

SUPPLY-CHAIN MANAGEMENT AND MANUFACTURING PERFORMANCE—LESSONS FROM THE 2002 ECONOMIC CENSUS

by

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Abstract: Using data gathered in the 2002 Economic Census, this paper assesses the incidence and possible effects of “outsourcing” (*i.e.*, contracting out to affiliates or other firms) important activities in the manufacturing supply chain. The paper finds that, in the case of many supply-chain activities, manufacturing establishments do not outsource, but perform the activity for themselves. Compared with these non-outsourcers, however, establishments that do outsource are generally larger and pay their employees better. They are also more productive—often far more productive. In addition, for most supply-chain activities, outsourcers own more inventories than non-outsourcers (even allowing for differences in establishment size). However, the association between outsourcing and increased inventory ownership disappears among establishments that manufacture to their business and final retail customers’ specifications.

Introduction*

Supply-chain questions added to the 2002 Economic Census reflect the Census Bureau's continuing effort to adjust survey instruments to address changes in the organization of production. The Bureau's ability to identify and quantify such changes affects the accuracy of official estimates of U.S. economic activity and the quality of policy and business decisions based on these estimates.

Responses to the supply-chain questions also illuminate important issues of economic performance. They tell us, for example, about changes in the production process that are likely to spur productivity growth and make the economy more resilient. They support fact-based discussion of "deindustrialization" and "off-shoring"—matters of special importance to the nation's long-term trade policy goals. And, in an era when countries increasingly specialize and compete in stages of production rather than finished products, they tell us about the conditions of industrial competitiveness.

This paper assesses 2002 supply-chain data gathered from manufacturing establishments. It looks first at the separation of activities (*i.e.*, functional differentiation) in the manufacturing supply chain, and compares characteristics of establishments that "out-source"¹ important supply-chain activities with characteristics of establishments that perform such work for themselves. Second, it discusses lessons in the data about the incidence and possible effects of supply-chain coordination (*i.e.*, functional integration).

The Data

On the 2002 Economic Census form mailed to manufacturing establishments, Question 28, Part A identified eight supply-chain activities and asked respondents to indicate whether these had been performed by: (i) the responding establishment, (ii) an affiliated establishment, (iii) another firm, or (iv) not at all. (A copy of Census Question 28 for manufacturers is at: <http://help.econ.census.gov/2002forms/mc31117.pdf>)

** The analysis and results in this paper have undergone a Census Bureau review more limited in scope than that given to official Census Bureau publications. The paper is released to inform interested parties of ongoing research and to encourage discussion of work in progress. The views expressed are those of the author and not necessarily those of the Census Bureau. E-mail comments to: Jeffrey.L.Mayer@census.gov*

¹ In this paper, the term "outsourcing" means contracting out a supply-chain activity to an affiliated establishment or another firm, whether the activity is then performed domestically or abroad. Where the paper refers exclusively to outsourcing overseas, it uses the term "off-shoring."

The eight activities were: (i) product design/engineering; (ii) bundling or kitting (*i.e.*, combining multiple items into a pre-packaged product); (iii) pick and pack (*i.e.*, taking goods from inventory and packaging them to fill orders); (iv) warehousing of finished products; (v) break bulk (*i.e.*, reducing large shipments into smaller portions for customers); (vi) local delivery; (vii) long-distance delivery; and (viii) processing returned merchandise.

Question 28, Part B, asked respondents to answer “Yes” or “No” to nine sub-questions examining the incidence of physical separation between the owners and holders of inventories, the “off-shoring” of stages in the production process, and the frequency with which respondents manufactured to customer specifications.

Tabulations based on responses to Question 28 by roughly 100,000 manufacturing establishments are posted together with this paper as a separate Appendix. These tabulations are the source of all tables included below. Supply-chain questions on the 2002 Economic Census will not be repeated on the 2007 Census.

Caveats: Users of Question 28 data and readers of this paper should understand that the data and tabulations have not been edited to remove occasional invalid responses. In addition, the present paper focuses only on respondents. While these are numerous—roughly two thirds of the total mailing to (147,871) manufacturing establishments—their experience may not be representative of either the non-respondents or the total population of manufacturing establishments.

Also, because respondents reporting on the location of their supply chain activities were free to identify more than one location, conclusions presented in the following text and tables reflect a degree of double counting (*e.g.*, for each supply chain activity, the number of responses indicating where the activity was performed, plus the number of responses stating that the activity was not performed at all, is consistently 5-15 percent greater than the number of respondents).

