Appendix D

Comparison of the National Bureau Indexes of Physical Output with Indexes Prepared by Other Agencies

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CHARACTER OF THE INDEXES COMPARED

THE three indexes of manufacturing output compared in this appendix—the National Bureau index, the Day-Thomas index, and the National Research Project index—are all based primarily on the Census of Manufactures, but they differ from one another with respect to both technical methods of construction and coverage of industries and time-periods.[1]

The National Bureau index, as explained in Chapter 2 and Appendix A, was constructed with the use of the Edgeworth formula. Indexes were derived for four overlapping periods (1899–1909, 1909–1919, 1919–1929, and 1929–1937), and these were spliced together to produce indexes on the 1929 base. Adjustments were made for changes in coverage. Value of products per unit was employed as the price coefficient in the computation of indexes for individual industries; value added per unit was the price coefficient in the computation of indexes for industrial groups and for all manufacturing industries combined.

The Day-Thomas index was constructed on the basis of a weighted geometric mean of relatives of output quantities. The

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[1] The "Day-Thomas index" is the index computed for 1899–1914 by W. M. Persons and E. S. Coyle; for 1914–1925 by E. E. Day and Woodlief Thomas; for 1927–31 by Aryness Joy; for 1933–35 by V. S. Kolesnikoff; and for 1937 by C. L. Dedrick. See E. E. Day and Woodlief Thomas, *The Growth of Manufactures, 1899 to 1923*, Census Monograph VIII (Bureau of the Census, 1928), pp. 23, 34; V. S. Kolesnikoff, "Index of Manufacturing Production Derived from Census Data, 1935," *Journal of the American Statistical Association* (Dec. 1937), pp. 713–14; and *Biennial Census of Manufactures, 1937* (1939), Part I, pp. 12, 17.

The National Research Project index was constructed by H. Magdoff, I. H. Siegel and M. B. Davis, and published in *Production, Employment and Productivity in 59 Manufacturing Industries, 1919–36*, Report No. S–1 (National Research Project, May 1939).

base was 1909 for the period 1899–1914, and 1919 for the period 1914–1937. For the indexes of output of individual industries the weight was value of products; for the indexes of groups and total manufacturing the weight was value added. The 1909 value was used for the 1899–1914 index, and the average of 1919 and the given year was employed similarly for the 1914–1937 index. No adjustments were made for changes in coverage, but imputed weights were used.[2]

For the National Research Project index the Laspeyres formula was used with 1929 as the base. The price coefficient employed in the computation of the indexes for most individual industries was value of product per unit. The remaining indexes for individual industries and the index for all manufacturing were constructed with employment per unit as the price coefficient. No adjustment was made for coverage changes, nor were imputed weights used.

Although the differences in construction are pronounced, the major source of variation among the indexes is to be traced to differences in coverage. These are shown in Table D–1, following. Indexes computed by the three agencies for the same individual industry are usually similar to one another. The more outstanding differences between the trends indicated by the three indexes for the same industry are described briefly in the notes below. These contain, also, brief descriptions of the indexes for industries or periods covered by Day-Thomas or National Research Project indexes but not by indexes constructed by the National Bureau of Economic Research.[3]

[2] See Appendix A, p. 372.

[3] There is still another index of manufacturing output based largely on Census data. This index, to which the present study owes much, was constructed at the National Bureau under the direction of Frederick C. Mills (see *Economic Tendencies in the United States* [1932], and *Prices in Recession and Recovery* [1936]). The index published in the present volume differs in certain technical respects from Dr. Mills' index. First, the number of industries covered by Dr. Mills' index is smaller, partly because the minimum coverage accepted by him as adequate for his purpose was 60 percent rather than the 40 percent specified by us and because less use was made of non-Census data by Dr. Mills than by us. Second, Dr. Mills used the Fisher "ideal" formula while we used the Edgeworth. Third, Dr. Mills' base periods are 1914 and 1927, rather than 1909, 1919 and 1929, selected in the present study. Fourth, the procedure of passing from output in the sample to output in all manufacturing industries differed: Dr. Mills used a modified type of imputed weighting, plus an adjustment based on employment and value added, while we used

