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Biopharmaceutical Industries in Massachusetts and
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Introduction

In an earlier set of research papers, we identified the individual industries comprising the biopharmaceutical sector in Massachusetts and the U.S. and tracked changes in payroll employment, total payroll, and value of shipments/receipts for those industries over the past five years and in some cases the past decade. One of the key indicators for gauging the economic performance of biopharmaceutical industries in Massachusetts is to compare trends in the value of shipments/receipts¹ generated by these industries with those of other industries in the state and with biopharmaceutical industries in the nation and all other states across the country. How much shipments/receipts growth occurred between 1997 and 2002 in biopharmaceutical industries in our state and across the country? How did shipments/receipts growth in the state's biopharmaceutical industries compare to the other major industrial sectors across the state? To provide answers to these key questions, we analyzed shipments/receipts data for biopharmaceutical industries in Massachusetts and the U.S. that were produced by the U.S. Census Bureau's Economic Censuses of 1997 and 2002. Annual shipments/receipts data for biopharmaceutical industries in this study are expressed both in nominal and real dollar terms.² The reader should note that the shipments/receipts data used in our analysis represent the total dollar value collected by the firms from selling biopharmaceutical industry products and services. From the available shipments/receipts data, we cannot estimate how much profit these industries made in these two time periods or how much of the revenue was received by workers. Understanding the economic profitability of biopharmaceutical industries and the compensation of employees are two important issues that will be dealt with in following papers.

¹ See Appendix A for the definition of value of shipments/receipts.

² We have used the Consumer Price Index for all Urban Consumers (the CPI-U) to convert nominal sales revenue into real 2002 dollars. Ideally, the nominal sales revenues data should be converted to real sales revenue by using the GDP price deflators for these industries. However, the U.S. Bureau of Economic Analysis (BEA), which produces GDP data does not produce price deflator data at the detailed level of the industries that we have used in our analysis. We can obtain a close match for some of these industries, but not an exact match. Using this close match data, the GDP deflator in bio-pharmaceutical industries in the U.S. increased from 98.2 in 1997 to 104.2 in 2003, a relative increase of 6.7 percentage points in 5 years. For Massachusetts, the GDP deflator in bio-pharmaceutical industries increased from 97.9 in 1997 to 104.5 in 2002, a relative increase of 7.6%. The CPI-U in the U.S. increased from 160.5 in 1997 to 179.9 in 2002, a relative increase of 12.1 percentage points. Thus, our estimates of real sales revenue using the CPI-U are more conservative than those that would have been generated by using the national or state GDP deflator.

Trends in Value of Shipments/Receipts of Biopharmaceutical Industries in Massachusetts and the U.S. Over the 1997-2002 Time Period

The nominal value of the shipments/receipts generated by biopharmaceutical industries in Massachusetts increased from \$6.73 billion in 1997 to \$11.20 billion in 2002, an absolute increase of \$4.47 billion, representing a relative increase of 66.5% over this five-year period. (Table 1). The growth in the value of shipments/receipts in biopharmaceutical industries in Massachusetts outperformed the growth rate of revenues in the same set of industries in the U.S. by 12 percentage points (66.5% versus 52.9%). Among the three biopharmaceutical industries, value of shipments/receipts increased by 53% in the medical supplies and instruments manufacturing industry, 71% in the pharmaceutical and medicine manufacturing industry, and 73% in research and development in the physical, engineering and life sciences service industry. Two of these biopharmaceutical industries in Massachusetts (pharmaceutical and medicine manufacturing and medical instrument and supplies manufacturing) outpaced the growth rate in the value of shipments/receipts generated by the same industries in the U.S. between 1997 and 2002. Research and development in the physical, engineering and life sciences services industry was the only biopharmaceutical industry in Massachusetts that lagged behind the U.S. in the growth rate of shipments/receipts. Sales revenue in this industry in Massachusetts between 1997 and 2002 grew at a very high rate of 73%, but this growth rate was nearly 4 percentage points lower than the national average (77% versus 73%).