Major Findings

Functional Differentiation—Incidence and Possible Effects

The present analysis assumes that domestic or foreign outsourcing of supply chain activities represents division of labor and specialization in the production process—developments usually associated with higher productivity. It finds that:

- **Many manufacturing establishments do not outsource, but perform for themselves functions also performed by companies elsewhere along the supply chain.** More than half of all manufacturing establishments responding to the 2002 Census supply-chain questions on product design, pick and pack, warehousing, local

delivery, and returns processing reported providing these services to themselves.
[Table 1, column (4).]

**Table 1:
Outsourcing of Activities in the Manufacturing Supply Chain**

Cell values in columns (3), (5), (7), and (9) are based on establishment responses to Question 28A(1) and (2)(a)-(g) in the 2002 Economic Census. These questions address supply-chain activities listed in column (1). Respondents checked boxes indicating whether activities were performed by the responding establishment, by an affiliated establishment, by another company, or not at all. Numbers of responses in each row are activity-specific.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Location ¹ Activity	Total Number of Respondents	Number Reporting Activity Performed by this Estab.	Column (3) as a % of Column (2)	Number Reporting Activity Outsourced to an Affiliated Estab.	Column (5) as a % of Column (2)	Number Reporting Activity Outsourced to Another Firm	Column (7) as a % of Column (2)	Number Reporting Activity Not Performed at All	Total Response as a % of All Forms Mailed
Product Design	97,414	58,074	59.6	13,487	13.8	13,826	14.2	24,974	65.9
Bundling & Kitting	94,503	40,697	43.1	2,827	3.0	3,523	3.7	51,309	63.9
Pick & Pack	95,770	57,956	60.5	3,520	3.7	2,477	2.6	35,435	64.8
Warehousing	96,624	66,045	68.4	4,807	5.0	4,892	5.1	27,527	65.3
Break Bulk	93,521	31,005	33.2	2,775	3.0	2,061	2.2	59,732	63.2
Local Delivery	96,544	49,417	51.2	4,152	4.3	26,371	27.3	26,049	65.3
Long-Dist. Delivery	96,276	31,110	32.3	5,095	5.3	43,907	45.6	24,006	65.1
Processing of Returns	96,538	65,335	67.7	4,014	4.2	2,390	2.5	28,122	63.3

¹ Because respondents were asked to check all applicable boxes, numerators in the percentage calculations entered in columns (4), (6), and (8) reflect some double counting. In addition, in each row, total responses entered in column (2) do not equal the sum of responses in columns (3), (5), (7), and (9). Full tabulations of aggregate responses to Question 28 sub-questions are included in the Appendix to this paper.

- **The tendency to outsource varies by function and is largely bi-modal.** At one end of the distribution, 5-7 percent of responding establishments outsource bundling and kitting, pick and pack, break bulk, and returns processing. At the other, 51 percent of respondents outsource long-distance delivery; 31 percent outsource local delivery, and 28 percent outsource product design. [The overall percentage of outsourcers for

each activity listed in Table 1, column (1), is the sum of the percentages entered for that activity in Table 1, columns (6) and (8).]

- **In most functional categories, establishments that outsource supply chain activities are larger than non-outsourcers [Table 2, columns (3) and (4)] and pay their employees more [Table 3, columns (3) and (4)].** Establishments that outsource product design and long-distance delivery are narrow exceptions to the general pattern in regard to size; product design is a narrow exception on pay.

**Table 2:
Employment-to-Establishment Ratios of Manufacturing Establishments by
Supply-Chain Activity and Location of the Activity**

In this paper, the employment-to-establishment ratio is the total employment of establishments in each category of activity and location, divided by the number of establishments in that category. Thus, for example, the ratio entered in column (2) of this table in the row on product design (115.4) represents the total employment of manufacturing establishments reporting on the 2002 Economic Census that they supplied their own product design services (6,704,571) divided by the number of such establishments (58,074). Data on establishment employment are from the 2002 Economic Census. Data on numbers of responding establishments by activity are from Table 1 (above). Tabulations of all data underlying this table are included in the Appendix.