TABLE D–1

Industrial and Time Coverage of Three Indexes of
Physical Output of Manufacturing Industries

Industry and Group	Census Years Covered by Index of Physical Output[a]		
	National Bureau of Economic Research	Day-Thomas[b]	National Research Project[c]
Foods			
Meat packing	99–37	99–35	19–35
Sausage, not elsewhere made	29–37	....	
Oleomargarine, not else-			
where made	25–37	....	....
Shortenings	27–37	....	....
Flour	99–37	99–35	19–35
Feeds	25–37	....	....
Cereals	25–37	....	....
Rice	99–37	14–31[d]	....
Macaroni	27–37	....	....
Bread and cake	23–37	....	23–35
Biscuits and crackers	23–37	....	23–35
Fish, canned	99–37	14–35	19–35
Fruits and vegetables,			
canned	99–37	99–35	19–35
Milk, canned	99–37	99–35	....
Butter	99–37		....
Cheese	99–37		....
Ice cream	23–37	....	19–35
Beet sugar	99–37	99–35	19–35
Cane sugar, not elsewhere			
made	99–37	....	....
Cane-sugar refining	99–37	99–35	19–35
Confectionery	25–37	....	25–35
Chocolate	21–37	....	....
Corn products	09–37	14–35	....
Flavorings	29–37	....	....
Baking powder	27–37	....	....
Ice	99–37	14–35	19–35
TOTAL	99–37	99–35	....

For footnotes see p. 650.

only an adjustment based simply on value added (see Appendix A for a more
detailed statement of this difference). Fifth, it was frequently possible for us,
in the course of our study of Dr. Mills' indexes and the re-examination of
the basic Census reports, to expand the scope of the data utilized by Dr. Mills
in the computation of the indexes for individual industries by the inclusion
of additional products, and to improve the homogeneity of the data by utiliz-
ing more detailed classes of products. There are a few other, minor, differ-
ences between the two indexes which need not be mentioned in detail.

TABLE D-1 (continued)

Industry and Group	Census Years Covered by Index of Physical Output[a]		
	National Bureau of Economic Research	Day-Thomas[b]	National Research Project[c]
Beverages			
Liquors, malt	99–37	}99–19	....
Liquors, distilled	99–37		....
Malt	25–37	....	....
Liquors, vinous	23–37	....	....
Beverages, nonalcoholic	31–37	....	....
TOTAL	99–37	99–19[e]	....
Tobacco products			
Cigarettes	99–37	99–35	19–35
Cigars	99–37	99–35	19–35
Tobacco products, other	99–37	99–35	19–35
TOTAL	99–37	99–35	....
Textile products			
Cotton goods	99–37	99–35	19–35
Lace goods	14–37	....	....
Woolen and worsted goods	99–37	99–35	19–35
Silk goods	}99–37	{99–35	}19–35
Rayon goods		{	
Hosiery, knit	99–37		[19–35
Underwear, knit	99–37	}99–35	[19–35
Outerwear, knit	99–37		[19–35
Cloth, knit	99–31		[19–31
Carpets and rugs, wool	99–37	99–35	....
Asphalted-felt-base floor covering	19–37	}14–31[d]	....
Linoleum	04–37		....
Oilcloth	04–37		....
Cordage and twine	99–37		....
Jute goods	99–37	}99–35	....
Linen goods	99–37		....
Clothing, men's, incl. work clothing	27–37	....	....
Gloves, textile, not elsewhere made	27–37	....	....
Shirts and collars, men's	27–37	....	....
Clothing, women's, not elsewhere classified	27–37	....	....
Corsets	27–37	....	....
Handkerchiefs	27–37	....	....

