SERVICE ESTABLISHMENTS OF MANUFACTURING COMPANIES: THEIR ROLE IN UNDERSTANDING REGIONAL MANUFACTURING OUTPUT

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Introduction

The Bureau of Economic Analysis (BEA) recently has boosted the analyst's ability to understand U.S. regional economies. Estimates of Gross State Product (GSP) by two digit SIC industry have been constructed for 1963 to 1986. (See Renshaw, Trott, and Friedenberg [5] and BEA [6].) This paper assesses the extent that GSP improves the Census Bureau's measure of manufacturing output, value added (VA), particularly its treatment of the activities of central administrative offices (CAOs) of manufacturing companies. First, how the Census methodology previously estimated value added in manufacturing leads one to believe *a priori* that the geographic distribution of manufacturing activity as suggested by the Census data will be fallacious. In essence, Census value added does not allocate properly a particular part of value added to states and regions—that part being the activities of CAOs of manufacturing companies. Second, the Census value added contains a secular distortion of regional manufacturing growth trends. As one notable example, Census value added has tended to underestimate the growth of manufacturing product in the Mid Atlantic and Great Lakes regions.

The GSP algorithm directly addresses the CAO-related problem with Census value added. It is therefore a step forward in eliminating regional distortion. Because the BEA makes several other adjustments in constructing GSP from value added, however, the magnitude of the CAO adjustment alone is not accessible to the public. This paper reconstructs the GSP estimates for 1963 and 1986 (in similar fashion to BEA) in order to illustrate the relative impact of this single adjustment on regional manufacturing product as reported for the Mid Atlantic and Great Lakes regions. In the process, two objectives are achieved:

- An assessment of the nature and extent of CAO bias in the measure of Census value added and the GSP correction, and

- A view of the structural transformations within the Great Lakes and Mid Atlantic regions between the manufacturing sector's production activities and manufacturing service activities.

Census Value Added

The Bureau of the Census derives its measure of value added by recording the value of final shipments of goods at each operating establishment (i.e., production plant) and the value of intermediate goods and materials at those same plants. The residual between value of shipments and the value of intermediate goods and materials is recorded as value added.

(1)   VA = Value of Shipments - Intermediate Goods

Geographic aggregation of value added is determined by summing the values of each individual establishment within the state, county, or city.

The Problem With Census Value Added

There are several peculiarities with Census value added that have been noted by Daniel Garnick [1] and others. One problem is that the value of shipments recorded at operating plants includes the value of services embodied in those final goods. Consequently, the Census method of netting value of goods and materials from shipments does not determine a net addition to value by manufacturing companies alone, but is gross of services purchased by manufacturing companies.

Another problem relates not to purchased services, but to service flows that occur within manufacturing companies. It is this problem that most directly relates to geographic distortion. All value added is recorded at the site of operating plants where the final shipments occur. Manufacturing companies also maintain auxiliary establishments or CAOs, however, where company services are produced. These include corporate planning and finance, R&D, advertising, payroll processing, warehousing, and other service activities. The value of these internal services is embodied in the value of the final manufactured product. For many multiestablishment companies, however, the geographic dispersion of auxiliary establishments across states and MSAs differs from the geographic dispersion of operating plants. Accordingly, while the value of manufacturing company services originating at auxiliary establishments will be counted in value added (and justly so), these services are misapportioned to geographic areas according to the location of operating establishments.

Israilevich and Testa [2] verified that Census value added follows the geographic distribution of operating plants while ignoring auxiliary activities. Using operating plant payroll as a proxy for operating plant

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location and auxiliary payroll as a proxy for auxiliary sites, the authors regressed 1982 value added by state on both operating and auxiliary payroll. While explaining 99 percent of the geographic variation, operating payroll was highly significant, but auxiliary payroll was not statistically significant.

What Effect On Regions?

The aforementioned weakness in data methodology has resulted in a systematic geographic distortion at the multistate or regional level. An examination of the operating versus auxiliary payroll distribution by state suggests a systematic regional bias. Auxiliary activities are concentrated in the area ranging from Massachusetts to New Jersey and westward along the manufacturing belt through Minnesota (Figure 1). (Exceptions are Wisconsin and Indiana.)

