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Calibrating Manufacturing Decline in the Midwest:
Value Added, Gross State Product, and All Points Between

William A. Testa and David D. Weiss

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Most people would agree that the Northeast and Midwest regions have lost manufacturing share to the West and South. However, in terms of regional shares of manufacturing output, what is the actual extent of manufacturing redistribution and decline? Are the movements and losses as large as commonly reported by our data?

The manufacturing sector includes more than factories; it includes corporate headquarters, regional service offices, warehouses, data processing centers and R&D labs (i.e. central administrative offices or "CAOs"). Two facts concerning such manufacturing activities have been documented by Israilevich and Testa (1989) and Testa and Weiss (1990). First, central administrative offices have not abandoned the older manufacturing belt with the same vigor as production activities but have tended to continue to concentrate in the region. Secondly, as measured by payroll, central administrative offices have become an increasingly important component of U.S. manufacturing activities.

These facts would not distort our perceptions of geographical shifts in U.S. manufacturing were it not for the fact that our most widely used output measure, Census value added, does not properly allocate the activities of CAO activities of multi-plant companies to states and regions (Garnick 1979). Misallocation arises because the Census method assigns CAO activity to states solely on the basis of the location of operating plants (i.e. factories) rather than by the location of CAOs themselves (Israilevich and Testa 1989). This tends to understate manufacturing levels and growth in the Midwest and Mid Atlantic regions (Testa and Weiss 1990).

Another peculiarity of value added relates to services purchased externally by manufacturing companies. Census value added includes or embodies the value of these purchased services even though such services are produced in outside sectors including transportation, wholesale trade, or business services such as advertising. This may or may not be troublesome from a conceptual viewpoint. Regardless, from a geographic perspective, we do not know where

these services originate, whether in the same state as the manufacturing plant or even in foreign nations. For this reason, a state's share of Census value added may present a distorted image of a state's share of national manufacturing activity.

Gross state product

With their estimates of Gross State Product (GSP) by state, the Bureau of Economic Analysis (BEA) addresses both of these distortions. The BEA starts with Census value added and adjusts for both the misallocation of CAO and for the "purchased services" problem. The BEA also makes a third and final adjustment to value added which appears to be arbitrary. However, *only* the end products of the GSP algorithm are reported, the intermediate steps are not available.

To examine the effects of the GSP algorithm we reconstruct facsimiles, but not duplicates, of BEA's intermediate steps for the Mid Atlantic and East North Central regions. We present and discuss regional shares of value added, gross state product, intermediate steps, and two additional conceptual measurements of a region's manufacturing output. In conclusion, we find that the region's share of U.S. manufacturing, and its change in share over time, is quite sensitive to particular variants of the measure. Researchers should exercise caution in choosing among these measurements. If possible, the BEA should make each variant available.

The Census Bureau first estimates value added at individual plants by subtracting purchases of intermediate goods and materials from the value of manufactured shipments. Value added is then summed across establishments to arrive at state value added by industry.

(1) $VA = VS - \text{Intermediate goods and materials}$

In reflecting on this algorithm, it is evident that services purchased by manufacturing companies become a component of value added as measured. The value of those services are embodied in the value of shipments.¹ Netted out intermediate goods and materials do not include purchased services so that services are not netted out by this subtraction.

The first problem we must solve is the location of central administrative offices. We follow a process similar, but not identical, to BEA in adjusting

for the location of central administrative office activities of multistate companies.² First, CAO activities are removed from value added by using the ratio of CAO activities for the 2-digit industry at the national level:

$$(2) VA'_{ij} = VA_{ij} * (1 - (KCAO_j + PCAO_j)/VA_j)$$

where:

VA_{ij} = reported value added in state i in industry j.

$KCAO_j$ = capital outlays of CAOs of industry j in the U.S.

$PCAO_j$ = payroll expenditures for employees at CAOs of industry j in the U.S.