For footnotes see p. 650.

TABLE D–1 (continued)

Industry and Group	Census Years Covered by Index of Physical Output[a]		
	National Bureau of Economic Research	Day-Thomas[b]	National Research Project[c]
Textile products (concluded)			
Elastic woven goods, not elsewhere made	27–37	. . . .	. . . .
Hats, fur-felt	99–37	99–31[d]	. . . .
Hats, cloth	27–37	. . . .	. . . .
Hats, straw, men's	27–37	. . . .	. . . .
Hats, wool-felt	99–37	. . . .	. . . .
Artificial leather	23–37	. . . .	. . . .
Wool shoddy	99–37	. . . .	. . . .
TOTAL	99–37	99–35	. . . .
Leather products			
Leather	99–37	99–35	19–35
Shoes, leather	99–37	99–35	19–35
Gloves, leather	99–37	99–14	. . . .
Belting, leather	27–37	. . . .	. . . .
TOTAL	99–37	99–35	. . . .
Rubber products			
Tires and tubes	14–37	14–35	21–35
Shoes, rubber	14–37	14–35	}21–35
Rubber goods, other	27–37	. . . .	
TOTAL	19–37	09–35	. . . .
Paper products			
Pulp	99–37	}99–35	{19–35
Paper	99–37		{19–35
Wall paper	29–37	. . . .	. . . .
Boxes, paper	. . . .	14–35	. . . .
TOTAL	99–37	99–35	. . . .
Printing and publishing			
TOTAL	99–37	14–35	19–35
Chemical products			
Chemicals, not elsewhere classified	99–37	99–35	}19–35
Gases, compressed	09–37	. . . .	
Rayon	14–37	. . . .	19–37
Cottonseed products	99–37	99–35	. . . .
Linseed products	23–37	. . . .	. . . .
Carbon black	14–37	. . . .	. . . .

For footnotes see p. 650.

TABLE D–1 (continued)

| Industry and Group | Census Years Covered by Index of Physical Output[a] | | |
	National Bureau of Economic Research	Day-Thomas[b]	National Research Project[c]
Chemical products (concluded)			
Soap	04–37	14–35	....
Wood-distillation products	99–37	....	....
Charcoal	21–37	....	....
Explosives	99–37	99–35	....
Fertilizers	99–37	99–35	19–35
Glue and gelatin	27–37	....	....
Paints and varnishes	99–37	99–35	19–35
Salt	99–37	14–35	....
Tanning and dye materials	99–37	....	....
TOTAL	99–37	99–35[f]	....
Petroleum and coal products			
Petroleum refining	99–37	99–35	19–35
Coke-oven products	99–37	99–35	19–35
Fuel briquettes	09–37	....	....
Gas, illuminating and heating	....	99–35[g]	19–35
TOTAL	99–37	f	....
Stone, clay and glass products			
Asbestos products	27–37	....	....
Roofing	29–37	....	....
Cement	99–37	99–35	19–35
Lime	04–37	14–31[d]	....
Wall plaster and board	27–37	....	....
Concrete products	25–37	....	....
Sand-lime brick	14–37	....	....
Clay products	99–37	99–35	19–35
Glass	25–37	99–35	19–35
TOTAL	25–37	[o]99–35	....
Forest products			
Lumber-mill products	99–37	99–35	19–35
Planing-mill products	25–37	....	19–35
Boxes, wooden, cigar	27–37	....	....
Cooperage	27–37	....	....
Caskets and coffins	27–37	....	....
Excelsior	25–37	....	....
Turpentine and rosin	99–37	99–35[h]	....
Furniture	....	....	19–35
TOTAL	99–37	99–35	....

For footnotes see p. 650.