Table 1:
Trends in the Nominal Value of Shipments/Receipts in Biopharmaceutical
Industries in Massachusetts and the U.S., 1997-2002
(in 1,000)

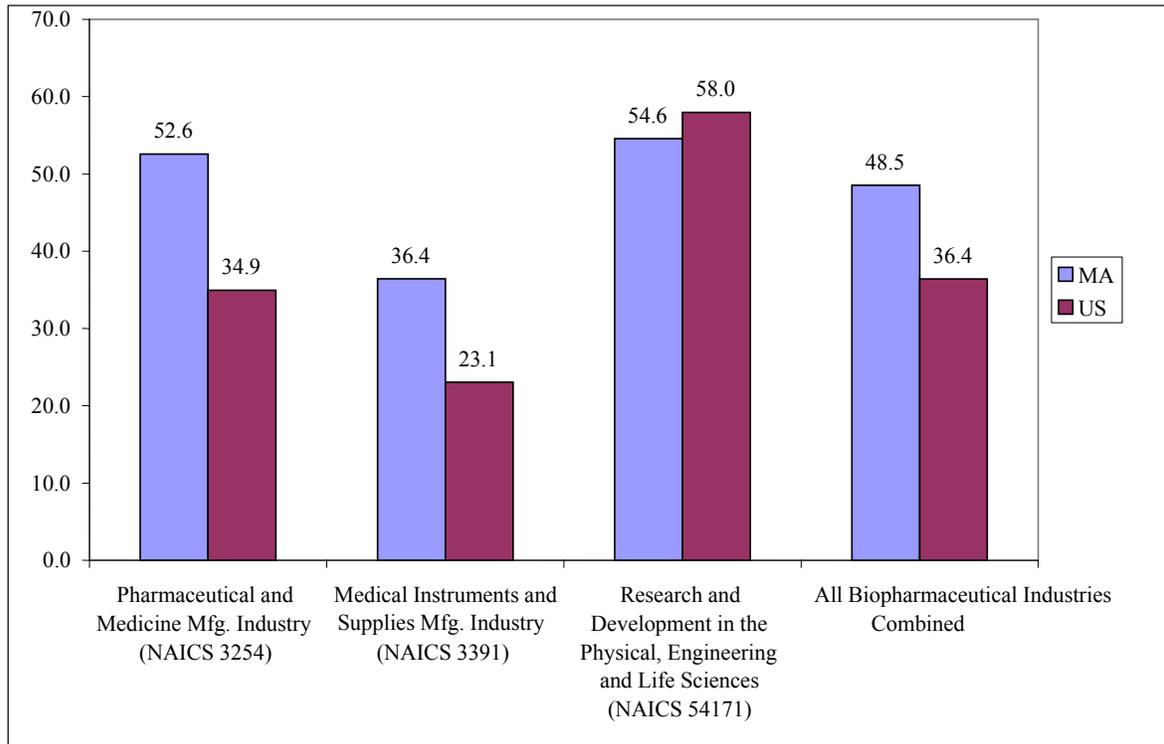
Massachusetts	1997	2002	Absolute Change	% Change
Pharmaceutical and Medicine Mfg. Industry (NAICS 3254)	\$2,124,000	\$3,632,725	\$1,508,725	71.0
Medical Instruments and Supplies Mfg. Industry (NAICS 3391)	\$2,008,850	\$3,072,093	\$1,063,243	52.9
Research and Development in the Physical, Engineering and Life Sciences (NAICS 54171)	\$2,595,285	\$4,496,928	\$1,901,643	73.3
All Biopharmaceutical Industries Combined	\$6,728,135	\$11,201,746	\$4,473,611	66.5
United States				
Pharmaceutical and Medicine Mfg. Industry (NAICS 3254)	\$92,932,786	\$140,557,276	\$47,624,490	51.2
Medical Instruments and Supplies Mfg. Industry (NAICS 3391)	\$44,893,840	\$61,928,760	\$17,034,920	37.9
Research and Development in the Physical, Engineering and Life Sciences (NAICS 54171)	\$34,145,927	\$60,453,069	\$26,307,142	77.0
All Biopharmaceutical Industries Combined	\$171,972,553	\$262,939,105	\$90,966,552	52.9