Moreover, the matter not only concerns the proper static assignment of manufacturing activity to regions. The geographic growth pattern of auxiliary payroll in the Northeast and Great Lakes versus the nation suggests a dynamic measurement bias. First, the auxiliary share of manufacturing payroll in the nation, although not large, has grown significantly from 5.7 percent of total manufacturing payroll in 1958 to 10.7 percent of total manufacturing payroll in 1986. Second, growth of auxiliary payroll in the six state Great Lakes region, led by Minnesota, Michigan, Illinois, and Ohio, has outpaced the nation (Table 1). Other things equal over time, this would suggest *a priori* that the loss of Midwestern share of manufacturing (deindustrialization) was being overstated. Such a direction of secular bias also would distort measurements of regional total factor productivity, tending to understate productivity growth in the older manufacturing belt region.

The GSP Solution

For service industry sectors, BEA produces estimates of output by summing payments to factors of production. For goods-producing industries—manufacturing, agriculture, mining, and construction—BEA prepares GSP estimates with Census value added adjusted to conform to the National Income and Product Accounts definition of output. For manufacturing, these adjustments are several, including an adjustment for location of CAO activities.

Essentially, BEA adjusts CAO activity by state by first removing an estimate of CAO services consumed in the process of manufacturing for each industry in each state. This is accomplished by estimating the non-CAO contribution for each dollar of manufacturing for each industry

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at the national level. This national level estimate (i.e., ratio) then is applied to reported value added by industry in each state.

As a second step in the CAO activity adjustment, an estimated sum of factor payments for CAOs by industry (for the nation) is allocated to states, not via the ad hoc method of the Census, but on a more rational geographic basis. That is, labor and capital charges of CAOs are allocated to states (by industry) based on the known geographic distribution of CAO payroll by industry.[1]

To take a numerical example, suppose that there are two states, A and B, and one industry. Suppose, for simplicity, that intermediate goods and materials are zero for the single industry—therefore, the value of shipments is equal to value added. Further suppose that auxiliary or CAO activities always account for 50 percent of value added for each and every company in a given industry. The Census procedure hypothetically would report value added and value of shipments as follows:

	State A	State B
VS=VA	80	120

Suppose the actual but unknown components of value added in each state are as follows:

	State A	State B
CAOs	10	90
Operating Establishments	40	60

In the above illustration, value added (as reported) is overstated by 30 in state A and understated by 30 for state B. Net intracompany services are flowing from B to A in the amount of 30.

To correct this problem, BEA adjusts as follows: First, 50 percent of reported value added is stripped from each state. This 50 percent is an estimate reflecting what is known about the industry (and its relationship to CAOs) at the national level of aggregation.

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[1] For simplification, the reported simulation of GSP correction for CAO (to follow) does not net out the estimated purchases of services by CAOs. The BEA does net out the purchases of services by CAOs. Such calculations were performed and are available by request from the authors.

	State A	State B
VS'	40	60

As a second step, auxiliary or CAO activity is added, based on the actual geography of CAOs by state:

	State A	State B
CAOs	10	90

which yields:

	State A	State B
VS"	50	150

Accordingly, the previously neglected service flow from state B to state A now is attributed more correctly to its origin, at least to the degree that the assumptions of the algorithm are accurate.

Discussion of BEA Method

The crucial assumptions behind the BEA adjustment for CAOs are that:

- The ratio of manufacturing company services to product is identical for each company in a given industry (step 1).

Industry aggregation will be a problem here. BEA is able to disaggregate by two digit SIC. As they point out, three digit industries within two digit categories (e.g., printing versus publishing) are not always similar from state to state. Still, their assumptions are reasonable given the availability of data.

- The labor/nonlabor factor ratio of a company's (and industry's) value added does not vary (step 2).

Total nonlabor charges (e.g., capital consumption, purchased services, and profit) of CAOs versus operating establishments are estimated from national data covering capital stock of CAOs versus operating establishments (book value) at the national industry level. This is another source of possible error—both in using capital stock book value to apportion nonlabor value added between CAOs and operating establishments and in assuming the national ratio of capital stocks (i.e., CAO/operating) to be the same for each company.

- Service flows within multiestablishment manufacturing companies occur only between auxiliaries and operating plants and not between operating plants as well.