TABLE D–1 (continued)

Industry and Group	Census Years Covered by Index of Physical Output[a]		
	National Bureau of Economic Research	Day-Thomas[b]	National Research Project[c]
Iron and steel products			
Blast-furnace products	99–37	99–35	19–35
Steel-mill products	99–37	99–35	19–35
Wire, not elsewhere made	09–37	. . . .	. . . .
Wrought pipe, not elsewhere made	25–37	. . . .	. . . .
Cast-iron pipe	14–37	. . . .	. . . .
Files	29–37	. . . .	. . . .
Firearms	21–37	. . . .	. . . .
Tin cans and tinware	27–37	. . . .	. . . .
TOTAL	99–37	99–35[k]	. . . .
Nonferrous-metal products			
Copper	99–37	⎫	
Lead	99–37	⎬ 14–35	19–35
Zinc	99–37	⎭	
Secondary metals, nonprecious	25–37	. . . .	19–35
Collapsible tubes	25–37	. . . .	. . . .
Nonferrous-metal products, not elsewhere classified	25–37	14–35	19–35
Clocks, watches and materials	27–37	. . . .	. . . .
Industries consuming nonferrous metals	. . . .	99–35[k]	. . . .
TOTAL	25–37	99–35	. . . .
Machinery			
Agricultural implements	21–37	14–23[i]	21–35
Phonographs	99–29	14–23[i]	. . . .
Radios	23–37	. . . .	. . . .
Refrigerators, mechanical	21–37	. . . .	. . . .
Scales and balances	27–37	. . . .	. . . .
Sewing machines	27–37	. . . .	. . . .
Typewriters	21–37	. . . .	. . . .
Washing and iron machines	27–37	. . . .	. . . .
Electrical machinery	. . . .	14–23[i]	21–31[j]
Textile machinery	. . . .	19–23[i]	. . . .
Machine tools	. . . .	19–23[i]	. . . .
Engines and waterwheels	. . . .	14–23[i]	. . . .
TOTAL	. . . .	. . . .	. . . .

For footnotes see p. 650.

TABLE D-1 (concluded)

Industry and Group	Census Years Covered by Index of Physical Output[a]		
	National Bureau of Economic Research	Day-Thomas[b]	National Research Project[c]
Transportation equipment			
Automobiles, incl. bodies and parts	99–37	99–35	19–35
Carriages, wagons and sleighs	99–37	99–35	. . . .
Cars, railroad, not elsewhere made	99–37	99–35	. . . .
Locomotives, not elsewhere made	99–37	14–35	. . . .
Ships and boats	99–37	99–35	. . . .
Motorcycles and bicycles	99–29	. . . .	. . . .
Carriages and sleds, children's	25–37	. . . .	. . . .
TOTAL	99–37	99–35	. . . .
Miscellaneous products			
Organs	99–35	. . . .	. . . .
Pianos	99–37	14–23[i]	. . . .
Buttons	14–37	. . . .	. . . .
Brooms	27–37	. . . .	. . . .
Pencils	29–37	. . . .	. . . .
Pens and points	29–37	. . . .	. . . .
Sporting goods, not elsewhere classified	29–37	. . . .	. . . .
TOTAL	. . . .	. . . .	. . . .

[a] Years are inclusive. In a few cases some years between the end years are not covered.

[b] The Bureau of the Census extended the Day-Thomas index through 1937, but published only the index for all manufacturing combined (*Census of Manufactures: 1937*, Part I, pp. 12, 17).

[c] The National Research Project is engaged in extending its index through 1937. (The index for rayon, 1937, has already been published.)

[d] Excluded 1919–31, in revision by Kolesnikoff.

[e] An index for 1933–37 was computed by the Bureau of the Census and included in the revised Day-Thomas index published by it (*loc. cit.*).

[f] Petroleum and coal products combined with chemical products.

[g] Excluded 1919–35, in revision by the Bureau of the Census.

[h] Included by Day-Thomas in the chemical products group.

[i] Considered "experimental" or "doubtful" by Day and Thomas. Not included in general index.

[j] "Electric lamps" only. Based on a special Bureau of Labor Statistics study.