Source: 1997 and 2002 Economic Censuses, U.S. Census Bureau, tabulations by authors

How did the growth rate of the real (inflation-adjusted) value of shipments/receipts in biopharmaceutical industries in Massachusetts differ from the growth rate of real value of shipments/receipts generated by biopharmaceutical industries across the country in 1997 and 2002? We converted the nominal value of 1997 shipments/receipts to constant 2002-dollar values using changes in the overall rate of inflation as measured by the U.S. CPI-U index. The CPI-U index for the entire U.S. increased from 165.9 in 1997 to 179.9 in 2002, a relative increase of 12.1 percentage points over this five-year period. (Chart 1). In Massachusetts, the real dollar value of shipments/receipts in biopharmaceutical industries increased by \$3.66 billion between 1997 and 2002, a relative increase of 48.5%, exceeding the national growth rate of only 36%. The growth rate of the real dollar value of shipments/receipts in the three biopharmaceutical industries varied from 23.1% in the medical instruments and supplies manufacturing industry to 39% in pharmaceutical and medicine manufacturing industries and to a high of 54.6% in research and development in the physical, engineering and life sciences services industry. The growth rate of Massachusetts' value of shipments/receipts for the

biopharmaceutical manufacturing industries outpaced the national growth rate in the real value of shipments/receipts in the same industries nationwide, and only slightly lagged the nation in the value of shipments/receipts growth in the research and development industries. In both nominal and real value terms, the growth rate of the value of shipments/receipts in biopharmaceutical industries in Massachusetts outpaced the U.S. growth rate in the value of the shipments/receipts in the same industries.

Chart 1:
Growth Rates of the Real Value of Shipments/Receipts in
Biopharmaceutical Industries in Massachusetts and the U.S., 1997-2002



Did the sales performance of biopharmaceutical industries in our state outpace that of other industries in the state? To provide an answer to this key question, we compared the growth rate of the value of shipments/receipts of biopharmaceutical industries in Massachusetts with those of 13 other major industries for whom sales revenue data were available from the U.S. Census Bureau.³ The evidence clearly indicates that the growth in the value of shipments/receipts of biopharmaceutical industries in our state was characterized by stellar performance. (Table 2). None of the other 13 major industries' value of

³ Among the industries for whom state revenue data were not available were utilities, information services, finance and insurance, and management of companies and enterprises.

shipments/receipts between 1997 and 2002 in Massachusetts grew at a rate above that of the biopharmaceutical industries. In the entire manufacturing sector in Massachusetts, the nominal value of shipments/receipts was unchanged between 1997 and 2002. Despite this absence of aggregate revenue growth in the overall manufacturing sector, both the pharmaceutical/medicine manufacturing industry and the medical instrument and supplies manufacturing industry experienced high rates of increase in the nominal value of their shipments/receipts. Thus, the biopharmaceutical manufacturing industries performance on this measure was well above the average for all manufacturing industries. While all other industries in Massachusetts experienced double digit revenue growth over this five-year period, only two industries (construction and professional/ scientific/ technical services) achieved growth rates as high as 50%. Eight of the 13 other available industries were characterized by growth rates in the value of shipments/receipts only one-half as high as that of the biopharmaceutical industries.