Then, CAO activity is allocated back to each industry in each state based on known location of CAO payroll activity.

$$(3) VA''_{ij} = VA'_{ij} + (PCAO_{ij}/PCAO_j) * (KCAO_j + PCAO_j)$$

where $PCAO_{ij}$ is equal to the payroll at CAO establishments in state i in industry j.

Now that central administrative offices have been allocated, value added is further adjusted for purchased services in a reasonable fashion. Following the methodology of the BEA, we eliminate purchased services by industry in each state using a national estimate of each industry's ratio of purchased services to value added:

$$(4) VA'''_{ij} = VA''_{ij} * (SERVRATIO_j)$$

where:

$SERVRATIO_j$ = the ratio of BEA gross product originating to census value added in national industry j.

BEA estimates the proportion of reported value added that consists of purchased services for each industry *at the national level* by subtracting gross product originating (BEA) from Census value added. The idea is that gross product originating does not contain purchased services but rather, it is built up from the sum of factor payments in manufacturing companies.

Finally, in addition to (1) adjusting for the location of CAOs and (2) the elimination of purchased services, BEA makes a third adjustment. Its stated reasons are to make its estimates "consistent with both the State estimates of wages and salaries by industry, mentioned earlier in the chapter, and GDP by industry in the National Income and Product Accounts (NIPAs)".³ The following equation represents the BEA method:

$$(5) \quad VA''_{ij} = VA''_{ij} * (BEAPAY_{ij} / CENPAY_{ij}) * \frac{GDP_j}{\sum_i (VA''_{ij} * (BEAPAY_{ij} / CENPAY_{ij}))}$$

where:

BEAPAY_{ij} = Payroll in state i in industry j as defined by BEA methodology

CENPAY_{ij} = Payroll in state i in industry j as defined by Census methodology

GDP_j = Gross Domestic Product in industry j in the U.S. (BEA)

Whatever its other intentions, this last step re-arranges the regional distribution of manufacturing that was arrived at in the previous two BEA adjustments and it does so for both for a state's individual industries and for its total manufacturing share.

Variations on a theme

There are some other measurements of manufacturing output that are of interest to researchers. Some researchers might choose to measure manufacturing as closely as possible to production activity alone. (At the same time, perhaps, another separate sector can be constructed comprising CAO services and purchased service activity.) Toward this end we further construct value added that is net of CAO activity *and* net of purchased services.⁴ To derive this production activity measurement we remove purchased services (step 4) from VA' (value added stripped of administrative offices).

Still another measurement involves an adjustment to purchased services. An alternative to using the BEA gross product originating for a measurement of purchased services would be to calculate purchases of services from the BEA input-output table for the United States. With this new service share we can

remove services from value added for an alternative measurement of GSP, one that is identical in concept but differs in source of data.

Comparison of measures

In 1986, compared to Census value added, proper accounting of CAO location boosts the East North Central and Mid Atlantic's share of the nation's value added (Table 1). The direction of these changes are what one would expect from knowing beforehand that these regions are specialized in corporate headquarters and R&D labs of manufacturing companies.

Table 1

Five measures of the regional share of nominal manufacturing output in 1986 (percent of U.S.)

	Census value added (VA)	VA adjusted for location of CAOs (VACAO)	VA adjusted for location of CAOs and net of services (VACAO SER)	BEA gross state product (GSP)	VA net of CAOs and services (VAPROD)
Illinois	5.9	6.1	5.9	5.4	5.8
Indiana	3.5	3.3	3.5	3.2	3.7
Michigan	5.8	6.4	7.0	6.1	6.3
Ohio	6.7	6.8	7.0	6.6	7.0
Wisconsin	2.8	2.8	2.6	2.6	2.7
East North Central	24.8	25.4	26.1	24.0	25.5
New Jersey	3.8	4.1	4.2	3.9	3.8
New York	7.4	7.6	7.4	7.6	7.2
Pennsylvania	5.1	5.3	5.3	5.1	5.2
Mid Atlantic	16.3	17.0	16.9	16.5	16.3
Eight States	41.1	42.3	43.0	40.5	41.8

Note: Due to problems with undisclosed data at the regional level, the following industries are omitted from total: SIC 21, 22, 24, and 31.