It is not difficult to imagine that some multiestablishment companies have, for example, no auxiliaries but that intracompany or interstate service flows are still substantial. Such companies would conduct and report their service activities at the site of an operating plant. If the company's operating plants are located in different geographic proportion than the company's service activity, a further reporting bias would exist that would not be addressed by the BEA method.

Applying the BEA Adjustment: Regional Findings

The BEA does not publish its intermediate steps, particularly the adjustment for CAOs in route from Census value added to BEA GSP. Nevertheless, the BEA method was applied using the same data to a sample of ten states, including Minnesota, the states of the East North Central Census region, the Mid Atlantic region, plus Connecticut.[2] These states were selected for two reasons. First, these states are part of the traditional manufacturing belt which has undergone sharp changes in fortune and structure and, second, the high manufacturing concentrations in these states assured that computational error from undisclosed data would be minimal. *County Business Patterns* [7] data covering auxiliary payroll by industry by state were crucial to the algorithm.

Taking Stock of Adjustment Size 1963 & 1986

For 1963, the adjustment for CAO location as applied to aggregate value added (all industries) was rather small for most Mid Atlantic and Great Lakes states (Table 2). This reflects the lesser importance of CAO activities in the nation in 1963 and also the smaller role of CAOs for the region relative to other regions. Two exceptions are New York, with a 5 percent upward adjustment, and Michigan, with a 6 percent upward adjustment. Michigan's larger adjustment results from its role as a domicile to the nation's domestic auto makers. New York historically has hosted a high concentration of corporate headquarters of firms in many industry sectors.

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[2]The BEA directly applies their algorithm only to benchmark years that coincide with the *Census of Manufactures* [8]. In contrast, this research applies the BEA algorithm for the 1986 year, which is not a census year for manufacturing.

By 1986, New York's star had faded as domicile to manufacturing auxiliaries, displaying only a 3 percent upward adjustment. Connecticut was the beneficiary of much corporate flight from New York City which is reflected in Connecticut's adjustment jump from minus 1 percent to plus 6 percent over the period. New Jersey also jumped plus 8 percent.

All of the other sample states increased their upward adjustment with the exception of Indiana. Minnesota's rapid industrialization—both involving CAOs and otherwise—has been remarkable. Overall, manufacturing output is adjusted upward 3 percent in the Great Lakes region in 1986 and 4 percent in the Mid Atlantic (plus Connecticut).

These upward adjustments highlight a significant structural change in the manufacturing belt's economy. Service activities related to manufacturing have not declined to the same extent as production activity. This finding is consistent with earlier literature that pointed out the tendency of branch plants to locate in the U.S. South while innovative establishments tended to remain behind. (See Jusenius and Ledebur [3]; Norton and Rees [4].)

Differences in growth rates arising from these upward adjustments appear to be modest (Table 3). In part, this follows from the large size of overall manufacturing growth over this long period. For the ten state region as a whole, the percentage growth in manufacturing rose from 68 percent (unadjusted) to 72.3 percent (adjusted). In several states such as Connecticut, New Jersey, Minnesota, and Michigan, however, the relative adjustment is significant.

Disaggregation by industry also results in wider dispersion (Tables 4-5). The chemicals industry (SIC 28) and scientific instruments industry (SIC 38) are two notables where the presence of CAO facilities has made a significant difference in growth in manufacturing output (for the Great Lakes region). In the Mid Atlantic region, chemicals (SIC 28) and electric machinery (SIC 36) realized upward adjustments owing to the relative growth of CAOs from 1963 through 1986.

Further disaggregation by state by industry reveals still a higher order of dispersion in the revisions. In viewing only the chemical industry (SIC 28), for example, Connecticut's upward adjustment rises 32 percent in 1986, while percent change in value added rises from 202 percent before adjustment to 305 percent after adjustment for CAO domicile in the state data (not shown).[3]

Conclusions

In its manufacturing estimates, the BEA seems to have identified several major problems with the Census value added. BEA has

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[3]Data for all industries and states are available from the authors on request.

constructed reasonable algorithms to correct the problems (given the available data and excluding long-term and time intensive statistical endeavors). In focusing on the magnitude of the correction for the location of auxiliary establishments for the Great Lakes and Mid Atlantic regions, a notable dimension of structural change can be observed. At the same time that this manufacturing belt shed much of its manufacturing production activity, it has retained relatively more of the services that are produced within manufacturing companies, e.g., R&D and corporate headquarters functions.