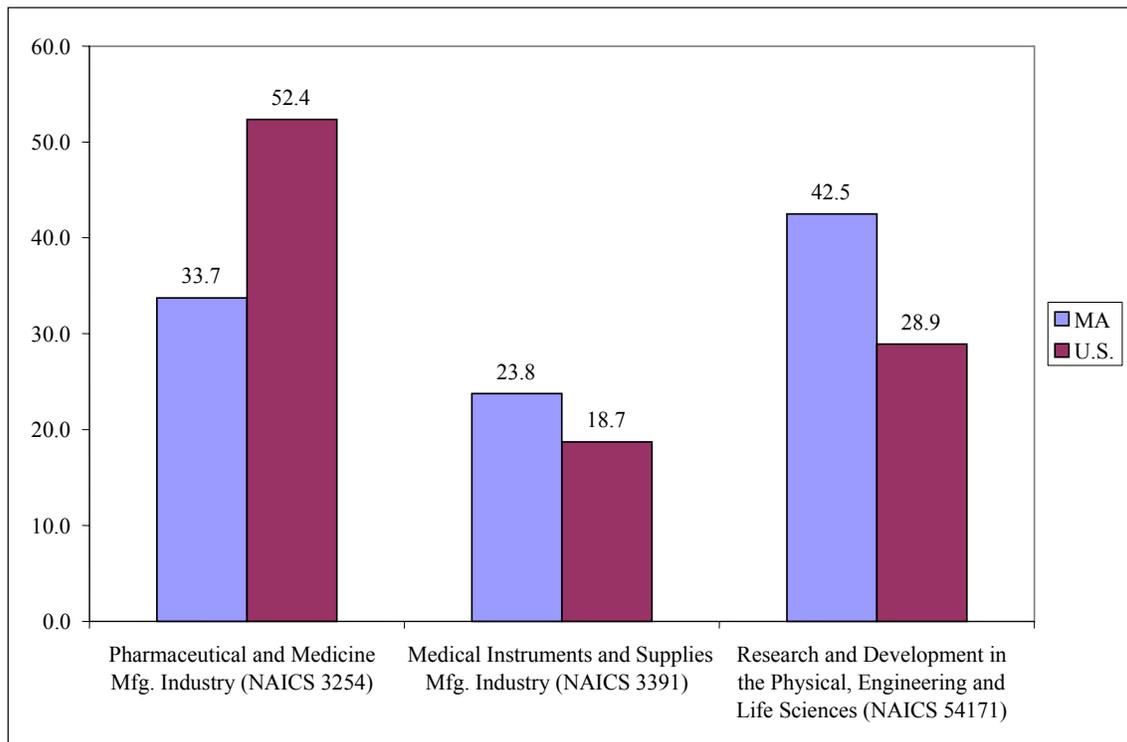
Table 2:
Growth Rates of the Nominal Value of Shipments/Receipts by
Major Private Sector Industries in Massachusetts and the U.S., 1997-2002

Industry	MA	U.S.
Biopharmaceutical Industry	66.5	52.9
Construction	52.6	40.6
Manufacturing	0.1	2.1
Wholesale trade	12.8	14.2
Retail trade	26.1	24.1
Transportation & warehousing	25.8	20.1
Real estate & rental & leasing	42.4	39.3
Professional, scientific, & technical services	54.8	45.8
Adm., support, waste management, remediation services	29.3	34.3
Educational services	20.1	50.2
Health care & social assistance	36.3	36.8
Arts, entertainment, & recreation	43.6	35.5
Accommodation & food services	27.0	28.3
Other services (except public administration)	23.0	13.6

It is also important to improve our knowledge base on the percentage share of overall biopharmaceutical industries' value of shipments/receipts generated by each of the three biopharmaceutical industries in both the state and the nation. The share of value of shipments/receipts of the three biopharmaceutical industries as a percent of total biopharmaceutical industry sales varied widely in both Massachusetts and the U.S. in 2002.

(Chart 2). Research and development in the physical, engineering and life sciences services industry in Massachusetts accounted for the highest share (42.5%) of biopharmaceutical industries' value of shipments/receipts followed by pharmaceutical and medicine manufacturing (34%) and medical instrument and supplies manufacturing (24%). The share of biopharmaceutical industries' value of shipments/receipts generated by firms in research and development in the physical, engineering and life sciences services industry of Massachusetts was nearly 14 percentage points higher than the U.S. average (49% versus 29%). In the U.S., the percentage share of the value of shipments/receipts from this particular industry was only 29%. In contrast, the Massachusetts' pharmaceutical and medicine manufacturing industry accounted for only 34 percent of the total value of biopharmaceutical industry shipments/receipts, a share that was nearly 19 percentage points below the national average.

