

U. S. DEPARTMENT OF COMMERCE

**The**  
**EMERGING**  
**DIGITAL**  
**ECONOMY II**

**APPENDICES**



JUNE 1999

# The Emerging Digital Economy II – Appendices

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## APPENDIX TO CHAPTER II

### INFORMATION TECHNOLOGY PRODUCING INDUSTRIES

This Appendix describes the sources of data and methods used to assess the economic impacts of Information Technology (IT) Producing industries represented in Chapter II of the *Emerging Digital Economy II* (EDE II) report.

#### **DEFINING INFORMATION TECHNOLOGY PRODUCING INDUSTRIES**

IT-producing industries selected for EDE II are the same as selected for last year's (1998) *Emerging Digital Economy* report. (Table A-2.1) As in last year's analysis, the criteria for selection were "industries that produce, process, or transmit information goods and services as either intermediate demand (inputs to production of other industries) or as final products (demand by consumers, investors, government, or exports) *or* industries that provided the infrastructure necessary to operate the Internet and electronic commerce (e-commerce).

IT-producing industries were selected according to their definition in the Office of Management and Budget's 1987 Standard Industrial Classification (SIC) Manual. Next year's report will use the new North American Industry Classification System (NAICS). The NAICS provides for an expansion of the number of industries classified, particularly in the new Information Sector.

Finally, industries presented here, in no way, represent an *official* U.S. government listing of IT-producing industries. Industries were selected as objectively as possible for this particular economic assessment. International organizations such as the Organization for Economic Co-operation and Development and private industry associations such as the American Electronics Association and the Information Technology Institute also maintain lists of what they consider to be IT-producing industries, which vary from the one used here.<sup>1</sup>

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<sup>1</sup>See last year's *Emerging Digital Economy* report for a comparison of industries used in this analysis with those used by the AEA and ITI.

**Table A-2.1**  
**Information Technology Producing Industries**

<b>Hardware Industries</b>	<b>SIC</b>	<b>NAICS</b>
Computers and equipment	3571, 2, 5, 7	334111, 2, 3, 9
Wholesale trade of computers and equipment	5045pt.	42413pt.
Retail trade of computers and equipment	5734pt.	44312pt.
Calculating and office machines, nec	3578, 9	334119, 333313, 339942, 334518
Electron tubes	3671	334411
Printed circuit boards	3672	334412
Semiconductors	3674	334413
Passive electronic components	3675-9	334414, 5, 6, 7, 8, 9, 336322
Industrial instruments for measurement	3823	334513
Instruments for measuring electricity	3825	334416, 334515
Laboratory analytical instruments	3826	334516
 <b>Software/Service Industries</b>		
Computer programming services	7371	54513
Prepackaged software	7372	51121, 334611
Wholesale trade of software	5045pt.	42143pt.
Retail trade of software	5734pt.	44312pt.
Computer integrated system design	7373	541512
Computer processing, data preparation	7374	51421
Information retrieval services	7375	514191
Computer services management	7376	541513
Computer rental and leasing	7377	53242
Computer maintenance and repair	7378	44312, 811212
Computer related services, nec.	7379	541512, 541519
 <b>Communications Services Industries</b>		
Telephone and telegraph communications	481, 22, 99	513321, 513322, 51333, 51331, 513322, 51334, 51339
Radio broadcasting	4832	513111, 513112
Television broadcasting	4833	51312
Cable and other pay TV services	4841	51321, 51322
 <b>Communications Equipment Industries</b>		
Household audio and video equipment	3651	33431
Telephone and telegraph equipment	3661	33421, 334416, 334418
Radio and TV communications equipment	3663	33422
Magnetic and optical recording media	3695	334613

## **MEASURING INFORMATION TECHNOLOGY PRODUCING INDUSTRIES**

IT-producing industries were measured in terms of their Gross Product Originating (GPO). GPO by industry is the contribution of each private industry and government to Gross Domestic Product (GDP). An industry's GPO, often referred to as its "value added" (the term used in last year's report) is equal to its gross output (sales or receipts and other operating income, commodity taxes, and inventory change) minus its intermediate inputs (consumption of goods and services purchased from other industries or imported). GPO and value added can be thought of more directly as the sum of the costs incurred by an industry, such as compensation of employees, net interest and indirect business taxes, and profits earned in production.

The analysis of IT-producing industries was made consistent with the Gross Product by Industry series published by the Bureau of Economic Analysis (BEA) which adds to GDP. Although GPO and value added are considered to be the same, value added data for manufacturing industries published by the Census are not the same as the BEA's published GPO series, *i.e.*, BEA excludes an industry's purchases of "other services" (SIC 89) in its GPO by industry measurement, not excluded by the Census value added measurement. For example, in 1996, the Census value added for the Electronic and electric equipment industry (SIC 36) was \$184.0 billion. The BEA GPO for SIC 36 was \$141.6 billion, a \$42.4 billion difference. This difference becomes a factor in the estimate of GPO for 4-digit SIC IT-producing industries, as discussed in the next section. In this analysis, the value added data from the Census was made consistent with the GPO series and is described below.

Annual production data were used to determine the effect on prices and contribution to overall economic (GDP) growth of IT-producing industries, *whether or not* all of the industry's production was finally used as an information product or by the Internet or electronic commerce. For example, not all production from the semiconductor industry is used by the computer industry and other industries considered to be IT-producing. Semiconductors are also used in autos, home appliances, and a variety of other goods. However, it would be difficult, if not impossible, to differentiate the industry's sales by users. Therefore, total annual production data of the semiconductor industry are used in this analysis.

GPO by industry avoids the duplication (double-counting) resulting from adding an industry's value of shipments, sales, or revenues to that of another industry. For example, the value of shipments of the computer industry already includes cost of semiconductors which is included in the semiconductor value of shipments. Adding the nominal GPO of the two industries avoids this double-counting. The sum of GPO for all industries and Government is GDP.

### **GPO of IT-Producing Industries: 1990-96**

The following is a description of the data and the methods used to derive GPO at the 4-digit SIC industry level for 1990 through 1996 for the IT-producing industries. (Table A-2.2) Published data from the Census at the 2, 3, and 4-digit SIC industry level and BEA at the 2-digit SIC level were used to derive these 1990-

**Table A-2.2**  
**Information Technology Producing Industries**  
**Gross Product Originating**

Industry	SIC	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
				(Value Added: \$millions, except as noted)					estimate		
<b>Total Gross Domestic Income (GDI)</b>		<b>\$5,726,400</b>	<b>\$5,906,600</b>	<b>\$6,199,700</b>	<b>\$6,505,500</b>	<b>\$6,932,400</b>	<b>\$7,296,100</b>	<b>\$7,693,800</b>	<b>\$8,166,700</b>	<b>\$8,534,202</b>	<b>\$8,875,570</b>
<b>Year-to-Year GDI Change (%)</b>			3.15%	4.96%	4.93%	6.56%	5.25%	5.45%	6.15%	4.50%	4.00%
<b>Hardware</b>											
Computers and equipment	3571,2,5,7	24,659.9	21,032.0	21,794.3	21,175.2	23,994.4	28,368.5	30,187.8	34,474.5	36,818.7	40,390.1
Computers and equipment wholesale sales	5045 pt	33,599.0	35,747.0	39,465.0	42,275.0	43,249.0	50,756.0	61,129.0	69,778.8	74,558.6	80,538.2
Computers and equipment retail sales	5734 pt	1,857.2	1,874.6	1,901.5	2,277.2	2,701.8	2,840.5	2,777.4	3,166.5	3,383.4	3,660.9
Calculating and office machines, nec	3578,9	2,241.5	1,950.9	2,138.7	2,155.3	2,151.4	2,450.3	2,509.3	2,674.9	2,816.7	3,019.5
Electron Tubes	3671	1,161.2	1,031.2	1,046.0	1,012.2	1,178.2	1,197.2	1,247.0	1,340.5	1,425.0	1,514.8
Printed circuit boards	3672	4,403.3	3,140.1	3,552.1	3,707.1	4,376.5	4,401.8	5,051.2	5,536.1	6,039.9	6,933.8
Semiconductors	3674	15,733.0	18,374.3	18,216.7	23,584.1	31,481.3	40,632.0	43,335.2	54,602.4	58,588.3	63,861.3
Passive electronic components	3675-9	11,542.6	12,695.2	13,466.6	14,322.1	16,002.9	15,279.6	15,055.2	14,573.5	15,316.7	16,618.6
Industrial instruments for measurement	3823	2,320.2	2,374.2	2,538.8	2,332.0	2,424.2	2,513.6	2,928.6	3,277.1	3,529.4	3,762.4
Instruments for measuring electricity	3825	3,298.6	3,439.7	3,472.4	3,078.3	3,530.3	3,956.8	4,877.7	5,199.6	5,480.4	5,864.1
Laboratory analytical instruments	3826	1,860.4	1,975.9	1,823.7	1,847.1	1,921.8	2,121.0	2,753.8	2,751.0	2,858.3	3,058.4
<b>Total Hardware</b>		<b>102,676.8</b>	<b>103,635.2</b>	<b>109,415.8</b>	<b>117,765.7</b>	<b>133,011.8</b>	<b>154,517.4</b>	<b>171,852.2</b>	<b>197,374.9</b>	<b>210,815.5</b>	<b>229,222.1</b>
<b>Software/Services</b>											
Computer programming services	7371	14,902.9	16,341.6	18,137.5	19,121.1	21,719.6	24,504.7	29,475.1	n.a.	n.a.	n.a.
Prepackaged software	7372	10,615.1	11,760.6	14,174.0	16,181.9	18,543.6	21,360.7	27,491.1	n.a.	n.a.	n.a.
Prepackaged software wholesale sales	5045 pt	1,697.0	1,806.0	1,994.0	2,136.0	2,185.0	2,564.0	3,088.0	n.a.	n.a.	n.a.
Prepackaged software retail sales	5734 pt	93.6	94.5	95.9	114.8	136.2	143.2	140.0	n.a.	n.a.	n.a.
Computer integrated systems design	7373	9,424.2	10,033.5	11,505.0	11,829.2	12,431.2	12,758.0	14,122.7	n.a.	n.a.	n.a.
Computer processing and data preparation	7374	10,256.1	10,833.9	12,226.0	13,649.4	16,792.4	20,493.1	28,687.2	n.a.	n.a.	n.a.
Information retrieval services	7375	2,435.2	2,534.1	2,803.9	2,936.4	3,130.0	3,668.3	4,834.8	n.a.	n.a.	n.a.
Computer services management	7376	1,369.0	1,514.6	1,860.2	1,755.5	1,820.8	1,960.8	2,035.0	n.a.	n.a.	n.a.
Computer rental and leasing	7377	1,587.9	1,438.9	1,488.1	1,490.6	1,596.3	1,763.9	2,203.5	n.a.	n.a.	n.a.
Computer maintenance and repair	7378	4,273.9	4,244.5	4,859.0	5,062.2	5,664.2	6,519.6	8,416.9	n.a.	n.a.	n.a.
Computer related services, nec	7379	3,006.0	3,424.6	4,291.2	5,197.8	6,814.5	8,729.9	11,537.5	n.a.	n.a.	n.a.
<b>Total Software and services</b>		<b>59,660.9</b>	<b>64,026.8</b>	<b>73,434.8</b>	<b>79,474.9</b>	<b>90,833.8</b>	<b>104,466.2</b>	<b>132,031.8</b>	<b>150,033.8</b>	<b>172,955.6</b>	<b>199,282.0</b>
<b>Communications</b>											
Household audio and video equipment	3651	1,627.0	1,779.0	1,866.0	2,017.9	2,028.3	1,938.9	1,612.7	1,567.6	1,533.1	1,499.3
Telephone and telegraph equipment	3661	8,272.0	7,965.2	10,199.6	10,681.2	10,895.0	12,078.0	14,959.2	15,767.0	16,634.2	17,199.8
Radio and TV and communications equip.	3663	9,698.2	8,666.6	10,022.7	9,376.4	12,876.9	14,152.4	13,687.1	15,124.3	16,712.3	18,467.1
Magnetic and optical recording media	3695	1,440.9	1,642.8	1,711.7	1,876.9	2,012.4	2,379.2	1,951.4	1,908.5	1,866.5	1,825.4
<b>Total Communications Hardware</b>		<b>21,038.1</b>	<b>20,053.7</b>	<b>23,800.0</b>	<b>23,952.4</b>	<b>27,812.5</b>	<b>30,548.5</b>	<b>32,210.5</b>	<b>34,367.4</b>	<b>36,746.1</b>	<b>38,991.7</b>
Telephone and telegraph communications	481,22, 99	119,100.0	123,700.0	129,700.0	134,600.0	142,100.0	145,200.0	157,000.0	158,600.0	182,253.0	193,894.0
Radio broadcasting	4832	4,931.7	5,302.1	4,953.8	6,545.7	7,019.2	8,022.9	8,593.5	9,389.0	10,449.2	11,860.9
Television broadcasting	4833	12,185.7	11,590.7	11,613.9	14,711.1	16,226.1	18,386.3	18,890.4	20,498.5	21,493.3	23,238.8
Cable and other pay TV services	4841	10,482.6	13,607.3	14,932.3	19,743.2	19,254.6	21,690.9	22,916.1	26,381.0	28,864.7	32,512.8
<b>Total Communications Services</b>		<b>146,700.0</b>	<b>154,200.0</b>	<b>161,200.0</b>	<b>175,600.0</b>	<b>184,600.0</b>	<b>193,300.0</b>	<b>207,400.0</b>	<b>214,868.5</b>	<b>243,060.2</b>	<b>261,506.5</b>
<b>Total IT-Producing Industries</b>		<b>330,075.8</b>	<b>341,915.7</b>	<b>367,850.6</b>	<b>396,793.0</b>	<b>436,258.2</b>	<b>482,832.1</b>	<b>543,494.6</b>	<b>596,644.6</b>	<b>663,577.5</b>	<b>729,002.3</b>
<b>Share of the Economy (%)</b>		5.8%	5.8%	5.9%	6.1%	6.3%	6.6%	7.1%	7.3%	7.8%	8.2%
<b>Contribution to Nominal Economic Growth (%)</b>			6.6%	8.8%	9.5%	9.2%	12.8%	15.3%	11.2%	18.2%	19.2%