For both regions the boost is modest -- 24.8 to 25.4 percent for the East North Central and from 16.3 to 17.0 percent share for the Mid Atlantic. Michigan's jump is most pronounced, rising from 5.8 to 6.4 percent largely on the basis of the auto company headquarters and design facilities there. In contrast to Michigan, upward adjustments to Illinois and New York seem relatively mild in relation to the renown of these metro areas in hosting corporate headquarters and high level service establishments.

Prior expectations on the netting out of services purchased by manufacturers, are not as strong. We know of no reasons to believe that the particular mix of manufacturing industries in the two regions' manufacturing sectors are relatively large or small purchasers of services.

A reason to exclude such services from any measure of a region's manufacturing sector is that U.S. geographers know little, if anything, about *where* such services are purchased. If General Motors Corp. purchases its advertising services in New York, for example, it would distort the size of the Michigan manufacturing sector to include such services. However, if most services *are* purchased locally, inclusion of purchased services as part of the "export base" would be accurate. Export of specialized manufacturing products from the regions would embody the value of services along with the activities of manufacturing companies.

In any case, the netting out of purchased services boosts the regions' shares of manufacturing--from 25.4 to 26.1 for the East North Central and from 42.3 to 43.0 percent for the East North Central and Mid Atlantic region. Apparently, in comparison to the remainder of the U.S., the mix of industries does not intensively purchase services

In comparing the adjusted manufacturing shares with gross state product, a peculiar result can be seen. For both regions, the share of the United States gross state product is significantly lower than the adjusted value added. For example, it is two percentage points below for the East North Central region. As seen in the series of adjustments, this final BEA step neutralizes the effects of the first two steps.

The third and final BEA step is somewhat arbitrary. Accordingly, it would be better to allow researchers access to the results of steps one and two.

Another approach to the task of defining the manufacturing sector would be to isolate a service sector--both purchased and internal services--from the manufacturing production activity. However, some service activities are reported jointly along with operating establishments of manufacturing companies so that this procedure may be subject to error.

Curiously enough, the regions' shares of estimated production activity alone are slightly higher than shares of either gross state product or Census value added in 1986. Apparently, the deficiency in purchased services (which is now netted out) overcomes the gains through correct CAO allocation (which is also netted out).

Substituting a figure for purchased services based upon the input-output table for one based upon gross product originating at first does not appear to have a major influence. In 1986 the eight state area's share of total adjusted value added drops from 43.5 to 43.2 percent (see Table 2). However, this figure hides changes among the states. Michigan's share drops from 7.2 to 6.9 percent. But this change is hidden by Illinois's rise from 5.9 to 6.0 percent of the United States total. In practice the change in estimated purchased services reweights the importance of various industries. This reweighting, although creating some significant changes at the state level, has little effect at the more aggregated regional level.

The various measurements of output display different time trends. Trends in manufacturing are important to regional researchers. For example, productivity trends are based on measures of output (e.g. Beeson (1987); Hulten and Schwab (1984)). A high growth measure of output will show larger increases in productivity than slowly growing measures. This lends another dimension to the magnitude of possible error in choosing among measures of manufacturing level share. For example, (Table 3) suggests that the East North Central's share of value added adjusted for CAOs and purchased services declined from 32.3 to 26.4 percent from 1963 to 1983. Gross state product estimates indicate a decline of 33.7 to 24.4 (5.9 percentage points versus 9.3).