(1)	(2)	(3)	(4)	(5)	(6)
Location Activity	Activity Performed by this Establishment ¹	Activity Performed by an Affiliated Establishment	Activity Performed by Another Company	All Responding Establishments (Includes non-performing establishments)	All Establishments Receiving Census Forms
Product Design	115.4	197.6	106.0	104.4	91.2
Bundling & Kitting	124.5	240.8	197.7	105.0	91.2
Pick & Pack	119.3	235.9	218.2	104.7	91.2
Warehousing	118.4	240.6	211.8	104.9	91.2
Break Bulk	116.2	238.6	223.5	105.0	91.2
Local Delivery	82.0	204.3	123.1	103.7	91.2
Long-Dist. Delivery	116.3	210.8	113.1	104.9	91.2
Processing of Returns	114.7	237.6	214.2	104.0	91.2

¹ Cell values in columns (2) through (5) are based on establishment responses to Question 28A(1) and (2)(a)-(g) in the 2002 Economic Census. Census respondents checked boxes indicating whether activities listed in column (1) of this table were performed by the responding establishment, by an affiliated establishment, by another company, or not at all. Because respondents were asked to check all applicable boxes, ratios entered in the cells of the table reflect some double counting in both numerators and denominators.

**Table 3:
Average Annual Payroll per Employee of Manufacturing Establishments,
by Supply-Chain Activity and Location of the Activity**

In this paper, average annual payroll per employee is the total payroll of establishments in each category of activity and location divided by the total employment of establishments in that category. Thus, for example, the value entered in column (2) of the table in the row on product design (41.4) represents (in \$1000s) the total annual payroll of manufacturing establishments reporting on the 2002 Economic Census that they did product design for themselves (\$277,344,706,000) divided by the total number of those establishments' employees (6,704,571). Data on establishment payroll and employment are from the 2002 Economic Census. Tabulations of all data underlying this table are included in the Appendix.

(Average payroll per employee in \$1000s)

(1)	(2)	(3)	(4)	(5)	(6)
Location Activity	Activity Performed by this Establishment ¹	Activity Performed by an Affiliated Establishment	Activity Performed by Another Company	All Responding Establishments (Includes non- performing establishments)	All Establishments Receiving Census Forms
Product Design	41.4	41.4	41.2	40.1	39.9
Bundling & Kitting	40.3	43.5	48.5	40.1	39.9
Pick & Pack	39.7	42.6	49.3	40.0	39.9
Warehousing	39.7	41.5	46.5	40.0	39.9
Break Bulk	39.3	40.3	49.5	40.1	39.9
Local Delivery	38.7	39.8	42.6	40.0	39.9
Long-Dist. Delivery	39.8	40.1	41.4	40.1	39.9
Processing of Returns	39.9	41.7	49.1	40.0	39.9

¹ Cell values in columns (2) through (5) are based on establishment responses to Question 28A(1) and (2)(a)-(g) in the 2002 Economic Census. Census respondents checked boxes indicating whether activities listed in column (1) of this table were performed by the responding establishment, by an affiliated establishment, by another company, or not at all. Because respondents were asked to check all applicable boxes, averages entered in the cells of the table reflect some double counting in the calculations of both total annual payroll and total employment.

- **In every functional category, outsourcers are more productive—often far more productive—than establishments that do the same work in-house.** [In Table 4, for each activity (*i.e.*, in each row) compare entries in columns (3) and (4) with the entry in column (2).]

Table 4:					
Average Receipts per Employee of Manufacturing Establishments by Supply-Chain Activity and Location of the Activity					
Average receipts per employee is the total receipts of establishments in each category of activity and location divided by the total employment of establishments in that category. Thus, for example, the value entered in column (2) of this table in the row on product design (259.1) represents the total annual receipts (in \$1000s) of manufacturing establishments that reported doing product design for themselves (\$1,736,990,082,000) divided by the total number of those establishments' employees (6,704,571). Data on establishment receipts and employment are from the 2002 Economic Census. Tabulations of all data underlying this table are included in the Appendix.					
(Average receipts per employee in \$1000s)					
(1)	(2)	(3)	(4)	(5)	(6)
Location Activity	Activity Performed by this Establishment ¹	Activity Performed by an Affiliated Establishment	Activity Performed by Another Company	All Responding Establishments (Includes non- performing establishments)	All Establishments Receiving Census Forms
Product Design	259.1	393.2	292.5	286.6	278.7
Bundling & Kitting	267.4	379.9	419.4	288.8	278.7
Pick & Pack	267.1	375.2	458.4	288.0	278.7
Warehousing	278.7	391.6	428.5	288.2	278.7
Break Bulk	279.0	353.2	521.6	289.8	278.7
Local Delivery	243.5	402.4	323.1	288.0	278.7
Long-Dist. Delivery	279.3	387.9	289.5	288.1	278.7
Processing of Returns	267.4	399.1	422.1	286.9	278.7
¹ Cell values in columns (2) through (5) are based on establishment responses to Question 28A(1) and (2)(a)-(g) in the 2002 Economic Census. Census respondents checked boxes indicating whether activities listed in column (1) of this table were performed by the responding establishment, by an affiliated establishment, by another company, or not at all. Because respondents were asked to check all applicable boxes, ratios entered in the cells of the table reflect some double counting in the calculations of both total receipts and total employment.					