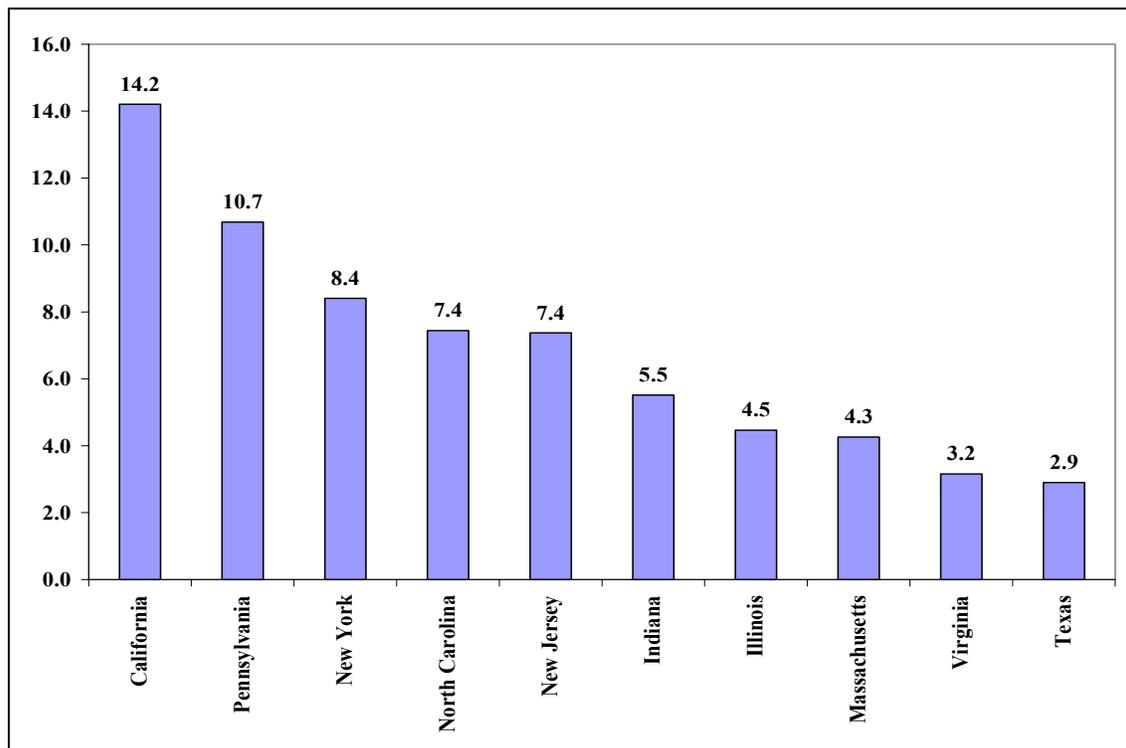
Chart 2:
Value of Shipments/Receipts of Three Biopharmaceutical Industries as a
Percent of Total Value of Shipments/Receipts of All Biopharmaceutical
Industries in Massachusetts and the U.S., 2002



The Biopharmaceutical Industries' Value of Shipments/Receipts in Massachusetts Compared to All Other States in 2002