As statistics would suggest, disaggregating these comparative measures by individual industry, by individual state, or by both individual state and industry, will produce scattered instances of wider disparities in reported shares of manufacturing. The remainder of the tables reported here are offered as samples. Some examples are as follows:

Table 2

Value added adjusted for location of CAOs and net of services

	Source of estimated services			
	BEA Gross product originating		BEA Input output table	
	1963	1986	1963	1986
Illinois	8.1	5.9	8.1	6.1
Indiana	4.1	3.5	4.1	3.3
Michigan	8.4	7.2	8.0	6.9
Ohio	8.8	7.2	8.6	7.0
Wisconsin	2.9	2.7	2.9	2.9
East North Central	32.3	26.4	31.8	26.3
New Jersey	5.2	4.2	5.3	4.0
New York	11.0	7.6	11.1	7.7
Pennsylvania	7.4	5.4	7.5	5.3
Mid Atlantic	23.7	17.1	23.8	16.9
Eight States	56.0	43.5	55.6	43.2

Table 3

Five measures of the regional share of nominal manufacturing output in 1963 and 1986
(percent)

	Census value added		VA adjusted for location of CAOs		VA adjusted for location of CAOs and net of services		BEA gross state product		VA net of CAOs and services	
	(VA)		(VACAO)		(VACAO SER)		(GSP)		(VAPROD)	
	1963	1986	1963	1986	1963	1986	1963	1986	1963	1986
Illinois	8.1	5.9	8.2	6.1	8.1	5.9	8.0	5.5	8.4	5.8
Indiana	4.3	3.5	4.1	3.3	4.1	3.5	4.3	3.3	4.5	3.7
Michigan	7.4	5.9	7.8	6.5	8.4	7.2	9.8	6.4	8.2	6.4
Ohio	8.7	6.8	8.6	6.9	8.8	7.2	8.7	6.5	9.3	7.1
Wisconsin	2.9	2.9	2.8	2.8	2.9	2.7	2.9	2.8	3.1	2.8
East North Central	31.3	25.0	31.4	25.6	32.3	26.4	33.7	24.4	33.5	25.8
New Jersey	5.4	3.8	5.4	4.1	5.2	4.2	5.1	4.0	5.3	3.8
New York	10.7	7.5	11.1	7.7	11.0	7.6	10.6	7.7	11.2	7.4
Pennsylvania	7.5	5.2	7.5	5.3	7.4	5.4	7.4	5.1	7.8	5.3
Mid Atlantic	23.5	16.5	24.0	17.1	23.7	17.1	23.2	16.8	24.3	16.4
Eight States	54.8	41.4	55.4	42.7	56.0	43.5	56.8	41.2	57.8	42.2

Note: Totals exclude SICs 21, 22, 24, 29, and 31.

Value added adjusted for CAOs and net of services suggests that Michigan's share of manufacturing declined from 8.3 to 7.0 from 1963 to 1986. GSP reports a drop from 9.6 to 6.2 (Table 4).

In 1986, GSP suggests that Illinois' share of the nation's petroleum refining industries stood at 4.4 percent while value added and CAO-adjusted value added suggest a share of approximately 6.4 or 6.5 percent (Table 7).

These examples display the importance of understanding the content of manufacturing output data for conducting regional research and for basic understanding of the region known as the manufacturing belt. The review of alternative output measures has suggested a few new insights into manufacturing in the region:

- Relative to our published measures of output--value added and gross state product--, manufacturing has not dispersed from the region to extent believed.
- This result follows because the region has retained CAOs, and *not* because its industries tend to purchase services more intensively in comparison to the industry mix of the rest of the nation.
- In viewing manufacturing output from operating plants alone, the region's loss in manufacturing share appears to be large.