Sources: ESA estimates derived from BEA and Census data for 1990-96;  
Estimates for 1997-99 derived from Commerce's "U.S. Industry and Trade Outlook."



1996 estimates of GPO. Published 4-digit SIC industry level data were not available for 1997-99 where industry growth estimates were used to determine GPO. This method is explained in the next section.

**GPO for Hardware and Communications equipment IT-producing industries**, all in manufacturing, were derived from Census value added data, at the 4-digit SIC level, and then made consistent with BEA's Gross Product by Industry data. Census sources for value added of these 4-digit SIC IT-producing sectors were from the *1990-91 and 1993-96 Annual Survey of Manufactures* and from the *1992 Census of Manufactures*.

The Census 4-digit industry value added data for IT-producing industries were adjusted by BEA's Gross Product by industry series at the 2-digit SIC level, within the same overall industry categories. For example, the Census published value added of Semiconductors (SIC 3674) of \$56.3 billion was reduced by a factor of 0.77 in 1996 ( the ratio of BEA's GPO for Electronic and electric equipment (SIC 36) of \$141.6 billion compared with the Census value added of \$184.0 billion). Thus, nominal GPO in 1996 for semiconductors was estimated to be \$43.3 billion.

GPO for wholesale trade of computer equipment (part of SIC 5045) was added to the category called IT-producing hardware industries since over half of wholesale trade of computers came directly from computer manufacturers' branch offices. Although counted by the Census as a wholesale sale and not a manufacturer's shipment, the actual sale is primarily a direct manufacturer's sale. The nominal value of computer sales from branch offices of manufacturers has been twice that of computer sales directly from manufacturing facilities through the 1990s.

Annual source data for 1990-91 and 1993-96 for wholesale trade of computers and equipment were available at the 3-digit SIC industry level in the Census' Current Business Report called the *Annual Benchmark Report for Wholesale Trade*. In this report, gross margins (sales less costs of goods sold) by wholesale industries were reported under SIC 504, Wholesale sales of professional and commercial equipment and supplies.

Source data for wholesale trade of computers and computer equipment in 1992, at the 4-digit SIC industry level are available from the Census' *1992 Economic Census of Wholesale Trade* and were used to derive the GPO for SIC 5045, Wholesale sales of computer equipment (and software). In this report, data for SIC 5045 include sales and purchased operating expenses from merchant wholesalers, manufacturer's sales from branch offices, and agents, brokers, and commission merchants. This Census report also separates sales and purchased operating expenses for computers, *both* equipment and software.

The ratio of manufacturer branch office sales to total wholesale sales of computer equipment (part of SIC 5045) and their corresponding purchased operating expenses were taken directly from the 1992 report. This ratio was then used to distribute the gross margin data of the annual reports (SIC 504) to derive final estimates of GPO of manufacturer sales of computer equipment from branch offices for 1990-91 and 1993-1996 at the 4-digit SIC level.

GPO for retail trade of computer equipment and software (SIC 5734) was derived in much the same way

as the wholesale estimates, described above. The Census' *Annual Benchmark Report for Retail Trade* reports total sales and gross margins for the 3-digit SIC sector (SIC 573). Data on purchased operating expenses as well as the distribution between equipment and software from the *1992 Census of Retail Trade* were then used to disaggregate the 3-digit SIC sector to the 4-digit SIC 5734 for 1990-91 and 1993-96.

**GPO for the computer software and computer services IT-producing industries** was derived using the *1992 Census of Service Industries* and Current Business Report called the *Service Annual Survey* for 1990-91 and 1993-96. Similar to the derivation of GPO for the wholesale and retail trade of computer equipment and software, 4-digit SIC data on revenue and operating expenses from the 1992 Census of Service Industries were used as a pattern to derive annual data from 3-digit SIC "controls" for 1990-91 and 1993-96.

The *1992 Census of Service Industries* includes a Subject Series report called *Sources of Receipts and Revenue* from which the cost of goods sold can be computed. For most of the Software and services IT industries, the cost of *goods* sold was less than 2 percent of total receipts. However, three of the computer services industries derived a significant portion of their revenue from the sale of a good: Computer rentals and leasing (SIC 7377) where the cost of goods sold represented 8.6 percent of total receipts; Computer maintenance and repair (SIC 7378), 7.6 percent; and Computer services, not elsewhere classified (SIC 7379), 2.4 percent. The costs of these goods (computers and equipment) for these service industries were deducted from total receipts to arrive at a gross margin estimate. The 1992 Census report also provides a Subject Series report called *Capital Expenditures, Depreciable Assets, and Operating Expenses*. The report lists operating expenses for 4-digit SIC Software and service IT industries.

GPO for the Software and service IT industries, in 1992, are computed by subtracting cost of goods sold and purchased operating expenses from its total receipts for the 4-digit sectors. This distribution is then applied to 4-digit receipts data for these industries in 1990-91 and 1993-96 using the annual report.

In 1996, the GPO to total receipts ratio of the Software and service IT industries average about 70 percent. In contrast, the GPO to shipments ratio for computer equipment manufacturing (SICs 3571, 2, 5, and 7) in 1996 was only 38 percent.

GPO for Prepackaged software wholesale sales (part of SIC 5045) and retail sales (part of 5734) were derived using data from the Census *Annual Benchmark Reports for Wholesale Trade and for Retail Trade* for 1990-91 and 1993-96 and the Census' *1992 Economic Census of Wholesale Trade and Census of Retail Trade*.

**GPO for the Communications services IT-producing industries** were taken directly from BEA's Gross product by industry series for 1990 through 1997.<sup>2</sup> Revenue and cost of purchased services data from the Census' *Annual Survey of Communications Services* were used to verify the BEA's published GPO for the telecommunications sector.

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<sup>2</sup>BEA GPO series are published at the 2-digit SIC level. Except for communications, all IT-producing industries are at the 4-digit level.

## GPO of IT-Producing Industries: 1997-99

GPO of IT-producing industries was estimated beginning in 1997 since Census data for these industries were not yet available. Estimates of annual industry shipments for 1997 through 1999 provided in the “U.S. Industry and Trade Outlook, 99.” (*Outlook*), jointly published by the Department of Commerce and DRI/McGraw-Hill were used to derive the estimates of GPO for each of the IT-producing industries.

First, annual GPO to shipments ratios were developed from actual data for 1990 through 1996. Then the *Outlook* estimates of shipments, sales, revenues, or receipts were converted to GPO based on a 3-year moving average of GPO to shipments ratios from the previous years. Thus, the shipments estimate for 1997 were converted to GPO based on the average ratio of GPO to shipments for 1994 through 1996. In 1998, the ratios for 1995 and 1996 and the calculated ratio for 1997 were averaged to calculate a GPO for that year. To calculate GPO for 1999, the ratio for 1996 and the calculated ratios for 1997 and 1998 were averaged.

## Real Dollar GPO of IT-Producing Industries

Except for Computers and equipment (including sale of computers from a manufacturer’s branch offices) and semiconductors, nominal GPO for IT industries was deflated using implicit deflators calculated from BEA’s published time series of nominal and real (chained 1992 dollar) Gross Product by Industry.<sup>3</sup> (Table A-2.3) Deflators for all IT-producing industries, except for computers and semiconductors, were calculated by dividing the 2-digit SIC nominal GPO by the chained 1992 dollar GPO. These deflators, in turn, were applied to the nominal GPO of 4-digit SIC IT-producing industries, *e.g.*, nominal GPO for the industries of Industrial instruments for measurement, Instruments for measuring electricity, and Laboratory and analytical instruments (SICs 3823, 3825, and 3826) were deflated by the ratio of nominal to real GPO for Instruments (SIC 38) since a deflator was not available for each of these 4-digit SIC industries.

The Computer and equipment industry (SIC’s 3571, 3572, 3575, and 3577) and the part of Computers and equipment wholesale sales that was sold from computer manufacturers’ branch offices (Part of SIC 5045) were deflated using a composite industry price index constructed from BEA’s quality-adjusted “hedonic” deflators for computers. These quality-adjusted deflators relate prices of computer and peripheral equipment models to characteristics of those models selected to represent the cost of producing them. The resulting composite price index for Computers and peripheral equipment was as follows:

	<b>Computers and computer parts</b>							
	SIC 3571, 3572, 3575, 3577, and part of 5045							
Year	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Deflator	1.35	1.20	1.00	0.84	0.75	0.59	0.42	0.33

<sup>3</sup>See <http://www.bea.doc.gov> and click on Industry and wealth data.