[k] Output measured by the total volume of nonferrous metals consumed in the United States.

NOTES ON DIFFERENCES

Foods

Canned fish. From 1919 to 1929 the NBER index for canned and preserved fish rose only 18 percent, while the Day-Thomas index rose 47 percent. The latter index does not include data for cured fish, which dropped nearly 30 percent in the 10 years.

Canned fruits and vegetables. Our index for canned fruits and vegetables agrees closely with the Day-Thomas index, except for one decade, 1899–1909. For that period our index indicates a rise of 69 percent, much smaller than the increase of 122 percent shown by the Day-Thomas index. The divergence appears to be due to the adjustment made by us for an increase that occurred in the coverage of the sample of products of the industry; to the use, by Day and Thomas, of three simple aggregates (canned vegetables, canned fruits, and dried fruits) whereas we used data for individual fruits or vegetables, combining them by means of price coefficients; and to the employment by Day and Thomas of 1909 weights, as contrasted with our use of the average of weights for 1899–1909.

Ice cream. The National Research Project index for the ice cream industry covers the period 1919–36, but our index applies only to 1923–37. The two indexes agree closely for the overlapping period, since they are derived from substantially the same statistics. For 1919–23 the National Research Project index is based on a sample of reports from ice cream manufacturers collected by the Department of Agriculture. The sample for these years appears, however, to be subject to an upward bias of unknown magnitude,[4] and for this reason we begin our index with 1923, the first year covered by Census data.

Corn products. The Day-Thomas index for corn products indicates a rise of 133 percent from 1919 to 1929. The products covered by this index increased considerably in relative importance, if we may judge from their value in relation to the total

[4] U. S. Department of Agriculture, "Production and Consumption of Manufactured Dairy Products," by E. E. Vial, *Technical Bulletin No. 722* (April 1940) , p. 23.

value of products of the industry. No adjustment for this change in the coverage of the sample was made by Day and Thomas. Our index, on the other hand, is adjusted for the increase, and shows a more moderate rise of 44 percent.

The group total. Our indexes for the foods group compare as follows with the Day-Thomas index:

	Percentage Change				
	1899–1935	1899–1909	1909–1919	1919–1929	1929–1935
NBER index					
Adjusted	+205	+48	+45	+54	−8
Unadjusted	+129	+41	+40	+26	−8
Day-Thomas index	+123	+41	+34	+32	−10

The differences between the NBER unadjusted index and the Day-Thomas index are slight, although the number of industries covered by our index is greater than the number covered by the Day-Thomas index. It is therefore the adjustment for changes in coverage, made by us but not by Day and Thomas, that accounts for the difference between the final NBER index—the adjusted index—and the Day-Thomas index.

Tobacco Products

Other tobacco products. Our index declines more than do the indexes computed by Day and Thomas and by the National Research Project because we make an adjustment for changes in coverage beginning with 1925.

Textile Products

Silk and rayon goods. The NBER index shows a rise of 33 percent from 1929 to 1935, whereas the Day-Thomas index indicates a fall of 17 percent and the NRP index a rise of 8 percent. The Day-Thomas index does not cover rayon goods, which rose while silk goods fell. The NRP index includes both rayon and silk goods, but is based on production data described by the Bureau of the Census as incomparable between 1933 and 1935. We bridged the gap between these two years by using Census data on materials consumed, which appear to be more comparable than the Census data on output. Because of changes in the Census

classification of this industry, no great precision can be claimed for any index based on the Census data.

Knit goods. The Day-Thomas knit goods index differs widely from the NBER index:

	Percentage Change				
	1899–1935	1899–1909	1909–1919	1919–1929	1929–1935
NBER index	+482	+73	+67	+80	+11
Day-Thomas index	+182	+96	+15	+30	−4

There appear to be two main sources of difference: (1) Our index is based on data more detailed than those used by Day-Thomas (see the following note on hosiery). (2) The weights we used in combining the indexes for the four sub-branches are the value added by each for 1923–35 (the only years for which value added is available for sub-branches), and the value of products of each for other years; Day and Thomas used value of products for all years. See also the note below on knit underwear, another component branch of the industry.