Table 4

Shares of manufacturing by state 1963 and 1986 (percent)

		Census value added (VA)		VA adjusted for location of CAOs and net of services (VACAOSER)		BEA gross state product (GSP)	
	n	1963	1986	1963	1986	1963	1986
Illinois	17	8.0	5.8	7.9	5.7	7.7	5.3
Indiana	17	4.2	3.5	4.1	3.5	4.3	3.2
Michigan	16	7.2	5.8	8.3	7.0	9.6	6.2
Ohio	18	8.2	6.5	8.2	6.7	8.2	6.3
Wisconsin	16	2.9	2.9	2.9	2.7	2.9	2.8

Table 5

The Mid Atlantic's share of U.S. manufacturing by industry, 1963 and 1986 (percent)

SIC	Census value added (VA)		VA adjusted for location of CAOs and net of services (VACAOSER)		BEA gross state product (GSP)	
	1963	1986	1963	1986	1963	1986
20	19.4	14.0	19.9	14.9	20.1	15.7
22	19.1	9.2	20.0	9.8	20.3	10.7
23	48.8	27.6	48.5	27.6	48.6	28.2
25	18.0	11.5	18.0	11.3	18.1	11.9
26	20.0	14.6	20.3	15.3	20.1	14.8
27	34.8	27.1	34.9	27.1	34.1	26.5
28	25.4	22.0	26.5	23.9	25.7	23.2
30	17.4	12.7	17.7	13.0	18.0	11.8
32	21.2	17.3	21.7	17.7	23.4	16.9
33	26.1	17.0	26.9	18.3	27.8	16.9
34	22.4	14.2	22.7	14.3	20.3	13.9
35	20.2	12.4	21.0	13.0	21.2	14.8
36	26.3	15.4	28.2	17.1	25.3	14.8
37	10.5	6.3	10.1	6.1	10.3	7.2
38	44.9	33.5	45.7	32.3	48.5	34.6
39	44.2	26.6	44.3	27.4	36.1	24.1

Table 6

The East North Central's share of U.S. manufacturing by industry, 1963 and 1986 (percent)

SIC	Census value added (VA)		VA adjusted for location of CAOs and net of services (VACAOSER)		BEA gross state product (GSP)	
	1963	1986	1963	1986	1963	1986
20	24.0	22.5	24.0	22.4	25.0	21.1
23	9.1	9.7	9.2	9.4	9.1	9.6
24	10.8	11.1	11.0	11.1	12.3	12.1
25	26.7	26.1	26.9	26.6	28.2	22.5
26	24.4	21.6	24.4	21.7	24.5	21.5
27	25.1	18.7	25.2	19.0	25.6	18.5
28	21.0	20.0	20.7	20.1	20.3	20.4
30	39.2	28.5	39.8	30.8	39.0	28.0
32	27.0	21.4	27.3	22.3	27.0	19.6
33	41.1	43.0	40.6	42.4	40.2	39.7
34	38.8	36.0	38.5	35.9	45.7	35.7
35	44.9	29.6	44.2	30.1	44.4	26.4
36	32.1	18.6	30.3	18.4	32.6	17.6
37	39.0	34.8	41.7	38.2	47.1	34.8
38	22.6	11.4	22.4	11.5	18.7	10.5
39	27.9	18.1	27.4	18.7	23.6	17.7

Table 7

The Illinois share of U.S. manufacturing by industry, 1963 and 1986 (percent)

SIC	Census value added (VA)		VA adjusted for location of CAOs and net of services (VACAOSER)		BEA gross state product (GSP)	
	1963	1986	1963	1986	1963	1986
20	9.4	7.4	9.9	7.6	9.6	7.2
23	3.4	1.7	3.4	2.1	3.5	1.7
24	2.2	1.5	2.4	1.6	2.2	1.5
25	6.8	5.0	7.0	5.0	8.0	3.8
26	5.1	4.5	5.0	4.5	5.2	3.8
27	11.4	7.7	11.5	8.0	11.7	7.8
28	6.9	6.0	6.7	5.9	6.6	6.7
29	6.7	6.4	6.3	6.5	6.3	4.4
30	6.6	6.1	6.5	6.1	6.2	6.2
32	6.9	4.6	7.0	4.7	6.6	3.4
33	7.7	6.8	7.7	6.9	7.4	6.8
34	11.6	8.5	11.9	8.5	11.4	8.0
35	13.1	8.2	13.4	8.7	12.9	6.8
36	10.6	5.6	10.2	5.8	10.7	5.1
37	2.3	2.6	2.3	2.6	2.2	2.2
38	11.9	3.8	11.9	4.6	9.9	3.6
39	10.7	6.0	10.3	6.3	9.5	6.3