**Table A-2.3  
IT-Producing Industries:  
Real Gross Product Originating**

Industry	SIC	1990	1991	1992	1993	1994	1995	1996	1997
(millions of chained \$1992)									
Total Gross Domestic Income (GDI)		<b>\$6,117,800</b>	<b>\$6,069,100</b>	<b>\$6,199,700</b>	<b>\$6,338,200</b>	<b>\$6,596,800</b>	<b>\$6,786,300</b>	<b>\$7,024,100</b>	<b>\$7,319,700</b>
Year-to-Year GDI Change (%)			-0.80%	2.15%	2.23%	4.08%	2.87%	3.50%	4.21%
<b>Hardware</b>									
Computers and equipment	3571,2,5,7	18,185.8	17,483.0	21,794.0	24,472.2	32,053.1	45,346.5	68,010.8	105,196.0
Computers and equipment wholesale sales	5045 pt	24,778.0	29,714.9	39,465.0	49,396.2	57,774.5	81,132.5	137,718.9	212,924.1
Computers and equipment retail sales	5734 pt	2,016.5	1,934.5	1,901.5	2,250.2	2,641.1	2,776.6	2,747.2	3,169.7
Calculating and office machines, nec	3578,9	2,293.2	1,961.6	2,138.7	2,173.0	2,236.7	2,763.1	2,890.8	3,135.3
Electron Tubes	3671	1,188.0	1,036.9	1,046.0	1,020.5	1,224.9	1,350.0	1,436.6	1,571.2
Printed circuit boards	3672	4,504.8	3,157.3	3,552.1	3,737.6	4,550.0	4,963.7	5,819.1	6,488.9
Semiconductors	3674	12,334.5	15,809.8	18,216.7	26,856.0	42,209.2	82,802.5	132,950.5	216,968.5
Passive electronic components	3675-9	11,808.6	12,764.8	13,466.6	14,450.0	16,637.5	17,229.9	17,344.1	17,081.8
Industrial instruments for measurement	3823	2,609.9	2,523.1	2,538.8	2,231.6	2,244.6	2,150.2	2,120.6	2,128.0
Instruments for measuring electricity	3825	3,710.5	3,655.4	3,472.4	2,945.7	3,268.8	3,384.8	3,532.0	3,376.4
Laboratory analytical instruments	3826	2,092.7	2,099.8	1,823.7	1,767.6	1,779.4	1,814.4	1,994.1	1,786.4
<b>Software/Services</b>									
Total software and services	7371-9, 5045pt & 5734pt	64,919.4	68,113.6	73,434.8	79,714.1	87,677.4	99,491.6	121,241.4	132,890.9
<b>Communications Hardware</b>									
Household audio and video equipment	3651	1,585.8	1,737.3	1,866.0	2,082.5	2,224.0	2,534.5	2,635.1	2,604.0
Telephone and telegraph equipment	3661	8,062.4	7,778.5	10,199.6	11,022.9	11,946.3	15,788.2	24,443.1	26,191.0
Radio and TV and communications equipment	3663	9,452.0	8,463.5	10,022.7	9,676.4	14,119.4	18,499.9	22,364.5	25,123.4
Magnetic and optical recording media	3695	1,404.4	1,604.3	1,711.7	1,936.9	2,206.6	3,110.1	3,188.6	3,170.3
<b>Communications Services</b>									
Telephone and telegraph communications	481,22, 99	120,546.6	125,075.8	129,700.0	133,664.3	137,961.2	138,549.6	152,427.2	160,526.3
Radio broadcasting	4832	5,110.6	5,477.3	4,953.8	6,083.4	6,410.3	6,970.3	6,734.7	6,593.4
Television broadcasting	4833	12,627.7	11,973.8	11,613.9	13,672.1	14,818.4	15,974.2	14,804.4	14,395.0
Cable and other pay TV services	4841	10,862.8	14,057.1	14,932.3	18,348.7	17,584.2	18,845.2	17,959.3	18,526.0
<b>Total IT-Producing Industries*</b>		<b>\$308,555.5</b>	<b>\$327,011.6</b>	<b>\$357,827.8</b>	<b>\$397,249.0</b>	<b>\$441,956.5</b>	<b>\$519,218.7</b>	<b>\$638,451.5</b>	<b>\$751,573.2</b>

\* Real chain weighted 1992 dollar estimates are not directly additive.

Source: ESA estimates derived from BEA and Census data.

A composite quality-adjusted price index was also used to deflate the semiconductor industry:

		<b>Semiconductor Industry</b>							
		SIC 3674							
Year		<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Deflator		1.27	1.16	1.00	0.87	0.75	0.49	0.33	0.25

Since quality-adjusted price indexes for these IT-producing industries were used, a *residual* deflator for the remainder of the 2-digit SIC industry was needed, *e.g.*, in nominal terms, Computers and parts, SIC 3571-7 accounted for only 22 percent of Industrial machinery industry, SIC 35. This means that the remaining 78 percent of the industry which includes industrial and commercial machinery needed a residual deflator that did not include computers and parts.

A *residual* price index was developed for the non IT-producing portion of SIC 35, SIC 50, and SIC 36 using a “Fisher” chain-type residual price index, with prices and nominal GPO as described above.<sup>4</sup> The method employs the Fisher-Ideal price relative -- the geometric mean of Laspyeres and Paasche price relatives. The Fisher chain-type residual price index is calculated by aggregating over the total industry (SIC 35) less the GPO associated with the IT-producing portion of the 2-digit industry (SIC 3571-7).

The residual price indexes for SIC 35, SIC 50,52, and SIC 36 are as follows:

**Industrial machinery less Computers and parts**  
SIC 35 less SICs 3571, 3572, 3575, and 3577

Year		<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1995</u>	<u>1997</u>
Deflator		0.94	0.98	1.00	0.99	0.98	0.95	0.96	0.92

**Wholesale Trade less Computer Manufacturer Sales**  
From Branch Offices  
SIC 50,52 less Part of SIC 5045

Year		<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Deflator		0.99	1.00	1.00	1.04	1.08	1.14	1.18	1.22

**Electronic and electric equipment less Semiconductors**  
SIC 36 less SIC 3674

Year		<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1994</u>	<u>1995</u>	<u>1996</u>	<u>1997</u>
Deflator		0.98	0.99	1.00	0.99	0.96	0.89	0.87	0.85

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<sup>4</sup>See Yuskavage, "Improved Estimates of Gross Product by Industry, 1959-94" *Survey of Current Business*, August 1996.

The chained 1992 dollar estimates of “total IT-producing industries” are constructed by aggregating over all IT-producing industries’ GPO and associated price indexes using a Fisher-Ideal quantity index formula.<sup>5</sup>

## IT Contribution to Lowering Inflation

Aggregate price indexes for all IT-producing industries and all other industries and government (the rest of the economy) were calculated from aggregate nominal and aggregate chained 1992 dollar estimates using the Fisher-Ideal quantity index formula. Price indexes for each component industry were calculated by dividing the nominal dollar GPO of the industry by the corresponding chained dollar (real) GPO. The aggregate nominal “rest of the economy” was total GDP less the nominal aggregate GPO for IT-producing industries. The rate of inflation in these two sectors of the economy was the calculated annual change in the index, scaled to equal the total relative price change in GDP.

## IT-Producing Industries: Contribution to Real Economic Growth

The methodology to compute IT-producing industries’ contribution to real economic growth is also affected by the non-additivity of the real chain weighted dollars so that a direct calculation cannot be made. The method to calculate component contributions to the change in real GDP is described by the BEA.<sup>6</sup>

Estimates were also presented regarding the contribution to GDP growth of Computers and equipment and Telecommunications using a “product side” analysis. The product side approach adds final expenditures (final demand) on commodities produced by industries across the major segments of the economy – personal consumption, investment, net exports, and government. The disadvantage of using the product side approach is that 4-digit SIC IT-producing industries are not consistently reported across all the segments of the economy. Thus only a partial analysis of IT-producing industries is possible, *i.e.*, BEA data are only available for Computers and equipment, including audio and video equipment, and Telecommunications, including Cable TV IT-producing industries.

## U.S. Trade in IT Goods and Services

U.S. exports and imports of goods from IT-producing industries are shown in Table A-2.4 and U.S. exports and imports of services from IT-producing industries are shown in Table A-2.5. The sources for these data are the Bureau of the Census for goods and BEA for services (*Survey of Current Business*).

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<sup>5</sup>See Yuskavage, "Gross Product By Industry Price Measures, 1977-96," *Survey of Current Business*, March 1998.

<sup>6</sup>See Yuskavage, "Gross Product by Industry Price Measures, 1977-96," *Survey of Current Business*, March 1998 and Landefeld and Parker, "BEA's Chain Indexes," and "Preview of the Comprehensive Revision of National Income and Product Accounts: BEA's New Featured Measures of Output and Prices," *Survey of Current Business*, July 1995.

**Table A-2.4**  
**U.S. Trade of IT Goods**

		1993	1994	1995	1996	1997	1998
		<b>EXPORTS</b>					
		(\$billions, FAS Value)					
<b>Total IT-Producing and Non-IT Producing</b>		<b>\$439.3</b>	<b>\$481.9</b>	<b>\$546.5</b>	<b>\$582.1</b>	<b>\$643.2</b>	<b>\$634.7</b>
<b>Non IT-Producing</b>		372.5	402.0	449.5	477.9	522.1	517.7
<b>IT-Producing</b>		66.8	79.9	97.0	104.3	121.1	117.0
<b>SIC</b>	<b>IT-Producing Industries</b>						
3571	Computers and parts	18.9	22.1	26.8	30.8	34.7	31.7
3572	Computer storage devices	3.1	3.4	3.8	3.3	3.5	3.4
3577	Computer peripheral equipment	3.2	3.4	3.6	3.5	3.2	3.1
3578	Calculating and accounting machines	0.2	0.2	0.2	0.3	0.3	0.3
3579	Office machines, nec	0.9	0.9	1.0	1.1	1.2	1.2
3651	Household audio and video equipment	2.7	3.1	3.3	3.5	4.1	4.5
3661	Telephone and telegraph apparatus	4.0	4.8	5.8	6.5	9.1	9.6
3663	Radio and TV communications equipment	4.1	5.3	6.8	6.5	6.9	6.5
3671	Electron tubes	0.9	1.2	1.5	1.7	2.3	2.5
3672	Printed circuit boards	1.0	1.4	1.7	1.7	2.0	2.2
3674	Semiconductors	13.5	17.4	22.4	23.8	28.7	28.6
3675	Electronic capacitors	0.7	0.8	1.2	1.3	1.6	1.5
3676	Resistors	0.3	0.3	0.4	0.4	0.5	0.5
3677	Coils and transformers	0.2	0.2	0.3	0.3	0.4	0.4
3678	Connectors	0.7	0.9	1.0	1.2	1.5	1.4
3679	Electronic components, nec	3.2	4.3	5.6	5.3	6.5	5.7
3695	Magnetic and optical recording media	1.7	1.7	2.0	2.7	2.6	2.0
3823	Industrial instruments for measurement	2.4	2.7	2.9	2.8	3.4	3.5
3825	Instruments for measuring electricity	3.1	3.4	4.2	4.9	5.8	5.6
3826	Laboratory analytical instruments	2.1	2.2	2.5	2.7	2.9	2.9
		<b>IMPORTS</b>					
		(\$billions, Customs Value)					
<b>Total IT-Producing and Non IT-Producing</b>		<b>\$580.5</b>	<b>\$663.8</b>	<b>\$743.5</b>	<b>\$791.3</b>	<b>\$870.2</b>	<b>\$913.9</b>
<b>Non IT-Producing</b>		481.0	541.8	593.4	638.1	703.7	742.0
<b>IT-Producing</b>		99.5	122.0	150.1	153.2	166.5	171.9
<b>SIC</b>	<b>IT-Producing Industries</b>						
3571	Computers and parts	18.2	22.7	28.3	29.9	33.7	37.4
3572	Computer storage devices	9.3	11.0	14.2	16.4	19.5	18.2
3577	Computer peripheral equipment	9.6	11.5	12.7	13.9	15.4	15.2
3578	Calculating and accounting machines	1.0	1.0	1.0	1.0	1.2	1.2
3579	Office machines, nec	1.2	1.4	1.7	1.6	1.6	1.7
3651	Household audio and video equipment	14.6	17.3	17.9	16.7	17.6	20.1
3661	Telephone and telegraph apparatus	5.7	6.8	6.9	7.5	8.3	9.3
3663	Radio and TV communications equipment	4.6	5.9	6.7	7.2	7.4	9.5
3671	Electron tubes	1.1	1.3	1.5	1.4	1.2	1.0
3672	Printed circuit boards	2.2	2.4	2.8	2.5	2.6	2.6
3674	Semiconductors	19.2	25.7	38.6	36.4	36.4	32.7
3675	Electronic capacitors	0.7	0.9	1.2	1.1	1.3	1.4
3676	Resistors	0.5	0.6	0.7	0.7	0.7	0.6
3677	Coils and transformers	0.7	0.8	1.0	1.0	1.1	1.3
3678	Connectors	0.8	0.9	1.1	1.2	1.5	1.5
3679	Electronic components, nec	4.4	5.3	6.5	6.8	8.5	9.1
3695	Magnetic and optical recording media	2.0	2.0	1.9	2.1	2.1	2.0
3823	Industrial instruments for measurement	1.5	1.9	2.2	2.1	2.3	2.6
3825	Instruments for measuring electricity	1.4	1.6	2.0	2.3	2.7	2.8
3826	Laboratory analytical instruments	0.9	1.0	1.2	1.4	1.5	1.7

Source: Bureau of the Census

**Table A-2.5**  
**U.S. Trade of IT Services**  
(\$billions, BOP\* basis)

	1993	1994	1995	1996	1997
	<b>EXPORTS</b>				
<b>Total private services</b>	\$172.0	\$187.8	\$204.2	\$224.2	\$239.2
<b>Non IT-producing services</b>	166.2	180.2	195.9	215.0	228.3
<b>IT-Producing Services</b>	5.8	7.6	8.3	9.2	10.9
<b>SIC</b>					
48 Telecommunications	2.8	3.0	3.3	3.4	4.0
737 Computer services	3.0	4.6	5.0	5.8	6.9
	<b>IMPORTS</b>				
<b>Total private services</b>	\$111.3	\$123.3	\$133.4	\$142.3	\$156.2
<b>Non IT-producing services</b>	104.5	115.5	125.1	132.9	146.5
<b>IT-Producing Services</b>	6.8	7.8	8.2	9.3	9.7
<b>SIC</b>					
48 Telecommunications	6.4	7.0	7.4	8.4	8.3
737 Computer services	0.4	0.8	0.8	0.9	1.4

\* Balance of payments basis.