- **Functional differentiation is associated with increased inventories.** Table 5 shows that, for all supply chain functions identified in the 2002 Economic Census, except product design and long-distance delivery, establishments that reported outsourcing to affiliates or unrelated companies owned larger inventories than establishments that performed the function themselves.

Table 5: Average Inventories per Establishment of Manufacturing Establishments, by Supply-Chain Activity and Location of the Activity					
<p>In this paper, average inventories per establishment is the total end-of-year (2002) inventories (in \$1000s) of establishments in each category of activity and location divided by the number of establishments in that category. Thus, for example, the value entered in column (2) of this table in the row on product design (3,595.5) represents (in \$1000s) the total end of year inventories of manufacturing establishments that reported doing product design for themselves (\$208,806,658,000) divided by the total number of those establishments (58,074)). Data on inventories are from the 2002 Economic Census; data on numbers of establishments are from Table 1 (above). Tabulations of all data underlying this table are included in the Appendix.</p>					
(Inventories in \$1000s)					
(1)	(2)	(3)	(4)	(5)	(6)
Location ¹ Activity	Activity Performed by this Establishment	Activity Performed by an Affiliated Establishment	Activity Performed by Another Company	All Responding Establishments (Includes non-performing establishments)	All Establishments Mailed
Product Design	3,595.5	6,119.9	3,105.6	3,082.1	2,683.2
Bundling & Kitting	3,780.6	8,973.4	7,413.3	3,106.7	2,683.2
Pick & Pack	3,632.8	8,549.3	9,345.4	3,112.6	2,683.2
Warehousing	3,592.1	8,645.8	9,135.2	3,110.3	2,683.2
Break Bulk	3,662.2	8,007.9	9,349.4	3,124.5	2,683.2
Local Delivery	2,188.2	6,637.9	4,040.1	3,064.5	2,683.2
Long-Dist. Delivery	3,517.1	7,074.6	3,464.7	3,100.5	2,683.2
Processing of Returns	3,404.1	8,703.5	8,950.2	3,046.0	2,683.2
<p>¹ Cell values in columns (2) through (5) are based on establishment responses to Question 28A(1) and (2)(a)-(g) in the 2002 Economic Census. Census respondents checked boxes indicating whether activities listed in column (1) of this table were performed by the responding establishment, by an affiliated establishment, by another company, or not at all. Because respondents were asked to check all applicable boxes, values entered in the cells of the table reflect some double counting in calculation of inventories and numbers of establishments.</p>					

Table 6 shows that the positive relationship between outsourcing and inventory ownership persists even after allowing for the fact that outsourcers are larger on average than non-outsourcers. On average, in 2002, outsourcers were 44 percent larger and owned 64 percent more inventories than non-outsourcers.

Table 6: Differences between Outsourcers and Non-Outsourcers¹—Establishment Size and Inventories			
Compared with Non-Outsourcers:	Weighted Average Percent Differences ² between Outsourcers and Non-Outsourcers for:		
	All Outsourcers	Outsourcers to Affiliates	Outsourcers to Other Firms
Outsourcers' avg. employment per establishment is greater by:	44 pct.	94 pct.	23 pct.
Outsourcers' avg. inventories per establishment is greater by:	64 pct.	118 pct.	42 pct.