Knit hosiery. The Day-Thomas index is based on a single series, representing the aggregate number of hose produced, but our index is based on several series of different types of hose, which we combined by using the respective prices of the various types. This factor explains the major part of the differences between the two indexes:

	Percentage Change				
	1899–1935	1899–1909	1909–1919	1919–1929	1929–1935
NBER index	+1,063	+116	+125	+125	+2
Day-Thomas index	+259	+110	+35	+31	−4

Knit underwear. The unadjusted index of knit underwear production—wherever made—fell from 140 in 1923 (1929: 100) to 80 in 1937, while the adjusted index—which relates to the "knit underwear industry"—fell from 103 in 1923 to 102 in 1937. The adjustment explains the discrepancy between our index and the corresponding National Research Project index.

Wool carpets and rugs. Our index of output for this industry takes into account the trend toward more expensive grades. If the index were based on output measured merely in terms of

square yards, as is the Day-Thomas index, the 1899–1937 rise in output would be less than the figure quoted by us. Indeed, according to the Day-Thomas index, output in 1914 was 12 percent higher than in 1935; according to our index, output in 1914 was 17 percent lower than in 1935.

Cordage and twine. Our index for cordage and twine fell 28 percent from 1929 to 1935, whereas the Day-Thomas index rose 8 percent during this period. The difference may be attributable to a revision made by Kolesnikoff, based on unpublished Census data, but no information on this point is available.

The group total. Our textile index compares as follows with the Day-Thomas index:

| | *Percentage Change* | | | | |
	1899–1935	1899–1909	1909–1919	1919–1929	1929–1935
NBER index					
Adjusted	+162	+60	+11	+49	−1
Unadjusted	+133	+47	+17	+34	+1
Day-Thomas index	+88	+51	+9	+30	−12

The differences are substantial, especially in the last two periods. The Day-Thomas index includes the output of cotton goods, knit goods, silk manufactures, woolen and worsted goods, wool carpets and rugs, and cordage and twine. The principal omissions from the Day-Thomas index are rayon manufactures and clothing, both included in the NBER index.

Leather Products

Leather. The National Bureau index for the leather industry differs somewhat from the Day-Thomas index:

| | *Percentage Change* | | | | |
	1899–1935	1899–1909	1909–1919	1919–1929	1929–1935
NBER index	+49	+28	+17	−4	+4
Day-Thomas index	+12	+12	+11	−16	+7

The index we have computed is based on detailed data, whereas the Day-Thomas index differentiates only four classes of leather.

The group total. Despite the rather considerable differences between our index of leather output and the Day-Thomas index

our unadjusted index of output for the entire leather products
group differs only slightly from the Day-Thomas index:

	Percentage Change				
	1899–	1899–	1909–	1919–	1929–
	1935	1909	1919	1929	1935
NBER index					
Adjusted	+56	+29	+9	+11	0
Unadjusted	+61	+29	+15	+6	+3
Day-Thomas index	+53	+27	+14	+3	+3

The substantial differences between the two leather indexes are
counterbalanced by relatively slight differences of opposite sign
between the two shoe indexes. (The shoe indexes are, of course,
weighted much more heavily than the leather indexes.) Our ad-
justed index differs somewhat from the Day-Thomas index, al-
though the 1899–1935 net changes are very close to one another.

