,902	315,889	4,750	141,805
2	Siemens	Germany	Electronics	85,894	426,000	5,490	53,873
3	Hewlett-Packard	United States	IT equipment	71,256	141,000	3,312	59,228
4	Hitachi	Japan	Electronics	67,157	306,989	3,307	12,226
5	Sony	Japan	Electronics	63,353	168,000	3,455	33,785
6	Matsushita	Japan	Electronics	62,744	291,232	4,514	21,745
7	Toshiba	Japan	IT equipment	47,944	176,398	2,601	13,679
8	Samsung	Korea	Electronics	47,613	173,000	2,500	40,404
9	NEC	Japan	IT equipment	41,090	141,909	2,661	12,080
10	Fujitsu	Japan	IT equipment	38,480	170,111	2,790	9,226
11	Nokia	Finland	Communications equipment	37,670	57,716	2,879	74,012
12	Dell Computer	United States	IT equipment	35,404	39,100	452	82,350
13	Microsoft	United States	Software	32,187	50,500	4,307	285,413
14	Mitsubishi	Japan	Electronics	30,848	116,192	1,632	n.a.
15	Philips	Netherlands	Electronics	29,947	170,000	2,871	21,471
16	Intel	United States	Electronics	28,527	78,700	4,034	177,332
17	Motorola	United States	Communications equipment	26,293	97,000	3,754	23,947
18	Canon	Japan	Electronics	25,760	97,802	1,864	42,202
19	EDS	United States	Services	21,731	137,000	0	10,608
20	Sanyo Electric	Japan	Electronics	19,856	80,500	853	n.a.
21	Cisco Systems	United States	Communications equipment	18,878	36,000	3,448	133,215
22	Alcatel	France	Communications equipment	18,694	75,940	2,100	13,203
23	LG Electronics	Korea	Electronics	18,080	55,000	551	n.a.
24	3M	United States	Electronics	17,179	68,774	1,066	56,129
25	Emerson	United States	Electronics	17,042	111,500	530	22,757
26	Sharp	Japan	Electronics	16,834	46,518	1,154	11,433
27	Tech Data	United States	Services	15,739	8,000	n.a.	1,900
28	Xerox	United States	Electronics	15,716	67,800	917	7,544
29	Ericsson	Sweden	Communications equipment	14,971	85,198	4,424	23,844
30	Ricoh	Japan	Electronics	14,732	74,600	644	13,997
31	Accenture	Bermuda	Services	13,397	75,000	235	19,691
32	Flextronics	Singapore	Electronics	13,379	95,000	n.a.	6,585
Communications firms							
1	NTT	Japan	Telecom	91,026	213,062	3,118	31,747
2	Verizon	United States	Telecom	67,734	245,000	n.a.	99,159
3	France Telecom	France	Telecom	52,048	211,554	680	24,140
4	Deutsche Telecom	Germany	Telecom	50,528	255,896	849	47,260
5	Vodafone	United Kingdom	Telecom	47,962	67,178	164	122,931
6	SBC	United States	Telecom	42,310	175,980	n.a.	67,703
7	AT&T	United States	Telecom	36,480	71,000	254	18,297

(table continues next page)

Table 2B.1 Top 50 information technology and communications firms
(millions of current US dollars and number employed) *(continued)*

Rank	Company	Country	Industry	Revenue, 2003	Employees, 2002	R&D, 2002	Market cap, 2003
8	Telecom Italia	Italy	Telecom	32,983	101,713	124	45,812
9	BT	United Kingdom	Telecom	30,460	108,600	540	22,568
10	Telefonica	Spain	Telecom	26,739	161,029	n.a.	47,180
11	Sprint	United States	Telecom	25,604	72,200	n.a.	n.a.
12	KDDI	Japan	Telecom	23,591	9,300	67	13,063
13	BellSouth	United States	Telecom	22,399	77,000	n.a.	41,612
14	China Mobile	China	Telecom	15,527	59,633	n.a.	40,608
15	Qwest	United States	Telecom	15,487	50,788	n.a.	5,984
16	BCE	Canada	Telecom	14,987	66,266	n.a.	17,993
17	Telstra	Australia	Telecom	13,242	44,977	28	31,250
18	Korea Telecom	Korea	Telecom	13,104	48,668	n.a.	n.a.

n.a. = not available

Note: Revenues for 2003 based on financial year reported in 2003 or most recent four quarters.

Source: OECD (2004a, table A.3), compiled from annual reports, Securities and Exchange Commission filings, and market financials.

Moreover, the IT and communications industry is highly diverse. Consider the recent ranking by the Organization for Economic Cooperation and Development of the top 50 global IT and communications companies (OECD 2004a). Twenty-two of the top 50 are IT companies and account for 47 percent of the total revenues included in the rankings. Eighteen of the companies are telecommunications carriers, accounting for 36 percent of revenues, while the remaining 10 are IT services, telecommunications equipment manufacturers, or software companies. Most of the telecommunications carriers are former government monopolies (some remain that), which owe the vast majority of their revenues to a historical legal monopoly and declining marginal costs in their industry. Throwing such old beasts together with software companies—an industry that barely existed 15 years ago, arose from private entrepreneurship, has essentially zero marginal costs at any level of production, and is only now going through a first round of consolidation—will invariably skew the ranking toward telecommunications carriers.

Finally, as with any table based on a single year and in dollar terms, rankings can change.