Source: Bureau of Economic Analysis

## Industry Use of IT Equipment

Data for industry current dollar spending on IT equipment were gathered from BEA's published series on Private Fixed Investment by Type (Table 5.4 in the *Survey of Current Business*). Four categories of equipment, Information processing and related equipment, Industrial equipment, Transportation and related equipment, and Other make up Producers' Durable Equipment and are shown in the table.

The contribution of IT equipment (Information processing and related equipment) to growth in capital expenditures was calculated based on the same methodology described above in the section called "IT-Producing Industries: Contribution to Real Economic Growth." Current dollar values were provided from Table 5.4 in the *Survey* while quantity indexes were derived from the chained 1992 real dollar amounts in Table 5.5 of the *Survey*. Industry detail of IT equipment investment and IT net capital stock are covered in the Appendix to Chapter III.



## **Appendix to Chapter III**

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## **APPENDIX TO CHAPTER III**

### **CONTRIBUTION OF INFORMATION TECHNOLOGY TO GPO PER WORKER**

Data sources, supplemental IT investment, capital stock and GPO per worker tables and a list of references to Chapter III of *the Emerging Digital Economy II* (EDE2) report are provided in this appendix. Many of the technical terms and caveats of the data were discussed in the footnotes of Chapter III.

#### ***IT INVESTMENT AND NET CAPITAL STOCK***

The Bureau of Economic Analysis (BEA) defines information processing equipment (IT equipment) to include: office, computing, and accounting machinery, communications equipment, photocopy and related equipment, and instruments. BEA produces annual estimates of investment flows and capital stock by industry and by type of asset (including the four equipment categories mentioned above).

In this analysis, IT investment and net capital stock data were used as criteria for identifying industries that are intensive users of IT equipment. The first measure of IT intensity is the current dollar value of an industry's IT net capital stock relative to its total equipment stock. (Table A-3.1) Net capital stock is the cumulative value of past gross investment less the cumulative value of past depreciation.<sup>7</sup> Total net capital stock of equipment, in addition to IT equipment, includes non-IT industrial equipment, transportation equipment, and other equipment.

IT investment expenditures per worker is the second measure of IT intensity. (Table A-3.2) Investment in IT equipment per worker includes annual purchases of IT equipment (historical cost) divided by the number of workers in each industry.

BEA provides investment and net capital stock data for 62 industries; however, for the purpose of this analysis, farming industries were excluded and several other industries were aggregated, resulting in a total of 53 industries. These industries were ranked according to both measures of IT intensity for the year 1996. The 15 highest ranking industries according to each intensity measure were designated as "major users" of information technology equipment. This resulted in a total of 22 industries used in subsequent analysis of IT-using industries. The investment and net capital stock data by industry and by asset type presented here are for 1996, the most recent data available at the time of analysis; subsequently, 1997 estimates were released. (<http://www.bea.doc.gov>)

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<sup>7</sup> For more detail on the estimation of wealth data, see Katz and Herman, "Improved Estimates of Fixed Reproducible Tangible Wealth, 1929-95," *Survey of Current Business*, May 1997, pp. 69-92.

**Table A-3.1**  
**IT Intensive Industries**  
**Ranked According to IT Net Capital Stock Share of Total Equipment Stock, 1996**

Rank	Industry	IT EQUIPMENT STOCK				SHARE OF TOTAL EQUIPMENT			
		\$millions				percent			
		1990	1992	1994	1996	1990	1992	1994	1996
1	Telephone and telegraph	\$152,337	\$159,800	\$159,658	\$177,453	86.9	86.4	84.6	84.4
2	Radio and television	20,795	24,605	24,708	32,986	78.5	79.4	77.9	78.8
3	Security and commodity brokers	1,555	1,315	1,517	1,835	56.2	54.0	54.4	56.3
4	Health services	15,551	18,456	22,669	24,975	52.0	52.1	54.2	56.3
5	Motion pictures	4,131	5,014	6,299	7,721	56.1	57.0	56.4	55.6
6	Other services, n.e.c.	10,037	10,739	11,906	14,812	48.5	48.9	48.7	51.1
7	Business services	23,387	24,506	33,918	44,149	38.5	38.7	44.9	48.7
8	Holding and investment offices	4,845	4,385	4,008	4,651	48.2	46.5	43.5	44.7
9	Legal services	3,665	3,614	3,355	3,379	41.8	42.2	40.3	40.5
10	Wholesale trade	47,167	50,433	61,007	78,924	37.1	37.0	37.1	38.8
11	Real estate	35,328	37,504	40,997	47,726	33.7	33.7	35.0	37.2
12	Insurance carriers	17,066	19,731	20,625	26,250	42.4	40.0	35.5	35.2
13	Instruments and related products	7,210	8,125	8,323	8,876	33.5	34.4	33.3	33.5
14	Depository institutions	39,896	41,678	43,240	45,491	31.5	30.5	29.1	29.1
15	Insurance agents, brokers, and service	709	742	776	766	29.6	31.2	30.0	29.0
16	Electronic and other electric equipment	14,674	15,474	17,045	21,426	25.5	25.7	25.5	26.8
17	Nondepository institutions	13,703	13,995	18,182	25,553	22.6	22.2	22.8	25.1
18	Educational services	409	402	394	411	24.3	24.6	24.2	24.9
19	Printing and publishing	7,218	7,753	7,869	8,298	24.2	24.9	24.3	24.6
20	Local and interurban passenger transit	1,319	1,175	1,139	1,317	23.8	24.4	23.0	23.6
21	Other transportation equipment	5,252	5,215	5,082	5,151	22.1	22.0	21.8	22.4
22	Chemicals and allied products	17,063	20,699	22,588	26,551	18.1	19.9	20.2	20.9
23	Personal services	1,994	2,175	2,026	1,979	26.1	26.8	23.2	20.7
24	Pipelines, except natural gas	373	487	677	953	18.1	18.8	18.2	18.6
25	Electric, gas and sanitary services	46,234	49,607	51,006	54,168	18.7	19.1	18.4	18.5
26	Industrial machinery and equipment	12,104	12,512	12,055	12,926	17.5	17.6	16.3	16.3
27	Transportation services	3,682	3,806	4,057	5,344	15.0	15.0	13.8	14.9
28	Retail trade	14,854	16,502	17,760	20,436	13.5	14.3	14.1	14.3
29	Hotels and other lodging places	1,858	1,836	1,673	1,891	14.2	14.2	13.2	14.0
30	Railroad transportation	4,541	4,808	5,411	6,433	9.5	10.6	11.4	13.0
31	Petroleum and coal products	3,073	4,506	5,200	5,642	10.6	12.8	13.0	12.9
32	Misc. manufacturing industries	529	608	655	779	9.8	10.5	10.7	11.5
33	Apparel and other textile products	408	442	566	679	8.5	8.9	10.3	11.4
34	Stone, clay, and glass products	2,693	2,780	2,605	2,793	11.5	11.9	11.0	11.2
35	Mining	9,329	8,954	8,949	9,008	11.3	11.4	11.2	10.9
36	Food and kindred products	6,084	7,211	7,698	8,705	9.5	10.5	10.5	10.8
37	Transportation by air	6,758	7,277	6,840	9,283	9.9	9.6	8.8	10.5
38	Tobacco products	436	434	436	453	9.5	9.4	9.3	9.5
39	Furniture and fixtures	411	409	430	475	9.2	9.0	8.7	8.9
40	Amusement and recreation services	1,247	1,120	1,090	1,155	12.9	11.3	9.1	8.5
41	Paper and allied products	4,615	5,205	5,099	5,499	7.4	7.8	7.4	7.5
42	Leather and leather products	60	58	65	64	6.5	6.6	7.2	7.3
43	Miscellaneous repair services	412	498	537	557	7.6	8.5	7.7	7.3
44	Textile mill products	1,025	1,128	1,280	1,405	5.5	6.0	6.3	6.6
45	Lumber and wood products	580	605	719	892	4.7	5.0	5.5	6.1
46	Primary metal industries	3,981	4,177	4,111	4,339	5.5	5.6	5.4	5.5
47	Rubber and misc. plastics products	1,108	1,285	1,461	1,925	4.7	5.0	5.0	5.4
48	Water transportation	852	953	1,234	1,498	2.8	3.3	4.2	5.1
49	Fabricated metal products	2,138	2,186	2,347	2,785	4.8	4.8	4.8	5.1
50	Trucking and warehousing	2,711	2,807	3,149	4,042	5.3	5.5	4.9	4.9
51	Auto repair, services, and parking	4,357	4,564	4,099	4,438	7.6	6.5	4.8	4.5
52	Motor vehicles and equipment	1,371	1,526	1,676	2,000	3.2	3.4	3.3	3.3
53	Construction	778	760	789	846	1.7	1.7	1.7	1.6
	<b>Total Private Nonfarm Industries</b>	<b>\$583,913</b>	<b>\$626,586</b>	<b>\$671,005</b>	<b>\$782,093</b>	<b>25.1</b>	<b>25.5</b>	<b>25.0</b>	<b>26.0</b>

Source: ESA calculations based on BEA data.

NOTE: BEA does not publish these industry level data because they are less reliable than the higher level aggregates in which they are included. Compared with the aggregates, the more detailed estimates are more likely to be based on judgmental trends, on trends in the higher level aggregate or on less reliable source data.