The magnitude of this single adjustment to regional output data for the manufacturing data is modest in aggregate, though it can be large for smaller geographic regions and for particular industries. Many measurements conducted by the regional analyst thus are affected by the proper choice of data and proper construction. For example, regional differences in productivity or in structural change would be affected. Accordingly, the BEA has taken a significant step forward in attempting to correct the CAO bias inherent in value added.

References

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7.   U.S. Department of Commerce, *County Business Patterns* (annual publications and data tapes).

8.   U.S. Department of Commerce, Bureau of the Census, *Census of Manufactures* (Washington D.C., 1963).

9.   U.S. Department of Commerce, Bureau of the Census, *Annual Survey of Manufactures* (Washington D.C., 1986).

Table 1
Auxiliary Payroll as a Percent of Total Payroll (in Manufacturing)

	Illinois	Indiana	Michigan	Minnesota
1958	5.8	1.7	10.5	6.8
1963	7.1	2.3	11.6	8.3
1967	6.9	1.8	11.4	10.7
1972	8.6	2.5	12.7	12.1
1977	10.7	2.9	13.1	15.0
1982	16.0	3.1	17.5	16.9
1986	15.0	3.6	15.1	19.5

	Ohio	Wisconsin	Great Lakes	United States
1958	4.5	3.1	5.8	5.7
1963	5.8	4.2	7.0	6.6
1967	5.9	4.6	7.1	6.6
1972	7.9	4.3	8.4	7.9
1977	7.9	5.7	9.4	8.3
1982	12.4	8.2	13.0	10.1
1986	12.2	8.6	12.7	10.7

Source: U.S. Department of Commerce, Bureau of the Census, *Census of Manufactures* [8] and *Annual Survey of Manufactures* [9]

Table 2
CAO-Adjusted Value Added for Mid Atlantic and Great Lakes States

	1963			1986		
	Value Added ($ millions)	Adjusted Value Added ($ millions)	Ratio	Value Added ($ millions)	Adjusted Value Added ($ millions)	Ratio
New York	19,452	20,347	1.05	72,867	75,061	1.03
Pennsylvania	14,006	14,077	1.01	52,089	53,208	1.02
Connecticut	4,151	4,123	.99	21,406	22,770	1.06
New Jersey	9,701	9,747	1.00	37,640	40,738	1.08
Illinois	14,515	14,558	1.00	58,291	59,914	1.03
Indiana	7,660	7,315	.96	34,939	32,900	.94
Michigan	12,915	136,351	1.06	56,732	62,472	1.10
Minnesota	2,636	2,684	1.02	19,496	21,352	1.10
Ohio	15,361	15,180	.99	66,081	66,905	1.01
Wisconsin	5,219	5,075	.97	28,434	28,077	.99
East North Central	55,669	55,763	1.00	244,477	250,268	1.02
Great Lakes (6)	58,305	58,447	1.00	263,973	271,620	1.03
Mid Atlantic (4)	47,309	48,295	1.02	184,002	191,776	1.04
NEMW Belt (10)	105,615	106,742	1.01	447,975	463,396	1.03

Table 3
Growth in CAO-Adjusted Value Added in Manufacturing 1963-1986

	Adjusted Value Added 1963 ($ millions–1982=100)	1986	Percent Change	Value Added 1963 ($ millions–1982=100)	1986	Percent Change
New York	46,132	68,171	47.8	44,242	66,204	49.6
Pennsylvania	34,317	48,695	41.9	33,996	47,536	39.8
Connecticut	9,903	20,945	111.5	9,928	19,658	98.0
New Jersey	21,265	37,391	75.8	21,182	34,539	63.1
Illinois	34,793	54,670	57.1	34,640	53,189	53.5
Indiana	17,171	30,493	77.6	17,961	32,371	80.2
Michigan	28,721	57,090	98.8	27,764	51,917	87.0
Minnesota	6,557	19,626	199.3	6,445	17,885	177.5
Ohio	35,780	61,574	72.1	36,103	60,770	68.3
Wisconsin	11,636	25,773	121.5	11,938	26,114	118.7
East North Central	128,101	229,599	79.2	128,405	224,361	74.7
Great Lakes (6)	134,657	249,225	85.1	134,850	242,246	79.6
Mid Atlantic (4)	111,617	175,202	57.0	109,349	167,937	53.6
NEMW Belt (10)	246,274	424,427	72.3	244,199	410,183	68.0