Rubber Products

Tires and tubes. The NRP index is based on the aggregate
weight of the rubber, textiles and chemicals consumed in the
production of tires and tubes. Our index is based on the number
of tires and tubes produced. Because the average physical weight
per tire was increasing in the period 1921–29, the NRP index
rose in relation to our index:

	Percentage Change	
	1921–	1929–
	1929	1935
NBER index	+156	−28
NRP ·	+212	−19

Rubber shoes. The aggregate production of rubber shoes—
wherever made—fluctuated in relation to the output of the rub-
ber shoes industry. The adjustment made by us for this fluctu-
ation explains in part the difference between our index for the
industry and the Day-Thomas index:

	Percentage Change		
	1914–	1919–	1929–
	1919	1929	1935
NBER index	+68	−13	−17
Day-Thomas index	+32	+8	−26

The Day-Thomas index, moreover, treats rubber heels as a product of this industry, while we class this item as a product of the industry called "other rubber goods."

The group total. Our index agrees fairly well with the Day-Thomas index:

	Percentage Change		
	1909–1919	1919–1929	1929–1935
NBER index	...	+86	−21
Day-Thomas index	+376	+80	−25

The 1909–19 figure in the Day-Thomas index relates presumably to rubber imports. No statement concerning the underlying data could be found in the Day-Thomas publications.

Paper Products

Paper boxes. Day and Thomas constructed an index of output of the paper box industry by using the output of paper boards in the paper industry.

The group total. Our unadjusted index for the paper products group differs appreciably from the Day-Thomas index only for the 1919–29 period. Our adjusted index differs for this period and also for the period 1899–1909:

	Percentage Change				
	1899–1935	1899–1909	1909–1919	1919–1929	1929–1935
NBER index					
Adjusted	+457	+100	+44	+89	+2
Unadjusted	+403	+88	+44	+90	−2
Day-Thomas index	+356	+91	+43	+69	−1

Chemical Products

Chemicals, not elsewhere classified. There are some differences between the NBER index for chemicals, n.e.c., and the Day-Thomas index:

	Percentage Change				
	1899–1935	1899–1909	1909–1919	1919–1929	1929–1935
NBER index	+524	+78	+61	+108	+5
Day-Thomas index	+613	+100	+110	+105	−17

The Day-Thomas index covers 10 chemicals and acids, while our index covers as many as 15 products in 1899, 35 in 1929 and 32 in 1937.

Soap. The Day-Thomas index is based on the output of hard soaps only. For this reason it shows a drop from 1929 to 1935 (−14 percent), whereas our index, which covers the output of all types of soap, remains unchanged.

The group total. See petroleum and coal products.

Petroleum and Coal Products

Coke-oven products. The Day-Thomas index is based on the output of coke alone. The NBER index is based on the output of coke plus by-products. Since the latter were increasing in relation to the former, our index indicates a greater rate of growth than does the Day-Thomas index:

	Percentage Change				
	1899–1935	1899–1909	1909–1919	1919–1929	1929–1935
NBER index	+219	+110	+60	+63	−42
Day-Thomas index	+72	+97	+11	+35	−42

Illuminating and heating gas. This industry is considered here as a nonmanufacturing industry, because it was excluded from the 1937 Census of Manufactures.

The group total. The index for the petroleum and coal products group must be combined with the index for chemical products if it is to be compared with the Day-Thomas index. The comparison follows:

	Percentage Change				
	1899–1935	1899–1909	1909–1919	1919–1929	1929–1935
NBER index					
Adjusted	+545	+72	+80	+112	−2
Unadjusted	+683	+84	+99	+112	0
Day-Thomas Index	+395	+95	+70	+87	−20

The Day-Thomas index advanced more rapidly than the NBER index in the first decade only. In the three later periods it advanced less rapidly, or fell more rapidly. The Day-Thomas index covers illuminating and heating gas, which we exclude.

Stone, Clay and Glass Products

Cement. The Day-Thomas index shows a rise of 320 percent in cement output between 1899 and 1909, whereas our index indicates an increase of 497 percent. The Day-Thomas index is based on the total output of all types of cement, aggregated without allowance for the relatively greater price of Portland cement. As a result the rate of growth shown by the Day-Thomas index is slower than the rate shown by a weighted index like ours.