¹ In this table “non-outsourcers” are establishments responding to the 2002 Economic Census who indicated that they performed for themselves supply chain activities identified in Census Questions 28A(1) and (2)(a)-(g).
² Calculations in this table are weighted averages of the percent differences between establishments that outsourced supply chain activities in 2002 and establishments that did not (*i.e.*, non-outsourcers) for the eight supply-chain activities cited in Census Question 28A. **The weighting method was as follows:** For each activity, the difference between non-outsourcers and outsourcers was calculated in percentage terms. Each percentage calculation was then multiplied by the number of establishments outsourcing the specific activity; and the resulting eight weighted percentages were summed and divided by the total number of outsourcers for all eight activities. Separate weighted averages were calculated for all outsourcers, outsourcers to affiliates, and outsourcers to other firms. Data underlying these calculations are provided in Census Bureau tabulations included in the Appendix.

Note: The finding that functional differentiation may not reduce inventories in the supply chain should not be surprising. The notion that supply chain innovations produce leaner inventories focuses not on differentiation but integration (*e.g.*, just-in-time supply relations). As we will see, responses to Question 28 sub-questions on supply chain integration—*e.g.*, sub-questions on whether respondents manufacture to other businesses’ or final retail customers’ specifications—lend some support to expectations of a connection between supply chain coordination and lean production.

- **Only 5.4 percent of respondents to 2002 Census Question 28B(6) for manufacturing establishments reported off-shoring “partially completed products for processing and return to the reporting establishment.”** Overall, these establishments were larger and somewhat less productive than other

respondents. [In Table 7, columns (5) and (6), compare the employment-to-establishment ratios and average receipts per employee of “Yes” respondents to those of “No” respondents.]

Table 7:
Characteristics of Manufacturing Establishments that “Off-Shore” Partial Fabrication¹—All Manufacturing and Selected Manufacturing Industry Groups

(1)	(2)	(3)	(4)	(5)		(6)	
	Num. of Respondents to Census Question 28B(6)	Num. of Respondents Answering “Yes” to Question 28B(6) ¹	Col (3) as a % of Col. (2)	Employment-to-Establishment Ratio ²		Avg. Receipts-per-Employee ³ (\$1000)	
				“No” Respondents	“Yes” Respondents	“No” Respondents	“Yes” Respondents
All Manufacturing	99,387	5,341	5.4	98	186	287	281
Apparel Mfg.	2,157	170	7.9	74	138	141	159
Computer & Electronic Prod. Mfg.	5,262	587	11.2	131	317	293	278
Electrical Equip. Appliance & Component Mfg.	2,508	196	7.8	141	228	223	204
Transportation Equipment Mfg.	4,643	377	8.1	235	555	373	362

¹ Establishments answering “Yes” to Question 28B(6) of the 2002 Economic Census which asked whether, during 2002, they sent “any partially completed products to a foreign facility for processing that were returned to this establishment for completion.” Respondents could answer only “Yes” or “No.”

² In this paper, the employment-to-establishment ratio is the total employment of establishments in each category of respondents divided by the number of establishments in that category. Data in this table and data underlying calculations in the table are drawn from tabulations included in the Appendix to this paper. Data on establishment employment and receipts are from the 2002 Economic Census.

³ In this paper, average receipts per employee is the total receipts of establishments in each category of respondents divided by the total employment of establishments in that category.

Note: Only one supply chain question in the 2002 Census deals explicitly with off-shoring—Question 28B(6). Because the question asks only about off-shored work returned to the reporting establishment, the responses may understate the actual extent of off-shoring by U.S. manufacturing establishments. In addition, because respondents to Question 28B(6) represent only two thirds of the total 2002 Census mailing to manufacturing establishments, the characteristics of off-shoring establishments reported in Table 7, both for all manufacturing and selected 3-digit NAICS manufacturing industry groups, are not statistically representative of all establishments in those categories.

Functional Integration—Incidence and Possible Effects

- **High positive response rates for Economic Census questions on whether an establishment manufactures to customers’ specifications indicate extensive integration along the production chain.** Seventy percent of respondents reported that they “manufacture products for another business to their specifications”; while 40 percent reported that they “manufacture products for a final retail customer to their specifications.” [See Table 8, column (4).]