To place the Massachusetts biopharmaceutical industries' value of shipments/receipts into comparative perspective, we compared the performance of our state with that of other states for whom value of shipments/receipts data for biopharmaceutical industries were available from the 2002 Economic Census. Massachusetts' value of shipments/receipts of \$11.20 billion ranked 8th highest among these 32 states. Massachusetts' share of the value of shipments/receipts for this industry nationwide was 4.2%. (Chart 3). Seven states ranked ahead of Massachusetts on this measure. Not surprisingly, California had the highest national share (14.2%) followed by Pennsylvania (10.7%), New York (8.4%), North Carolina and New Jersey (7.4%), Indiana (5.5%), and Illinois (5.5%). Massachusetts biopharmaceutical industries have increased their share of the national value of shipments/receipts in this industrial sector from 3.9% in 1997 to 4.3% in 2002. This seemingly modest increase of 0.4 percentage points in the national share actually represents a large dollar volume increase. A 4 percentage point increase in the pool of \$266 billion translates to a sizable \$1.06 billion increase in the nominal value of shipments/receipts in the state between 1997 and 2002.

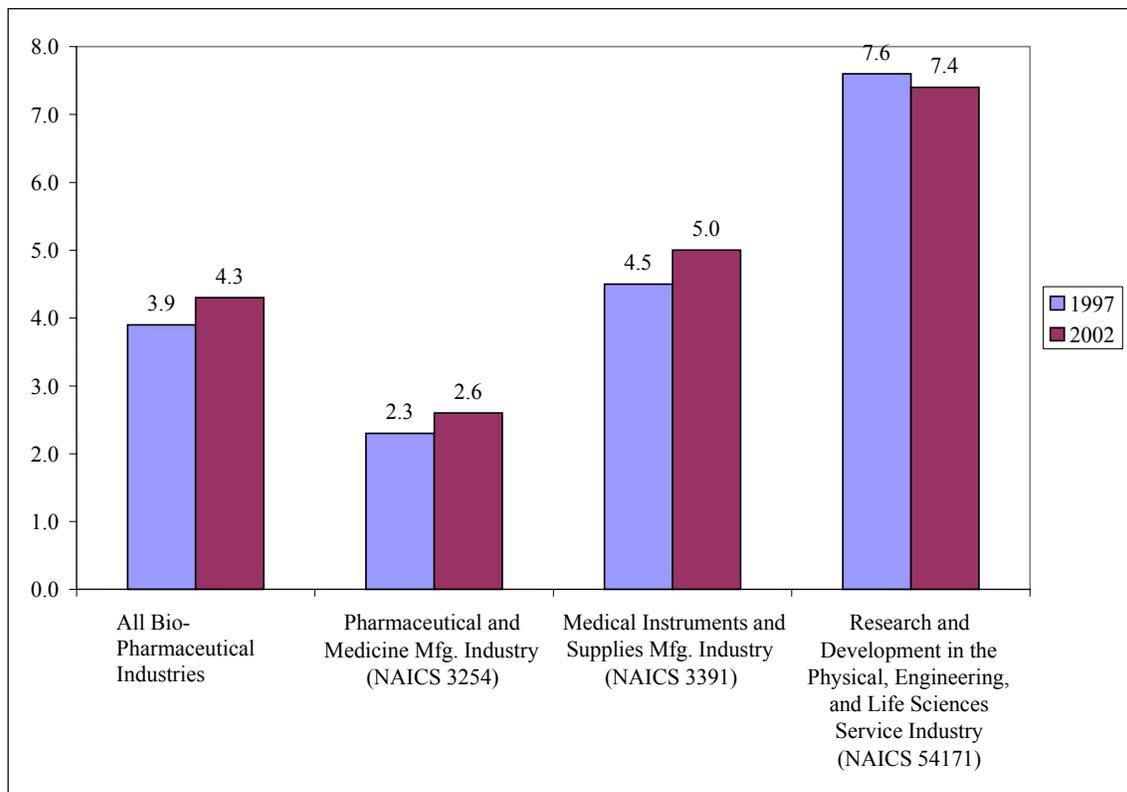
Chart 3:
Ten States with the Highest Percentage Shares of the National Value of Shipments/Receipts in Biopharmaceutical Industries in 2002