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Table 4
Comparison of CAO-Adjusted & Original Value Added by Industry–Great Lakes Region

	1963			1986			Percent Change 1963-1986	
	Value Added ($ millions–1982=100)	Adjusted Value Added ($ millions–1982=100)	Ratio	Value Added ($ millions–1982=100)	Adjusted Value Added ($ millions–1982=100)	Ratio	Value Added	Adjusted Value Added
SIC 20	11,815	11,933	1.01	24,672	25,023	1.01	108.8	109.7
SIC 24	1,130	1,150	1.02	2,951	2,911	.99	161.2	153.1
SIC 25	1,989	2,007	1.01	4,070	4,165	1.02	104.6	107.5
SIC 26	4,452	4,457	1.00	9,645	9,651	1.00	116.6	116.5
SIC 27	8,622	8,654	1.00	12,823	13,031	1.02	48.7	50.6
SIC 28	6,816	6,694	.98	19,025	19,223	1.01	179.1	187.2
SIC 30 (5 sts '63)	3,835	3,920	1.02	10,887	11,702	1.07	183.9	198.5
SIC 32	5,435	5,473	1.01	6,347	6,561	1.03	16.8	19.9
SIC 33	20,254	20,028	.99	16,757	16,527	.99	-17.3	-17.5
SIC 34	13,840	13,779	1.00	25,393	25,256	.99	83.5	83.3
SIC 35	20,967	20,639	.98	64,313	65,969	1.03	206.7	219.6
SIC 36	9,232	8,734	.95	21,497	21,326	.99	132.9	144.2
SIC 37	15,739	16,802	1.07	40,225	44,045	1.09	155.6	162.1
SIC 38	2,026	2,025	1.00	5,436	6,656	1.22	168.3	228.7
SIC 39 (5 sts '63)	2,183	2,137	.98	2,845	2,961	1.04	30.3	38.6

Table 5
Comparison of CAO-Adjusted & Original Value Added by Industry–Mid Atlantic (4)

	1963			1986			Percent Change 1963-1986	
	Value Added ($ millions–1982=100)	Adjusted Value Added	Ratio	Value Added ($ millions–1982=100)	Adjusted Value Added	Ratio	Value Added	Adjusted Value Added
SIC 20	8,937	9,171	1.03	14,528	15,549	1.07	62.8	69.5
SIC 22	2,035	2,117	1.04	2,019	2,153	1.07	-0.8	1.7
SIC 23	8,066	8,031	1.00	7,565	7,667	1.01	-6.2	-4.5
SIC 25	1,392	1,395	1.00	1,849	1,854	1.00	32.8	32.9
SIC 27	11,624	11,665	1.00	17,565	17,580	1.00	51.1	50.7
SIC 28	8,342	8,689	1.04	21,747	23,923	1.10	160.7	175.3
SIC 32	4,148	4,239	1.02	4,913	5,026	1.02	18.4	18.6
SIC 33	13,772	14,127	1.03	7,168	7,712	1.08	-48.0	-45.4
SIC 34	8,977	9,078	1.01	11,241	11,510	1.02	25.2	26.8
SIC 35	10,624	11,015	1.04	29,226	30,552	1.05	175.1	177.4
SIC 36	8,056	8,543	1.06	18,762	21,139	1.13	132.9	147.4
SIC 37	5,581	5,377	.96	12,101	11,583	.96	116.8	115.4
SIC 38	3,978	4,043	1.02	14,017	13,554	.97	252.4	235.2
SIC 39	3,967	3,973	1.00	4,550	4,696	1.03	14.7	18.2

Figure 1

Percent of Manufacturing Payroll at Auxiliary Establishments—1982

Legend:
- Less than 3%
- 3 - 5%
- 5 - 10%
- Greater than 10%