Table 8: Characteristics of Establishments that Manufacture to Customers’ Specifications [Based on Responses to 2002 Economic Census Questions 28B(7)-(9)]									
(1)	(2)	(3)	(4)	(5)		(6)		(7)	
During 2002, did this establishment:	Num. of Respondents	Num. of Respondents Answering “Yes”	Col. (3) as a % of Col. (2)	Employment-to-Establishment Ratio ¹		Avg. Receipts per Employee ² (\$1000)		Avg. Inventories per Establishment ³ (\$1000)	
				“No” Rspts.	“Yes” Rspts.	“No” Rspts.	“Yes” Rspts.	“No” Rspts.	“Yes” Rspts.
Manufacture products for a government to their specifications? [Question 28B(7)]	99,256	17,877	18.0	96	135	285	291	2,726	4,474
Manufacture products for another business to their specifications? [Question 28B(8)]	99,751	69,473	69.6	99	105	341	264	3,201	2,968
Manufacture products for a final retail customer to their specifications? [Question 28B(9)]	99,161	39,120	39.5	100	109	291	280	3,064	3,014
<p>¹ In this paper, the employment-to-establishment ratio is the total employment of establishments in each category of respondents divided by the number of establishments in that category. Data reported in this table and data underlying calculations in the table are drawn from tabulations included in the Appendix to this paper. Data on establishment employment, receipts, and inventories are from the 2002 Economic Census.</p> <p>² In this paper, average receipts per employee is the total receipts of establishments in each category of respondents divided by the total employment of establishments in that category.</p> <p>³ In this paper, average inventories per establishment is the total end-of-year inventories of establishments in each category of respondents divided by the number of establishments in that category.</p>									

- **Respondents who manufacture for “another business” or “final retail customer” to their specifications are slightly larger and hold somewhat smaller inventories,**

than respondents who do not manufacture on these terms.² [See Table (8), column (7).] This finding—especially when compared with the relationship between functional differentiation (*i.e.*, outsourcing) and inventories—is evidence for the view that coordination in the supply chain (*e.g.*, just-in-time supply practices) allows manufacturers to reduce inventories and related costs.

- In contrast to establishments that manufacture for another business or final retail customer, **establishments that manufacture for a government, according to government specifications, are substantially larger and own nearly 50 percent more inventory than establishments who do not manufacture on these terms.** [Table 8, column (7).]

Using the Supply-Chain Data to Address Other Questions

The supply-chain data gathered in the 2002 Economic Census are a valuable and largely untapped resource for statisticians, economists, and others interested in the structure and operations of U.S. industries and businesses. This paper uses tabulations based on these data to examine the incidence and possible effects of functional differentiation and integration in manufacturing industries. These tabulations, posted as an Appendix to the present paper, may enable researchers to frame and address their own questions about the manufacturing supply chain. The Census Bureau encourages researchers to use the tabulations and invites their comments on the current paper.

² Distinctions here are blurred by the fact that some respondents seem to manufacture for more than one of the categories of customers identified in Table 8. The total number of “Yes” responses on questions 28B(7), 28B(8), and 28B(9)—roughly 126 thousand—substantially exceeds the number of respondents to each of the individual questions, roughly 99 thousand.

Appendix Table IA
Tabulations of Responses and Non-Responses to 2002 Economic Census Questions
28.A.1., 28.A.2.a.-f. – Manufacturing Establishments

* A sample of 2002 Economic Census Question 28 is available at <http://help.econ.census.gov/2002forms/mc31101.pdf>