**Table A-3.2**  
**IT Intensive Industries**  
**Ranked According to IT Investment per Worker, 1996**

Rank	Industry	1990	1992	1994	1996	Change 1990 to 1996
1	Telephone and telegraph	\$20,655	\$23,011	\$26,520	\$29,236	\$8,581
2	Nondepository institutions	10,303	9,297	14,079	18,129	7,826
3	Pipelines, except natural gas	2,000	6,563	12,105	18,069	16,069
4	Radio and television	13,409	11,237	9,658	17,512	4,103
5	Electric, gas and sanitary services	9,081	9,172	8,171	9,728	647
6	Petroleum and coal products	5,260	9,365	7,814	8,102	2,841
7	Real estate	5,551	5,557	5,295	7,610	2,058
8	Chemicals and allied products	4,036	4,657	4,339	6,049	2,012
9	Insurance carriers	3,549	4,059	4,078	5,911	2,361
10	Depository institutions	4,824	5,338	5,157	5,897	1,073
11	Holding and investment offices	3,344	3,566	2,826	5,739	2,395
12	Railroad transportation	2,581	2,623	4,703	4,587	2,006
13	Wholesale trade	1,835	2,383	3,238	4,488	2,652
14	Motion pictures	2,740	3,310	4,531	4,225	1,485
15	Electronic and other electric equipment	1,970	2,066	2,656	3,511	1,541
16	Transportation services	1,717	1,643	2,400	2,797	1,080
17	Tobacco products	1,344	1,937	2,005	2,560	1,216
18	Business services	1,289	1,647	2,102	2,449	1,160
19	Mining	2,096	1,915	2,594	2,274	178
20	Instruments and related products	1,777	2,024	1,949	2,269	493
21	Transportation by air	1,354	1,693	971	1,993	639
22	Water transportation	844	975	2,007	1,652	809
23	Paper and allied products	2,124	1,596	1,327	1,640	-484
24	Industrial machinery and equipment	1,616	1,591	1,419	1,589	-28
25	Other transportation equipment	1,051	1,186	1,175	1,464	413
26	Printing and publishing	1,432	1,334	1,338	1,405	-26
27	Food and kindred products	939	1,110	1,045	1,268	330
28	Security and commodity brokers	707	807	1,079	1,266	559
29	Stone, clay, and glass products	1,302	1,200	1,023	1,262	-40
30	Primary metal industries	1,074	1,086	1,190	1,239	165
31	Auto repair, services, and parking	1,237	1,283	1,072	1,134	-103
32	Legal services	1,119	892	780	857	-262
33	Motor vehicles and equipment	545	505	537	689	143
34	Rubber and miscellaneous plastics products	400	436	461	685	285
35	Miscellaneous manufacturing industries	389	517	465	623	234
36	Other services, n.e.c.	370	396	432	603	233
37	Fabricated metal products	407	382	446	549	142
38	Health services	424	514	573	543	119
39	Trucking and warehousing	292	267	497	523	230
40	Textile mill products	386	384	495	500	114
41	Miscellaneous repair services	307	499	503	478	171
42	Local and interurban passenger transit	311	166	463	476	165
43	Personal services	419	489	367	376	-43
44	Lumber and wood products	196	209	294	339	142
45	Retail trade	199	272	260	321	121
46	Insurance agents, brokers, and services	259	321	364	297	38
47	Furniture and fixtures	259	245	254	296	37
48	Hotels and other lodging places	284	157	134	260	-25
49	Apparel and other textile products	99	141	195	242	142
50	Leather and leather products	135	167	186	219	84
51	Amusement and recreation services	135	136	179	218	83
52	Educational services	51	53	48	51	1
53	Construction	34	31	36	35	1
	<b>Total Private Nonfarm Industries</b>	<b>\$1,345</b>	<b>\$1,472</b>	<b>\$1,580</b>	<b>\$1,929</b>	<b>\$584</b>

Sources: ESA calculations based on BEA and BLS data.

NOTE: BEA does not publish these industry level data because they are less reliable than the higher level aggregates in which they are included. Compared with the aggregates, the more detailed estimates are more likely to be based on judgmental trends, on trends in the higher level aggregate or on less reliable source data.

Table A-3.3

## Gross Product Originating Per Worker in IT-Producing, IT-Using, and Non-IT Intensive Industries \*

Industry Group	SIC	1990	1991	1992	1993	1994	1995	1996	1997	Avg. Annual Growth Rate 1990 to 1997 (Percent)
<b>Total Private Nonfarm</b>		<b>50,278</b>	<b>50,443</b>	<b>51,587</b>	<b>52,193</b>	<b>53,185</b>	<b>53,332</b>	<b>54,192</b>	<b>55,265</b>	<b>1.4</b>
<b>IT-Producing</b>		79,628	85,518	95,524	105,265	113,982	126,686	146,153	159,112	<b>10.4</b>
Goods		49,250	53,364	64,381	75,806	96,152	132,581	171,726	221,108	23.9
Services		97,031	102,971	111,519	119,746	123,049	126,875	140,601	144,376	5.8
<b>IT-Using</b>		60,555	60,303	61,023	60,968	61,327	60,213	60,223	59,944	<b>-0.1</b>
Goods		84,680	86,490	86,869	90,178	95,926	99,164	99,763	99,717	2.4
Services		58,535	58,180	58,999	58,779	58,864	57,563	57,604	57,399	-0.3
<b>Non-IT (Neither IT-Producing nor IT-Using)</b>		40,713	40,454	41,137	41,563	42,550	42,738	42,832	43,903	<b>1.1</b>
Goods		54,065	53,910	55,006	56,006	58,081	59,028	58,284	59,352	1.3
Services		31,535	31,572	32,203	32,392	32,784	32,683	33,462	34,586	1.3
<b>All Industries Other Than IT-Producing</b>		48,998	48,890	49,678	49,930	50,624	50,235	50,323	50,844	<b>0.5</b>
<b>Illustrative IT-Producing Industries</b>										
Semiconductors	3674	51,336	68,221	83,717	125,819	191,383	352,041	512,327	780,295	47.5
Computers & equipment wholesalers	5045pt.	84,097	100,518	142,304	182,348	212,682	283,899	451,070	647,533	33.9
Computers & related equipment	3571,2,5,7,8,9	46,618	46,713	61,125	73,473	97,120	137,706	199,281	292,579	30.0
Magnetic & optical recording media	3695	74,409	80,317	93,587	106,540	117,100	185,787	189,459	177,310	13.2
Telephone & telegraph equipment	3661	67,300	68,552	93,066	98,182	103,196	121,755	150,218	154,295	12.6
Electron tubes	3671	37,618	34,722	37,175	40,323	48,980	58,333	61,135	71,111	9.5
Radio broadcasting	4832	43,019	47,015	43,878	53,693	56,478	61,684	59,441	57,584	4.3
Passive electronic components & printed circuit boards	3672,5-9	52,445	54,348	60,403	62,608	70,856	69,030	69,141	67,103	3.6
Telephone & telegraph communications	481,2,9	126,945	132,960	142,402	147,957	150,268	149,557	162,191	159,616	3.3
Household audio & video equipment	3651	27,244	29,412	31,773	33,613	35,058	39,497	34,672	33,962	3.2
Cable & other pay TV services	4841	86,350	109,821	114,336	134,719	121,690	121,191	105,643	105,742	2.9
Instruments for measuring electricity	3825	40,775	43,413	45,629	40,463	45,910	47,539	47,537	44,780	1.3
Television broadcasting	4833	110,093	105,403	101,343	117,660	124,839	130,189	116,113	112,373	0.3
Computers & equipment retailers	5734pt.	28,285	26,833	25,211	28,757	31,239	29,643	26,830	27,345	-0.5
Analytical instruments	3826	69,865	74,675	64,909	62,928	66,067	64,508	67,255	59,666	-2.2
Industrial instruments for measurement	3823	39,188	39,986	41,620	36,886	36,203	33,492	32,033	32,194	-2.8

\*To calculate GPO/W for each group of industries above, the group's total GPO in chained 1992 dollars was calculated from the GPO of the individual industries in the group based on the BEA method of aggregation outlined in the *Survey of Current Business*, March 1998, p. 38, which is the same method used in Chapter II of this report.

Source: Derived from GPO and employment data compiled in Chapters II and IV of this report.

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## **APPENDIX TO CHAPTER IV**

### **LABOR MARKETS IN THE DIGITAL ECONOMY**

This appendix contains supplemental data, data sources and methodologies for estimating the employment effects of information technologies as described in Chapter IV of *The Emerging Digital Economy II* (EDE II) report.

#### ***IT INDUSTRY EMPLOYMENT AND WAGES***

##### **Employment**

Most of the employment estimates used in this analysis (Tables A-4.1 and A-4.2) are from the Current Employment Statistics (CES) survey, conducted monthly on a sample of nonfarm establishments by the Bureau of Labor Statistics (BLS) in conjunction with state employment security agencies. Private nonfarm employment includes all full and part-time employees except those in the agricultural and government sectors. These data can be found at the BLS website (<http://www.bls.gov>) and are also published in the November 1997 *Monthly Labor Review*.

For some IT-producing industries employment data were not available at the 4-digit SIC level, but instead at the 2- or 3-digit SIC level. In four cases, SIC 357 - Computer and office equipment, SIC 367 - Electronic components and accessories, SIC 737 - Computer and data processing services and SIC 48 - Communications, all of the 4-digit sub-industries were identified as IT-producing industries. Therefore, industries for which data were missing could be computed as a residual from the 2- or 3-digit aggregates. For example, all of SIC 48 (Communications) are IT-producing industries, but CES data are only available for 481, 4832, 4833, and 4841. After subtracting employment levels in SICs 481, 4832, 4833 and 4841 from SIC 48, the residual was reported as employment in a combined industry including SICs 482 and 489.

BLS also collects employment data through the Covered Employment and Wages (ES202) program, a Federal-State cooperative program that counts all employees covered by unemployment insurance programs. These data are published annually in *Employment and Wages, Annual Averages*. When CES employment figures were not available at the necessary level of detail (4-digit SIC level) and a residual could not be calculated, employment levels were estimated by applying the 4-digit SIC level employment distribution of the ES202 numbers to the aggregate (3-digit SIC level) CES numbers. When CES employment numbers were not available at the 3-digit SIC level, ES202 employment numbers were used.

Estimates of employment by wholesale and retail sellers of computer equipment and software (SICs 5045 and 5734) were divided among the hardware and software/services categories using the same distribution as value added -- 95 percent to hardware and 5 percent to software/services.