Our state's share of the national value of shipments/receipts varied by industry segment of the biopharmaceutical sector in 2002. Among the three biopharmaceutical industries, Massachusetts' share of national nominal value of shipments/receipts in 2002 was 2.6% in pharmaceutical and medicine manufacturing industry, 5.0% in medical instruments and supplies manufacturing, and 7.4% in research and development in the physical, engineering and life sciences service industry. (Chart 4). The two biopharmaceutical manufacturing industries increased their national share of value of shipments/receipts between 1997 and 2002. In contrast, research and development firms in the physical, engineering and life sciences service industry captured a national share of the value of shipments/receipts in 2002 that was slightly below the 1997 share (7.6% in 1997 versus 7.4% in 2002). Despite the modest decline in the national share of shipments/receipts in this particular industry, Massachusetts ranking was 3rd highest in terms of the value of shipments/receipts volume among all states. The absolute dollar value of value of shipments/receipts in both pharmaceutical and medicine manufacturing and medical instrument and supplies manufacturing industries in Massachusetts in 2002 ranked among the top 10 states.

The state's biopharmaceutical industries clearly were a state leader in generating higher value of shipments/receipts over the 1997-2002 period and increasing its national share of such revenues over the same time period. Given the Commonwealth's abundant human capital resources and the high productivity and wages of workers in this sector, the state should aim to improve its comparative position in this key industry sector over the remainder of the current decade.

Chart 4:
Trends in the National Share of Biopharmaceutical Value of
Shipments/Receipts Generated by Massachusetts' Biopharmaceutical Industries, 1997-2002



Appendix A: U.S. Census Bureau's Definition of Value of Shipments/Receipts/Revenues Used in the Report

The measurement of sales revenue data in Economic Censuses of the U.S. Census Bureau are sector specific. In manufacturing industries, sales revenue represents “total value of shipments”. The value of shipments according to the Census Bureau’s definition includes, “the received or receivable net selling values, “Free on Board” (FOB) plant (exclusive of freight and taxes), of all products shipped, both primary and secondary, as well as all miscellaneous receipts, such as receipts for contract work performed for others, installation and repair, sales of scrap, and sales of products bought and sold without further processing. Included are all items made by or for the establishments from material owned by it, whether sold, transferred to other plants of the same company, or shipped on consignment. The net selling value of products made in one plant on a contract basis from materials owned by another was reported by the plant providing the materials”.

For the professional, scientific, and technical services industry, sales revenue means “receipts/revenue”, which according to the Census Bureau’s definition, “includes gross receipts from customers or clients for services provided, from the use of facilities, and from merchandise sold in 2002 whether or not payment was received in 2002. Receipts do not include sales and other taxes collected directly from customers and paid directly to a local, state, or federal tax agency. Also excluded are gross receipts from departments and concessions operated by others; sales of used equipment previously rented or leased to customers; domestic intra-company transfers; proceeds from the sale of real estate (land and buildings), investments, or other assets (except inventory held for resale); income from interest, rental of real estate, dividends, contributions, and grants; receipts of foreign parent firms and subsidiaries; and other non-operating income, such as franchise fees. Receipts do not include service receipts of manufacturers, wholesalers, retail establishments, or other businesses whose primary activity is other than service. They do, however, include receipts other than from services rendered (e.g., sale of merchandise to individuals or other businesses) by establishments primarily engaged in performing services and classified in the service industries... Revenue includes receipts from customers or clients for services provided in 2002, whether or not payment was received in 2002, and gross sales of merchandise, minus returns and allowances. Also included are income from interest, dividends, gross rents (including display space rentals and share of receipts from departments

operated by other companies), gross contributions, gifts, grants (whether or not restricted for use in operations), royalties, dues and assessments from members and affiliates, commissions earned from the sale of merchandise owned by others (including commissions from vending machine operators), and gross receipts from fundraising activities. Revenue includes gains or losses from the sale of real estate (land and buildings), investments, or other assets (except inventory held for resale). Receipts from taxable business activities of firms exempt from federal income tax (unrelated business income) are also included in revenue.”