Question 28.A.1. Product Design/engineering

NAICS	Description	Activity Performed by this Establishment	Activity Performed by Another Establishment	Activity Performed by Another Company	Activity not Performed	Total Establishments Responding to at least One Item on Question	Non – Response on question but Reported other Supply Chain Information	Reported but Supply Chain Question Reply was Invalid	Non-responding Establishments	Total Establishments Mailed
	Employment to Establishments Ratio	66.7	152.8	112.9	33.8	49.2	41.2	31.6	38.0	45.0
	Average Payroll per Employee (\$1,000)	37.2	38.4	36.7	39.4	38.0	33.6	35.4	37.6	37.5
	Average Receipts per Employee (\$1,000)	196.0	237.4	170.4	226.1	207.5	148.1	186.7	187.6	200.7
	Average End of Year Inventories per Establishment (\$1,000)	1,565.0	4,375.9	2,531.8	648.0	1,076.0	563.3	526.8	646.6	920.9
331-----	Primary Metal Manufacturing									
	Employment to Establishments Ratio	168.2	193.4	336.9	123.5	150.9	136.9	93.8	121.9	140.6
	Average Payroll per Employee (\$1,000)	43.4	42.2	49.8	45.0	43.9	42.1	47.2	42.7	43.8
	Average Receipts per Employee (\$1,000)	276.9	351.2	392.3	325.5	294.1	260.9	278.9	254.8	286.1
	Average End of Year Inventories per Establishment (\$1,000)	6,990.4	8,418.2	17,743.9	4,784.2	6,156.9	4,474.9	4,812.1	4,327.2	5,664.4
332-----	Fabricated Metal Product Manufacturing									
	Employment to Establishments Ratio	80.3	149.3	100.2	46.3	65.6	47.8	43.0	48.8	59.9
	Average Payroll per Employee (\$1,000)	37.0	39.8	41.6	37.6	37.2	37.5	35.5	37.1	37.1
	Average Receipts per Employee (\$1,000)	175.8	231.4	314.8	151.6	169.4	148.5	148.9	153.9	165.1
	Average End of Year Inventories per Establishment (\$1,000)	1,933.9	3,916.4	3,833.5	743.4	1,415.2	981.3	890.7	908.4	1,259.7
333-----	Machinery Manufacturing									
	Employment to Establishments Ratio	101.6	213.2	189.9	54.9	90.0	54.1	58.2	62.6	80.8
	Average Payroll per Employee (\$1,000)	42.3	40.8	47.4	46.9	43.0	43.6	42.4	42.7	42.9
	Average Receipts per Employee (\$1,000)	221.9	290.7	445.6	203.8	222.7	221.6	173.4	238.9	222.2
	Average End of Year Inventories per Establishment (\$1,000)	3,731.7	7,618.7	8,737.1	1,745.2	3,224.6	1,539.5	1,750.9	2,450.9	2,891.9
334-----	Computer and Electronic Product Manufacturing									
	Employment to Establishments Ratio	167.9	457.1	429.6	97.0	156.2	95.7	139.0	131.8	145.9
	Average Payroll per Employee (\$1,000)	50.3	52.5	61.2	50.4	50.6	54.7	52.4	53.0	51.4
	Average Receipts per Employee (\$1,000)	297.5	489.2	322.0	291.5	293.2	176.2	368.5	258.4	289.1
	Average End of Year Inventories per Establishment (\$1,000)	5,907.2	15,024.5	11,720.1	5,224.8	5,787.6	2,436.8	4,828.6	4,797.3	5,303.5
335-----	Electrical Equipment, Appliance, and Component Manufacturing									
	Employment to Establishments Ratio	146.1	312.5	295.9	124.0	149.9	61.1	87.7	96.2	131.5
	Average Payroll per Employee (\$1,000)	36.3	39.7	38.0	37.2	36.7	34.6	35.3	37.1	36.6
	Average Receipts per Employee (\$1,000)	215.9	261.9	260.1	236.5	221.7	196.1	170.0	190.0	214.0
	Average End of Year Inventories per Establishment (\$1,000)	3,727.7	7,334.4	10,398.7	2,585.9	3,639.6	1,629.9	2,400.7	2,570.8	3,265.0
336-----	Transportation Equipment Manufacturing									
	Employment to Establishments Ratio	265.6	542.0	916.7	247.8	266.3	142.2	308.1	133.9	241.7
	Average Payroll per Employee (\$1,000)	47.4	53.1	60.9	51.0	48.9	46.1	52.8	47.7	49.3
	Average Receipts per Employee (\$1,000)	329.3	353.6	672.5	433.9	374.0	416.9	525.3	272.9	386.0
	Average End of Year Inventories per Establishment (\$1,000)	9,052.9	25,342.5	35,759.6	5,810.3	8,129.0	3,376.0	21,686.1	5,839.8	8,974.8
337-----	Furniture and Related Product Manufacturing									
	Employment to Establishments Ratio	119.0	194.1	65.3	64.4	92.8	53.8	46.6	62.9	76.7
	Average Payroll per Employee (\$1,000)	29.1	30.5	31.8	30.5	29.5	36.8	27.1	29.6	29.6
	Average Receipts per Employee (\$1,000)	141.6	149.5	169.6	118.3	133.2	125.0	127.6	139.1	133.2
	Average End of Year Inventories per Establishment (\$1,000)	1,788.6	3,992.2	1,177.1	734.8	1,282.3	512.3	612.6	928.3	1,050.9
339-----	Miscellaneous Manufacturing									
	Employment to Establishments Ratio	93.8	265.3	139.3	46.4	82.5	41.0	41.9	56.5	69.8
	Average Payroll per Employee (\$1,000)	38.4	41.4	44.9	35.8	38.1	34.8	38.3	36.1	37.7
	Average Receipts per Employee (\$1,000)	189.5	251.4	268.7	141.2	185.5	145.9	162.6	169.2	179.8
	Average End of Year Inventories per Establishment (\$1,000)	2,645.4	8,518.7	4,477.2	664.0	2,165.3	760.4	908.7	1,370.8	1,768.4