**Table A-4.1  
Information Technology Producing Industries: Employment Trends, 1989 to 1997**

Industry	SIC	1989	1990	1991	1992	1993	1994	1995	1996	1997	Change 1989-97	AAG* 1989-97 (Percent)
		(Units 000s)										
<b>Total Private Employment</b>		<b>90,105</b>	<b>91,098</b>	<b>89,847</b>	<b>89,956</b>	<b>91,872</b>	<b>95,036</b>	<b>97,885</b>	<b>100,189</b>	<b>103,120</b>	<b>13,015</b>	<b>1.7</b>
Year to Year Change in Employment			1.1%	-1.4%	0.1%	2.1%	3.4%	3.0%	2.4%	2.9%		
<b>Hardware</b>												
Electronic computers	3571	293.7	278.5	258.8	241.9	216.1	201.1	190.0	189.3	195.8	-97.9	-4.9
Computers and equipment wholesalers	5045pt.	291.0	294.9	295.5	277.6	270.9	271.8	285.7	305.3	328.8	37.8	1.5
Computers and equipment retailers	5734pt.	68.3	71.3	72.1	75.4	78.2	84.5	93.7	102.4	115.9	47.6	6.8
Computer storage devices & peripheral equipment	3572,7	95.8	94.3	94.3	91.3	93.2	97.9	104.5	114.2	118.5	22.7	2.7
Computer terminals, office and accounting machines, and office machines, n.e.c.	3575,8,9	69.2	64.8	62.2	57.8	54.1	55.2	57.7	58.3	60.3	-8.9	-1.7
Electron tubes	3671	34.8	31.9	28.8	26.9	24.8	24.5	24.0	22.9	22.5	-12.3	-5.3
Semiconductors	3674	249.7	239.6	231.6	217.4	213.8	220.5	235.2	259.6	278.1	28.4	1.4
Printed circuit boards, electronic capacitors, resistors, coils, transformers, and connectors	3672,5-8	175.5	169.4	161.0	156.6	161.6	168.2	187.0	195.7	205.8	30.3	2.0
Electronic components, n.e.c.	3679	151.4	141.4	133.4	126.5	127.5	131.0	134.6	138.4	145.9	-5.5	-0.5
Industrial instruments for measurement	3823	65.9	66.6	63.1	61.0	60.5	62.0	64.2	66.2	66.1	0.2	0.0
Instruments for measuring electricity	3825	98.3	91.0	84.2	76.1	72.8	71.2	71.2	74.3	75.4	-22.9	-3.3
Analytical instruments	3826	29.8	30.0	28.1	28.1	28.1	26.9	28.1	29.7	29.9	0.1	0.0
<b>Total Hardware</b>		<b>1,623.4</b>	<b>1,573.6</b>	<b>1,513.1</b>	<b>1,436.6</b>	<b>1,401.6</b>	<b>1,414.8</b>	<b>1,475.9</b>	<b>1,556.2</b>	<b>1,643.0</b>	<b>19.6</b>	<b>0.2</b>
Share of Total Employment		<b>1.8%</b>	<b>1.7%</b>	<b>1.7%</b>	<b>1.6%</b>	<b>1.5%</b>	<b>1.5%</b>	<b>1.5%</b>	<b>1.6%</b>	<b>1.6%</b>		
<b>Software/Services</b>												
Computer programming services	7371	140.7	150.8	156.9	168.6	188.3	209.9	245.3	276.2	321.7	181.0	10.9
Prepackaged software	7372	98.8	112.8	124.4	130.8	144.8	157.4	180.8	201	229.6	130.8	11.1
Prepackaged software wholesalers	5045pt.	15.3	14.9	14.9	14.0	13.7	13.7	14.4	15.4	16.6	1.3	1.0
Prepackaged software retailers	5734pt.	3.6	3.6	3.6	3.8	4.0	4.3	4.7	5.2	5.9	2.3	6.3
Computer integrated systems design	7373	98.0	97.5	98.7	102.5	109.5	116.4	129.9	143.5	162.9	64.9	6.6
Computer processing and data preparation	7374	200.6	196.7	198.2	204.4	207.3	209.5	223.1	230	248.6	48.0	2.7
Information retrieval services	7375	45.9	47.7	45.2	45.2	46.2	48.0	56.9	70.2	81.3	35.4	7.4
Computer services management, rental and leasing, and maintenance and repair	7376,7,9	117.9	126.6	131.1	141.2	154.9	172.9	205.3	253.5	309.3	191.4	12.8
Computer maintenance and repair	7378	34.4	39.8	42.5	42.8	41.8	44.5	48.6	53.3	57.2	22.8	6.6
<b>Total Software/Services</b>		<b>755.2</b>	<b>790.4</b>	<b>815.6</b>	<b>853.3</b>	<b>910.4</b>	<b>976.6</b>	<b>1,109.1</b>	<b>1,248.3</b>	<b>1,433.1</b>	<b>677.9</b>	<b>8.3</b>
Share of Total Employment		<b>0.8%</b>	<b>0.8%</b>	<b>0.9%</b>	<b>0.9%</b>	<b>1.0%</b>	<b>1.0%</b>	<b>1.1%</b>	<b>1.2%</b>	<b>1.4%</b>		
<b>Communications Equipment</b>												
Household audio and video equipment	3651	65.0	62.4	61.2	59.8	59.5	59.9	55.7	54.8	53	-12.0	-2.5
Telephone and telegraph equipment	3661	138.7	126.3	116.7	109.6	110.0	109.5	111.7	114.5	119.9	-18.8	-1.8
Radio and TV communications equipment and communications equipment, n.e.c.	3663,9	133.2	137.2	134.4	128.9	129.0	138.3	153.2	155.8	155.9	22.7	2.0
Magnetic and optical recording media	3695	17.6	18.9	20.0	18.3	18.2	18.8	16.7	16.8	17.9	0.3	0.2
<b>Total Communications Equipment</b>		<b>354.5</b>	<b>344.8</b>	<b>332.3</b>	<b>316.6</b>	<b>316.7</b>	<b>326.5</b>	<b>337.3</b>	<b>341.9</b>	<b>346.7</b>	<b>-7.8</b>	<b>-0.3</b>
Share of Total Employment		<b>0.4%</b>	<b>0.5%</b>	<b>0.5%</b>	<b>0.5%</b>	<b>0.5%</b>	<b>0.5%</b>	<b>0.5%</b>	<b>0.3%</b>	<b>0.3%</b>		
<b>Communications Services</b>												
Telephone communications	481	885.9	913.0	909.2	885.2	879.0	893.4	899.7	911.4	975.1	89.2	1.2
Telephone and telegraph communications	482,489	38.3	36.6	31.5	25.6	24.4	24.7	26.7	28.4	30.6	-7.7	-2.8
Radio broadcasting	4832	118.6	118.8	116.5	112.9	113.3	113.5	113.0	113.3	114.5	-4.1	-0.4
Television broadcasting	4833	111.9	114.7	113.6	114.6	116.2	118.7	122.7	127.5	128.1	16.2	1.7
Cable and other pay TV services	4841	117.4	125.8	128.0	130.6	136.2	144.5	155.5	170	175.2	57.8	5.1
<b>Total Communications Services</b>		<b>1,272.1</b>	<b>1,308.9</b>	<b>1,298.8</b>	<b>1,268.9</b>	<b>1,269.1</b>	<b>1,294.8</b>	<b>1,317.6</b>	<b>1,350.6</b>	<b>1,423.5</b>	<b>151.4</b>	<b>1.4</b>
Share of Total Employment		<b>1.4%</b>	<b>1.4%</b>	<b>1.4%</b>	<b>1.4%</b>	<b>1.4%</b>	<b>1.4%</b>	<b>1.3%</b>	<b>1.3%</b>	<b>1.4%</b>		
<b>Total IT-Producing Industries</b>		<b>4,005.2</b>	<b>4,017.7</b>	<b>3,959.7</b>	<b>3,875.4</b>	<b>3,897.9</b>	<b>4,012.8</b>	<b>4,239.9</b>	<b>4,497.0</b>	<b>4,846.3</b>	<b>841.1</b>	<b>2.4</b>
Share of Total Employment		<b>4.4%</b>	<b>4.5%</b>	<b>4.5%</b>	<b>4.4%</b>	<b>4.4%</b>	<b>4.4%</b>	<b>4.5%</b>	<b>4.5%</b>	<b>4.7%</b>		

Source: Bureau of Labor Statistics

\*AAG- average annual rate of growth

**Table A-4.2**  
**Information Technology Using Industries: Employment Trends, 1989 to 1997**

Industry	SIC	1989	1990	1991	1992	1993	1994	1995	1996	1997	Change 1989-97	AAG* 1989-97 (percent)
		(Units: 000s)										
<b>Total Private Employment</b>		<b>90,105</b>	<b>91,098</b>	<b>89,847</b>	<b>89,956</b>	<b>91,872</b>	<b>95,036</b>	<b>97,885</b>	<b>100,189</b>	<b>103,120</b>	<b>13,015</b>	<b>1.7</b>
<b>Year to Year Change in Employment</b>			<b>1.1%</b>	<b>-1.4%</b>	<b>0.1%</b>	<b>2.1%</b>	<b>3.4%</b>	<b>3.0%</b>	<b>2.4%</b>	<b>2.9%</b>		
Chemicals and allied products	28	1,073.9	1,086.1	1,075.9	1,084.1	1,080.5	1,057.0	1,038.1	1,033.8	1,033.8	-40.1	-0.5
Petroleum and coal products	29	156.0	157.4	160.0	157.6	151.5	149.1	145.2	142.1	139.7	-16.3	-1.4
Electronic and other electric equipment	36	778.4	746.3	704.0	684.1	681.3	699.9	706.9	702.1	688.7	-89.7	-1.5
Instruments and related products	38	831.9	818.3	798.6	763.3	734.1	701.0	679.9	685.3	691.9	-140.0	-2.3
Railroad transportation	40	292.5	278.6	262.0	254.3	248.3	240.5	238.4	230.9	226.9	-65.6	-3.1
Pipelines exc. Natural gas	46	18.5	18.5	19.0	19.2	18.4	17.1	15.1	14.5	14.3	-4.2	-3.2
Electric, gas, and sanitary services	49	938.1	957.1	961.2	954.0	944.4	928.3	910.9	883.7	865.9	-72.2	-1.0
Wholesale trade	50,51	5,880.7	5,863.2	5,770.6	5,705.4	5,696.4	5,876.5	6,077.9	6,161.3	6,302.6	421.9	0.9
Depository institutions	60	2,273.4	2,250.5	2,164.2	2,095.7	2,088.8	2,065.7	2,025.1	2,018.6	2,027.0	-246.4	-1.4
Nondepository institutions & holding/ investment offices	61,67	578.9	593.5	603.0	624.5	677.5	717.1	680.1	731.9	789.0	210.1	3.9
Security and commodity brokers	62	430.2	424.2	419.6	440.1	471.6	515.5	525.4	553.0	596.8	166.6	4.2
Insurance carriers	63	1,438.4	1,462.2	1,494.6	1,495.6	1,529.0	1,551.9	1,528.8	1,517.1	1,535.4	97.0	0.8
Insurance agents	64	651.8	663.3	666.3	656.6	668.0	683.6	695.5	708.6	724.4	72.6	1.3
Real estate	65	1,296.0	1,315.0	1,299.0	1,290.0	1,322.0	1,361.0	1,351.0	1,382.0	1,419.0	123.0	1.1
Business services	73	4,185.4	4,367.4	4,289.2	4,479.8	4,841.9	5,322.1	5,722.5	6,065.3	6,572.1	2,386.7	5.8
Motion pictures	78	374.7	407.7	410.9	400.9	412.0	441.2	487.6	524.7	548.1	173.4	4.9
Health services	80	7,462.8	7,814.3	8,182.9	8,490.0	8,755.9	8,991.9	9,230.4	9,477.9	9,719.5	2,256.7	3.4
Legal services	81	880.4	907.7	911.9	913.5	924.0	924.0	921.4	927.5	947.3	66.9	0.9
Other services n.e.c.	83-87, 89	5,966.5	6,262.3	6,369.1	6,516.4	6,742.1	6,979.4	7,337.6	7,590.8	7,906.3	1,939.8	3.6
<b>Total IT-Using Industries</b>		<b>35,508</b>	<b>36,394</b>	<b>36,562</b>	<b>37,025</b>	<b>37,988</b>	<b>39,223</b>	<b>40,318</b>	<b>41,351</b>	<b>42,749</b>	<b>7,240</b>	<b>2.3</b>
Share of Total Employment		<b>39.4%</b>	<b>40.0%</b>	<b>40.7%</b>	<b>41.2%</b>	<b>41.3%</b>	<b>41.3%</b>	<b>41.2%</b>	<b>41.3%</b>	<b>41.5%</b>		

Source: Bureau of Labor Statistics

\*AAG- average annual rate of growth

As in the case of value added, employment in industries identified as both IT-producing and IT-using were only counted once, as an IT-producing industry. For example, SIC 737 - Computer and data processing services is part of SIC 73, Business services, an IT-using industry. Employment (and wage) estimates for Business services reported in Tables A-4.2 and A-4.4 exclude employment (and wages) in SIC 737.

References to employment projections in this analysis are for the 1996 to 2006 timeframe and are the latest available. BLS will release employment projections for 1998 to 2008 in November 1999. See the *Emerging Digital Economy*, Appendix I (<http://www.ecommerce.gov>) for detailed industry employment projections tables and supporting documentation.

## Wages

Industry level wage data are collected through the BLS ES202 program and include gross wages and salaries, bonuses, stock options, tips and other gratuities and in some cases the value of meals and lodging.<sup>8</sup> These estimates along with industry employment were used to compute annual wages per worker. (Table A-4.3 and A-4.4) Since employment estimates are from the CES survey and wages are from the ES202 survey, they do not exactly match employment per worker estimates using ES202 employment numbers (as published by the American Electronics Association and Business Software Alliance).

Wage estimates presented in this report are for 1989 to 1997; however, 1997 estimates are preliminary. Estimates for 1991 and earlier are not comparable to recent estimates because of changes in reporting requirements. (See *Covered Employment and Wages Annual, 1997*.)

Wages for the railroad transportation industry (SIC 40), an IT-using industry, are not available because most railroad employees are covered by unemployment programs under the Railroad Retirement Act and thus not covered by the ES202 survey. (Table A-4.4)

Note that these simple averages are for purposes of comparing relative wages across industries and should not be interpreted as official BLS estimates of mean or median earnings. Estimates of wages per worker include all occupations in each industry and should not be confused with earnings for specific occupations explained in the following section.