Table 8

The Michigan share of U.S. manufacturing by industry, 1963 and 1986 (percent)

SIC	Census value added (VA)		VA adjusted for location of CAOs and net of services (VACAOSER)		BEA gross state product (GSP)	
	1963	1986	1963	1986	1963	1986
20	3.3	3.4	3.3	3.5	3.5	3.3
23	2.1	4.2	2.1	3.9	2.1	4.6
24	2.2	1.6	2.2	1.7	2.7	1.7
25	6.2	9.4	6.1	9.6	6.7	9.3
26	4.7	3.5	4.5	3.3	4.7	2.8
27	3.0	2.6	3.1	2.5	3.0	2.3
28	4.3	3.5	4.3	3.8	4.6	3.4
30	5.0	5.0	4.9	5.1	5.3	4.7
32	4.4	3.8	4.3	3.7	4.2	3.4
33	7.6	7.1	7.4	7.0	7.6	6.9
34	8.7	9.0	8.4	8.8	13.4	9.7
35	10.4	6.5	10.0	6.6	10.3	5.7
36	2.2	1.6	2.2	1.6	2.5	1.7
37	19.8	16.1	23.4	20.7	29.9	19.3
38	3.7	1.9	3.6	1.7	2.0	1.5
39	5.1	3.4	4.9	3.3	4.2	1.9

Table 9

Share of the chemicals industry (SIC 28) 1963 and 1986 (percent)

	Census value added (VA)		VA adjusted for location of CAOs and net of services (VACAOSER)		BEA gross state product (GSP)	
	1963	1986	1963	1986	1963	1986
SIC						
Illinois	6.9	6.1	6.7	5.9	6.6	6.7
Indiana	3.4	4.1	3.1	3.6	3.2	3.3
Michigan	4.3	3.5	4.3	3.8	4.6	3.4
Ohio	5.4	5.1	5.7	5.7	5.0	6.0
Wisconsin	0.9	1.2	0.9	1.2	0.9	1.0
East North Central	21.0	20.0	20.7	20.1	20.3	20.4
New Jersey	12.0	10.6	11.8	11.3	11.0	10.7
New York	7.8	6.2	9.2	6.9	8.8	6.6
Pennsylvania	5.6	5.2	5.5	5.7	5.9	5.8
Mid Atlantic	25.4	22.0	26.5	23.9	25.7	23.2

Footnotes

¹To assume otherwise is to believe that the price of the final manufactured good does not cover its cost of production including purchased services.

²The BEA also nets out intermediate purchases of CAOs and we do not.

³See BEA 1985, p. 25.

⁴Note that this neglects the fact that many service functions of manufacturing companies are located in conjunction with operating plants. As a result, the algorithm does not strip off these services and it does nothing to address geographic distortion of a multi-plant multi-state company having its service center located along with one of its operating or production plants.

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Appendix

Service share of value added 1977

<u>SIC</u>	<u>Input/ output</u>	<u>Census of manufactures</u>
20	18.2	24
21	14.6	-
22	15.9	15
23	14.4	28
24	13.6	3
25	22.0	26
26	14.5	16
27	26.2	30
28	33.4	41
29	41.9	-
30	16.2	28
31	17.2	19
32	23.2	29
33	19.8	25
34	13.9	22
35	11.9	19
36	16.7	28
37	12.2	13
38	14.1	12
39	24.6	31