Question 28.A.2.c. Warehousing of finished products

31-----	Manufacturing									
	Establishments	66,045	4,807	4,892	27,528	96,624	6,083	16,069	29,095	147,871
	Employment	7,818,284	1,156,436	1,035,949	1,696,735	10,136,230	339,123	1,099,293	1,904,237	13,478,883
	Annual Payroll (\$1,000)	310,376,551	48,024,606	48,151,818	70,391,899	405,896,708	12,720,354	44,097,847	74,559,023	537,273,932
	Receipts (\$1,000)	2,178,918,778	452,879,626	443,884,947	508,894,418	2,920,963,260	71,944,985	338,872,796	424,303,930	3,756,084,971
	End of Year Inventories - 2002 (\$1,000)	237,236,987	41,560,366	44,689,532	43,537,792	300,528,269	7,259,657	36,669,727	52,309,832	396,767,485

Appendix Table IA
Tabulations of Responses and Non-Responses to 2002 Economic Census Questions
28.A.1., 28.A.2.a.-f. – Manufacturing Establishments

* A sample of 2002 Economic Census Question 28 is available at <http://help.econ.census.gov/2002forms/mc31101.pdf>

Question 28.A.1. Product Design/engineering

NAICS	Description	Activity Performed by this Establishment	Activity Performed by Another Establishment	Activity Performed by Another Company	Activity not Performed	Total Establishments Responding to at least One Item on Question	Non – Response on question but Reported other Supply Chain Information	Reported but Supply Chain Question Reply was Invalid	Non-responding Establishments	Total Establishments Mailed
	Employment to Establishments Ratio	140.3	329.9	370.8	116.0	148.1	93.4	87.7	96.2	131.5
	Average Payroll per Employee (\$1,000)	36.6	38.5	37.9	37.3	36.7	33.5	35.3	37.1	36.6
	Average Receipts per Employee (\$1,000)	215.7	255.9	264.1	244.6	221.4	214.5	170.0	190.0	214.0
	Average End of Year Inventories per Establishment (\$1,000)	3,670.1	7,214.3	10,560.9	1,730.9	3,587.7	2,638.4	2,400.7	2,570.8	3,265.0
336-----	Transportation Equipment Manufacturing									
	Employment to Establishments Ratio	242.1	534.6	736.1	306.9	263.1	175.1	308.1	133.9	241.7
	Average Payroll per Employee (\$1,000)	46.3	50.0	58.8	53.8	48.7	51.5	52.8	47.7	49.3
	Average Receipts per Employee (\$1,000)	301.9	420.9	603.2	470.5	374.7	394.8	525.3	272.9	386.0
	Average End of Year Inventories per Establishment (\$1,000)	7,349.0	24,897.3	31,334.7	9,834.7	8,025.9	4,304.0	21,686.1	5,839.8	8,974.8
337-----	Furniture and Related Product Manufacturing									
	Employment to Establishments Ratio	111.4	196.3	130.7	43.0	91.9	43.5	46.6	62.9	76.7
	Average Payroll per Employee (\$1,000)	29.9	28.3	31.9	31.1	29.9	29.8	27.1	29.6	29.6
	Average Receipts per Employee (\$1,000)	134.9	172.0	139.9	106.3	133.2	115.3	127.6	139.1	133.2
	Average End of Year Inventories per Establishment (\$1,000)	1,561.6	3,165.9	3,058.5	414.6	1,252.7	470.0	612.6	928.3	1,050.9
339-----	Miscellaneous Manufacturing									
	Employment to Establishments Ratio	87.4	231.7	123.6	43.7	81.1	48.8	41.9	56.5	69.8
	Average Payroll per Employee (\$1,000)	38.5	39.3	42.7	36.2	38.1	34.1	38.3	36.1	37.7
	Average Receipts per Employee (\$1,000)	180.9	257.4	295.0	150.0	184.4	169.2	162.6	169.2	179.8
	Average End of Year Inventories per Establishment (\$1,000)	2,386.7	7,495.4	4,386.1	645.8	2,130.9	832.6	908.7	1,370.8	1,768.4