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<sup>8</sup>Bureau of Labor Statistics, *BLS Handbook of Methods*, Bulletin 2940, April 1997. (<http://www.bls.gov/pdf/homch5.pdf>)

**Table A-4.3**  
**Information Technology Producing Industries: Annual Wages Per Worker, 1989 to 1997**

	SIC	1989	1990	1991	1992	1993	1994	1995	1996	1997	Change 1989-97	AAG 1989-97 (percent)
<b>Average All Private Industries</b>		\$22,184	\$23,209	\$23,952	\$25,375	\$25,746	\$26,248	\$27,164	\$28,320	\$29,787	\$7,602	3.8
<b>IT-Producing Industries</b>		\$34,561	\$36,774	\$38,350	\$41,286	\$42,518	\$43,942	\$46,405	\$49,192	\$52,920	\$18,359	5.5
<b>Hardware</b>												
Electronic computers	3571	\$43,670	\$46,406	\$48,597	\$52,360	\$54,655	\$55,629	\$59,563	\$62,445	\$70,286	\$26,616	6.1
Computer equipment wholesalers	5045pt.	\$44,152	\$46,314	\$49,243	\$52,497	\$52,944	\$52,886	\$54,305	\$56,730	\$63,436	\$19,285	4.6
Computer equipment retailers	5734pt.	\$27,674	\$29,054	\$31,108	\$32,233	\$30,534	\$32,054	\$33,780	\$35,013	\$37,312	\$9,638	3.8
Computer storage devices & peripheral equipment	3572.7	\$33,447	\$35,938	\$39,003	\$41,194	\$42,650	\$42,901	\$46,517	\$50,988	\$58,489	\$25,042	7.2
Computer terminals, office and accounting machines, and office machines, n.e.c.	3575,8,9	\$34,028	\$39,259	\$41,254	\$43,253	\$44,806	\$44,330	\$46,568	\$49,452	\$52,637	\$18,609	5.6
Electron tubes	3671	\$31,365	\$32,257	\$34,410	\$38,364	\$37,581	\$39,755	\$41,875	\$40,952	\$43,067	\$11,702	4.0
Semiconductors	3674	\$35,404	\$38,109	\$40,544	\$44,480	\$47,362	\$49,537	\$53,801	\$54,406	\$59,507	\$24,103	6.7
Printed circuit boards, electronic capacitors, resistors, coils, transformers, and connectors	3672,5-8	\$23,407	\$24,209	\$25,230	\$25,690	\$26,460	\$27,479	\$28,294	\$29,404	\$31,453	\$8,046	3.8
Electronic components, n.e.c.	3679	\$26,450	\$27,051	\$28,838	\$29,715	\$30,651	\$31,947	\$32,912	\$33,924	\$35,709	\$9,259	3.8
Industrial instruments for measurement	3823	\$29,577	\$31,697	\$32,995	\$35,082	\$35,835	\$37,048	\$38,427	\$40,464	\$43,464	\$13,887	4.9
Instruments for measuring electricity	3825	\$34,676	\$36,802	\$39,596	\$42,497	\$43,984	\$48,188	\$51,559	\$54,538	\$59,257	\$24,581	6.9
Laboratory analytical instruments	3826	\$33,034	\$34,453	\$35,883	\$38,724	\$39,232	\$42,586	\$44,193	\$50,061	\$52,204	\$19,171	5.9
<b>Hardware</b>		\$35,425	\$37,597	\$39,871	\$42,375	\$43,275	\$44,171	\$46,280	\$48,294	\$53,044	\$17,619	5.2
<b>Software/Services</b>												
Computer programming services	7371	\$38,709	\$41,857	\$43,053	\$46,222	\$47,552	\$50,057	\$52,731	\$56,918	\$60,028	\$21,319	5.6
Prepackaged software	7372	\$41,670	\$45,505	\$49,413	\$56,995	\$54,489	\$56,976	\$63,700	\$70,081	\$77,422	\$35,752	8.1
Prepackaged software wholesalers	5045pt.	\$44,152	\$46,314	\$49,243	\$52,497	\$52,944	\$52,886	\$54,305	\$56,730	\$55,135	\$10,983	2.8
Prepackaged software retailers	5734pt.	\$27,674	\$29,054	\$31,108	\$32,233	\$30,534	\$32,054	\$33,780	\$35,013	\$37,219	\$9,545	3.8
Computer integrated systems design	7373	\$39,645	\$43,795	\$44,640	\$48,556	\$49,689	\$52,749	\$54,711	\$59,352	\$61,430	\$21,785	5.6
Computer processing and data preparation	7374	\$28,137	\$30,452	\$30,772	\$34,374	\$36,131	\$36,625	\$39,749	\$43,341	\$43,660	\$15,523	5.6
Information retrieval services	7375	\$30,960	\$32,704	\$35,044	\$36,704	\$38,896	\$38,583	\$42,197	\$45,308	\$49,582	\$18,621	6.1
Computer services management, rental and leasing, and maintenance and repair	7376,7,9	\$38,721	\$41,185	\$43,242	\$45,970	\$46,830	\$48,924	\$51,827	\$54,647	\$60,365	\$21,644	5.7
Computer maintenance and repair	7378	\$33,152	\$34,296	\$34,071	\$36,589	\$37,488	\$37,236	\$37,819	\$39,546	\$40,559	\$7,407	2.6
<b>Software/Services</b>		\$35,745	\$38,763	\$40,409	\$44,327	\$45,295	\$47,224	\$50,718	\$54,867	\$58,688	\$22,943	6.4
<b>Communications Equipment</b>												
Household audio and video equipment	3651	\$27,270	\$28,942	\$30,882	\$32,692	\$33,866	\$36,895	\$32,370	\$35,103	\$39,943	\$12,673	4.9
Telephone and telegraph equipment	3661	\$36,197	\$37,197	\$38,312	\$42,381	\$45,400	\$46,840	\$49,902	\$54,640	\$57,440	\$21,243	5.9
Radio and TV communications equipment and communications equipment, n.e.c.	3663,9	\$31,857	\$34,468	\$35,484	\$39,077	\$40,326	\$40,065	\$42,735	\$44,400	\$48,461	\$16,604	5.4
Magnetic and optical imaging devices	3695	\$27,854	\$31,101	\$33,242	\$37,452	\$38,834	\$39,324	\$39,187	\$45,731	\$43,009	\$15,155	5.6
<b>Communications Equipment</b>		\$32,516	\$34,283	\$35,495	\$38,921	\$40,789	\$41,713	\$43,220	\$46,404	\$49,983	\$17,467	5.5
<b>Communications Services</b>												
Telephone communications	481	\$35,479	\$37,230	\$38,271	\$41,393	\$43,273	\$45,050	\$46,774	\$48,658	\$50,683	\$15,204	4.6
Telephone and telegraph communications	482,489	\$36,038	\$39,699	\$42,635	\$41,719	\$44,098	\$47,206	\$48,539	\$52,925	\$55,719	\$19,681	5.6
Radio broadcasting	4832	\$21,178	\$22,088	\$22,498	\$23,508	\$24,272	\$25,956	\$27,248	\$29,296	\$31,170	\$9,993	5.0
Television broadcasting	4833	\$37,213	\$41,726	\$39,974	\$41,440	\$42,177	\$43,749	\$47,180	\$51,051	\$51,421	\$14,208	4.1
Cable and other pay TV services	4841	\$24,737	\$25,994	\$27,148	\$29,594	\$30,507	\$31,426	\$34,553	\$35,466	\$37,654	\$12,917	5.4
<b>Communications Services</b>		\$33,324	\$35,239	\$36,015	\$38,598	\$40,122	\$41,778	\$43,731	\$45,689	\$47,685	\$14,361	4.6

Source: ESA calculations based on BLS data.

AAG- average annual rate of growth

**Table A-4.4**  
**Information Technology Using Industries: Annual Wages Per Worker, 1989 to 1997**

	SIC	1989	1990	1991	1992	1993	1994	1995	1996	1997	Change 1989-97	AAG* 1989-97 (percent)
<b>Average All Private Industries</b>		<b>\$22,184</b>	<b>\$23,209</b>	<b>\$23,952</b>	<b>\$25,375</b>	<b>\$25,746</b>	<b>\$26,248</b>	<b>\$27,164</b>	<b>\$28,320</b>	<b>\$29,787</b>	<b>\$7,602</b>	<b>3.8</b>
<b>IT-Using Industries</b>		<b>\$24,763</b>	<b>\$25,988</b>	<b>\$26,835</b>	<b>\$28,724</b>	<b>\$29,412</b>	<b>\$29,464</b>	<b>\$30,653</b>	<b>\$32,042</b>	<b>\$33,532</b>	<b>\$8,769</b>	<b>3.9</b>
Chemicals and allied products	28	37,534	39,813	41,873	44,252	45,082	47,021	49,325	52,103	55,968	18,434	5.1
Petroleum and coal products	29	40,918	42,948	45,175	48,268	49,472	52,314	53,437	54,815	59,191	18,273	4.7
Electronic and other electric equipment	36	26,573	27,561	28,799	30,550	31,357	32,631	33,345	34,596	37,069	10,496	4.2
Instruments and related products	38	33,438	34,626	36,643	38,904	39,615	40,882	42,577	45,201	47,151	13,713	4.4
Railroad transportation	40	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Pipelines, exc. Natural gas	46	41,209	44,928	46,813	50,835	51,342	53,784	56,339	56,955	59,371	18,162	4.7
Electric, gas, and sanitary services	49	36,788	38,062	39,892	42,582	43,767	45,618	46,880	49,361	51,797	15,009	4.4
Wholesale trade	50,51	28,334	29,363	30,173	32,271	34,609	33,698	35,155	36,467	38,198	9,864	3.8
Depository institutions	60	23,894	25,039	25,965	28,323	28,852	29,822	31,788	33,986	36,168	12,273	5.3
Nondepository credit institutions	61	30,007	31,277	32,617	37,043	39,048	36,425	39,162	40,537	44,626	14,619	5.1
Security and commodity brokers	62	61,571	64,448	70,324	90,545	92,492	81,849	90,569	103,502	113,425	51,854	7.9
Insurance carriers	63	27,590	29,449	30,893	33,042	33,286	34,221	35,837	38,269	40,232	12,642	4.8
Insurance agents	64	28,258	29,848	30,908	32,481	33,018	34,355	35,625	37,411	39,387	11,129	4.2
Real estate	65	21,704	21,861	21,898	22,952	23,291	23,927	24,808	26,040	27,819	6,115	3.2
Holding and Investment offices	67	36,490	40,544	40,505	47,607	48,962	48,751	56,027	66,398	71,132	34,641	8.7
Business services	73	15,557	16,490	16,569	17,377	17,656	17,427	18,417	19,585	20,619	5,062	3.6
Motion pictures	78	20,825	22,681	22,648	23,989	26,284	26,550	27,607	30,032	30,261	9,436	4.8
Health services	80	23,447	25,087	26,192	27,760	28,188	28,837	29,961	30,635	31,402	7,955	3.7
Legal services	81	38,200	40,543	41,455	44,211	44,585	45,554	46,987	48,713	50,759	12,559	3.6
83-87,												
Other services, n.e.c.	89	19,250	20,356	20,590	21,956	22,337	22,589	23,594	24,678	25,987	6,737	3.8

Source: ESA calculations based on BLS data.

\*AAG- average annual rate of growth



## **IT OCCUPATIONAL EMPLOYMENT AND WAGES**

### **Employment**

Occupations considered to be essential to IT and to electronic commerce were selected based on consultations with BLS and are the same as those used for the original EDE report. Our definition of IT occupations is much broader than the “core IT occupations” *i.e.*, computer scientists, engineers, programmers and systems analysts used by the Technology Administration, National Science Foundation, Information Technology Association of America and others. This is because the definition of IT occupations used in this analysis covers occupations not only involved in conducting electronic commerce, but in maintaining the infrastructure that enables it. As shown in the box below, these occupations range from data entry keyers and telephone operators to powerline installers and data processing equipment repairers in addition to "core IT occupations." Table A-4.5 shows employment levels by IT occupation and IT industry group and Table A-4.6 provides a brief description of duties of each IT occupation.

<b>IT-Related Occupations</b>	
Engineering, science, and computer systems managers Electrical and electronics engineers Electrical powerline installers and repairers Electrical and electronics technicians Broadcast technicians Computer equipment operators Electronic semiconductor processors Communications equipment operators Telephone and Cable TV installers and repairers	Computer engineers, scientists, and systems analysts Computer programmers Data processing equipment repairers Electromechanical equipment assemblers, precision Data entry keyers, composing Electrical and electronic equipment assemblers, precision Duplicating, mail and other office machine operators Billing, posting and calculating machine operators Electronics repairers, commercial and industrial equip. Central office and PBX installers and repairers

The primary source for employment by occupation and industry is the BLS *National Industry-Occupation Matrix 1996 to 2006*, compiled by the Office of Employment Projections (OEP). These estimates are located on the BLS website at (<http://www.bls.gov/emphome.htm>) and are published in the November 1997 *Monthly Labor Review*. New estimates for the 1998 to 2008 timeframe will be available in November 1999.

### **Wages**

Wages are collected as part of the Occupational Employment Statistics (OES) survey. The OES survey is conducted in a three year cycle, during which one-third of the sample is surveyed each year. Because of changes in estimation methods, 1997 wage and employment estimates are not comparable to those for 1996 and therefore wages are only reported for 1997. The 1997 mean wage estimates for each occupation shown in Table A-4.6 are available at the OES website (<http://www.bls.gov/oeshome.htm>).

**Table A-4.5  
Information Technology Occupations:  
Employment Projections and Education/Training Requirements, 1996 and 2006**

(Units 000s)

Occupations	All IT Occupations			IT-Producing			IT-Using			Non-IT		
	1996	2006	Change	1996	2006	Change	1996	2006	Change	1996	2006	Change
<b>Education and Training Requirements: High*</b>	<b>2,508</b>	<b>3,945</b>	<b>1,437</b>	<b>779</b>	<b>1,548</b>	<b>769</b>	<b>999</b>	<b>1,414</b>	<b>415</b>	<b>730</b>	<b>982</b>	<b>252</b>
Engineering, science, and computer systems managers	343	498	155	71	118	47	160	243	82	111	137	26
Electrical and electronics engineers	367	472	105	116	164	48	151	191	40	100	117	17
Computer systems analysts, engineers, and scientists	933	1,937	1,004	293	827	534	319	582	263	321	528	207
Electrical and electronic technicians and technologists	297	341	44	75	91	17	157	181	24	66	69	3
Computer programmers	568	697	129	224	347	124	212	218	6	132	132	-1
<b>Education and Training Requirements: Moderate</b>	<b>897</b>	<b>998</b>	<b>101</b>	<b>508</b>	<b>592</b>	<b>83</b>	<b>204</b>	<b>199</b>	<b>-5</b>	<b>185</b>	<b>208</b>	<b>23</b>
Broadcast technicians	46	53	7	34	38	3	8	11	3	4	5	1
Data entry keyers, composing	18	10	-8	5	3	-1	6	3	-2	8	3	-5
Central office and PBX installers and repairers	81	85	4	78	82	5	0	0	0	3	3	-1
Data processing equipment repairers	80	121	41	32	66	34	29	30	1	19	26	7
Electronic semiconductor processors	58	65	7	57	64	7	1	1	0	0	0	0
Electronics repairers, commercial and industrial equip.	60	67	7	7	8	1	15	20	5	38	39	1
Telephone and cable TV line installers and repairers	201	242	41	155	190	36	0	0	0	46	51	5
Electrical powerline installers and repairers	108	111	3	20	21	1	58	51	-7	30	38	9
Electromechanical equipment assemblers, precision	51	51	0	16	15	-1	24	24	0	11	12	1
Electrical and electronic equip. assemblers, precision	194	193	-1	106	105	-1	61	58	-3	27	31	4
<b>Education and Training Requirements: Low</b>	<b>917</b>	<b>742</b>	<b>-175</b>	<b>160</b>	<b>105</b>	<b>-55</b>	<b>499</b>	<b>467</b>	<b>-31</b>	<b>259</b>	<b>170</b>	<b>-89</b>
Communications equipment operators	328	295	-33	95	56	-39	162	183	21	71	56	-15
Computer operators	291	198	-93	54	37	-16	143	102	-41	94	58	-36
Duplicating, mail, and other office machine operators	196	149	-47	9	9	0	115	102	-13	72	38	-34
Billing, posting, and calculating machine operators	102	100	-2	2	3	0	78	80	2	21	17	-4
<b>All IT Occupations</b>	<b>4,322</b>	<b>5,685</b>	<b>1,363</b>	<b>1,447</b>	<b>2,237</b>	<b>791</b>	<b>1,701</b>	<b>2,081</b>	<b>379</b>	<b>1,174</b>	<b>1,367</b>	<b>193</b>
<b>Share of All IT Occupations</b>	<b>100%</b>	<b>100%</b>		<b>33%</b>	<b>39%</b>	<b>6%</b>	<b>39%</b>	<b>37%</b>	<b>-3%</b>	<b>27%</b>	<b>24%</b>	<b>-3%</b>

High: Associate's degree, bachelor's degree or work experience plus a bachelor's degree or higher

Moderate: long-term on-the-job training, work experience in a related occupation or post secondary vocational training

Low: short to moderate-term on-the-job training

\*The grouping of education and training categories into high, moderate and low requirement levels reflects the author's interpretation of training intensity. BLS classifies occupations into 11 categories that describe education and training needed by most workers to become fully qualified. A description of these education and training categories can be found in the November 1997, Monthly Labor Review, p.8:

Source: Bureau of Labor Statistics

## **EDUCATION AND TRAINING REQUIREMENTS BY OCCUPATION**

The Bureau of Labor Statistics divides education and training requirements into eleven categories that describe the education and training needed by most workers to become fully qualified (See box on page 34). *Note that these education and training categories were not intended to be measured as skills.* The eleven categories include occupations that require training ranging from short-term on-the-job training to a first professional degree. The box below shows the 11 BLS categories and how they correspond to the three levels of training intensity presented in Table A-4.5.

<b>Concordance of BLS and ESA Education and Training Requirement Levels</b>	
<b>BLS Categories</b>	<b>ESA Intensity Levels</b>
First professional degree	High
Doctoral degree	High
Master's degree	High
Work experience, plus a bachelor's or higher degree	High
Bachelor's degree	High
Associate's degree	High
Post-secondary vocational training	Moderate
Work experience in a related occupation.	Moderate
Long-term on-the-job training	Moderate
Moderate-term on-the-job training	Low
Short-term on-the-job training	Low

## Occupational Education and Training Requirement Categories

**First professional degree** *Occupations that require a professional degree.* Completion of the academic program usually requires at least 6 years of full-time equivalent academic study, including college study prior to entering the professional degree program.

**Doctoral degree** *Occupations that generally require a Ph.D. or other doctoral degree.* Completion of the degree program usually requires at least 3 years of full-time equivalent academic work beyond the bachelor's degree.

**Master's degree** *Occupations that generally require a master's degree.* Completion of the degree program usually requires 1 or 2 years of full-time equivalent study beyond the bachelor's degree.

**Work experience, plus a bachelor's or higher degree.** *Occupations that generally require work experience in an occupation requiring a bachelor's or higher degree.* Most occupations in this category are managerial occupations that require experience in a related nonmanagerial position.

**Bachelor's degree.** *Occupations that generally require a bachelor's degree.* Completion of the degree program generally requires at least 4 years, but not more than 5 years, of full-time equivalent academic work.

**Associate's degree.** *Occupations that generally require an associate's degree.* Completion of the degree program generally requires at least 2 years of full-time equivalent academic work.

**Post-secondary vocational training.** *Occupations that generally require completion of vocational school training.* Some programs last only a few weeks while others may last more than a year. In some occupations, a license is needed that requires passing an examination after completion of the training.

**Work experience in a related occupation.** *Occupations that generally require skills obtained through work experience in a related occupation.* Some occupations requiring work experience are supervisory or managerial occupations.

**Long-term on-the-job training.** *Occupations that generally require more than 12 months of on-the-job training or combined work experience and formal classroom instruction for workers to develop the skills needed for average job performance.* This category includes formal and informal apprenticeships that may last up to 4 years and short-term intensive employer-sponsored training that workers must successfully complete. Individuals undergoing training are generally considered to be employed in the occupation. This category includes occupations in which workers may gain experience in nonwork activities, such as professional athletes who gain experience through participation in athletic programs in academic institutions.

**Moderate-term on-the-job training.** *Occupations in which workers can develop the skills needed for average job performance after 1 to 12 months of combined on-the-job experience and informal training.*

**Short-term on-the-job training.** *Occupations in which workers generally can develop the skills needed for average job performance after a short demonstration or up to 1 month of on-the-job experience and instruction.*

**Table A-4.6**  
**IT Occupations: Earnings and Educational Requirements, 1997**

Occupation	Description of Duties	1997 Mean Wages	Most Significant Source of Training *
Engineering, science, and computer systems managers	Plan, coordinate, and direct research, development, design, production and computer-related activities.	\$68,600	Work experience plus degree
Electrical and electronic engineers	Design, develop, test, and supervise the manufacture of electrical and electronic equipment, including computer hardware and communications and video equipment.	\$56,800	Bachelor's degree
Computer engineers	Design hardware, software, networks, and processes to solve technical problems.	\$56,600	Bachelor's degree
Systems analysts	Solve computer problems and enable computer technology to meet the specific needs of an organization.	\$51,400	Bachelor's degree
Computer programmers	Develop and write computer programs to store, locate, and retrieve specific documents, data, and information.	\$50,500	Bachelor's degree
Database administrators	Use database management systems to coordinate changes to, testing, or implementing computer data bases. May coordinate measures for system security.	\$48,000	Bachelor's degree
Computer support specialists	Provide technical assistance and training to computer system users and investigate and resolve computer software and hardware problems.	\$39,000	Bachelor's degree
Electrical and electronic technicians	Help design, develop, test, and manufacture electrical and electronic equipment including computers.	\$36,100	Associate's degree
Computer operators	Oversee the operation of computer hardware systems and must anticipate problems, take preventive action and solve problems that occur.	\$25,800	Moderate-term O-J-T
Broadcast technicians	Repair, set up, and operate electronic equipment used to record and transmit radio and television programs.	\$29,400	Post secondary vocational training
Communications equipment operators (telephone and switchboard operators, etc.)	Relay incoming, outgoing, and interoffice calls, supply information to callers, record messages, and may perform routine clerical work.	\$18,500 to \$27,700	Short-term to Moderate-term O-J-T
Duplicating, mail, and other machine operators	Operate machines that produce copies and machines that print names, addresses, etc. on envelopes or forms.	\$18,900	Short-term O-J-T
Billing, posting, and calculating machine operators	Operate machines that automatically perform mathematical processes to calculate and record billing, accounting, statistical, and other numerical data.	\$20,300	Short-term O-J-T
Data entry keyers, composing	Operate photocomposing or comparable data entry composing machines.	\$20,400	Post secondary vocational training
Central office and PBX installers and repairers	Install, test, analyze, and repair telephone or telegraph circuits and equipment.	\$40,200	Post secondary vocational training
Data processing equipment repairers	Repair, maintain, and install electronic computers (mainframes, minis, and micros) and peripheral equipment.	\$30,400	Post secondary vocational training
Electronics repairers, commercial and industrial equipment	Install and repair industrial controls, including communications and medical diagnostic equipment.	\$34,400	Post secondary vocational training
Electromechanical, electrical, and electronic equipment assemblers, precision	Assemble, test, and prepare electrical and electromechanical equipment such as computers, magnetic drums and tape drives.	\$22,300 to 23,400	Work experience in related occupation
Telephone and cable television line installers and repairers	String and repair telephone and television cable and other equipment for transmitting messages or TV programming.	\$32,700	Long-term O-J-T
Electrical powerline installers and repairers	Install and repair cables or wires used in electrical power or distribution systems.	\$41,100	Long-term O-J-T
Electronic semiconductor processors	Process (saw, load, clean, polish) materials used to manufacture electronic semiconductors.	\$32,656	Moderate-term O-J-T

Source: Bureau of Labor Statistics

O-J-T: on-the-job training

\* A description of education and training categories can be found in the November 1997, *Monthly Labor Review*, p.83.