Glass. The Day-Thomas index of glass production begins in 1899. It represents plate and window glass for the years 1899–1935, and in addition two series on bottles and jars, and pressed and blown glass for 1899–1914. In our opinion the output of the entire glass industry could not be measured adequately by these series: for 1914–25, because of inadequate coverage; and for 1899–1914, because the bottles and jars and pressed and blown glass series are excessively heterogeneous. Quantities of the individual bottles, jars, etc. are known, but values are not; therefore we concluded that no properly weighted indexes of the output of these glass products could be constructed.

The National Research Project index begins in 1919. For 1919–25 it is based on the Census data for window glass and plate glass; on Bureau of Labor Statistics data for glass containers (unweighted aggregates of different types); on Census data for 5 series of pressed and blown ware—equal in value to one third of the total value of pressed and blown ware and available for 1919 and 1925 only. Beginning with 1925 the National Research Project index is based on Census data of about the same detail as the data utilized by us.

The group total. The Day-Thomas index for the group begins in 1899. It is based on the output of cement, clay products and glass. Concerning the index for glass see above. The Day-Thomas index agrees closely with ours for the years 1929 to 1935.

Forest Products

Lumber-mill products. The Day-Thomas index for lumber shows a fairly sharp peak in 1909. The rise from 1899 to 1909 was 29 percent, and the fall from 1909 to 1919, 27 percent. In

other respects the index agrees well with the index worked out in the present study. The differences stem from the fact that the Day-Thomas index relates to the *product,* lumber, while our index relates to the *industry,* lumber-mill products. It seems that between 1899 and 1909 there was a considerable shift of processing operations from the lumber-mill products industry to the planing-mill products industry, followed by a shift in the other direction from 1909 to 1919.

Planing-mill products. For 1919–25 the National Research Project index for planing-mill products is based on the value of the industry's products deflated by an index of dressed lumber prices. We did not compute an index for this period.

Furniture. The National Research Project index for furniture is based on the value of the industry's products deflated by the Bureau of Labor Statistics prices of furniture.

Turpentine and rosin. The NBER index is adjusted for changes in the degree to which the products, turpentine and rosin, are made within the industry, "turpentine and rosin." This fact explains the differences between it and the Day-Thomas index.

The group total. The National Bureau indexes for the forest products group differ in several respects from the Day-Thomas index:

	Percentage Change				
	1899–1935	1899–1909	1909–1919	1919–1929	1929–1935
NBER index					
Adjusted	−28	+1	−5	+27	−41
Unadjusted	−49	−3	−8	+4	−45
Day-Thomas index	−46	+29	−27	+8	−47

The difference between the NBER unadjusted index and the Day-Thomas index is large in the first two decades. On this divergence see lumber-mill products above. The adjusted index differs also in the third decade, for the reason cited in footnote 4, Chapter 17, above.

Iron and Steel Products

The group total. Our indexes for iron and steel products rose more rapidly than the Day-Thomas index:

	Percentage Change				
	1899– 1935	1899– 1909	1909– 1919	1919– 1929	1929– 1935
NBER index					
Adjusted	+193	+110	+34	+70	−39
Unadjusted	+160	+83	+40	+57	−35
Day-Thomas index	+113	+74	+33	+58	−42

Nonferrous-Metal Products

Secondary metals. The NRP index for secondary metals for 1919–25 was obtained by deflation of the value of the industry's products by an index of the prices of secondary metals. The index shows a rise of 72 percent from 1919 to 1925.

Nonferrous-metal products, not elsewhere classified. An index of output of this industry was computed by Day and Thomas for the period beginning in 1914. This index was based on the total weight of semifinished products. Examination of the underlying Census data reveals broad changes in the Census definition of semifinished products, and these changes destroy the continuity of the series. Thus the 1919, 1921 and 1923 output of semifinished products includes castings and machinery fittings; the 1914 output excludes castings and machinery fittings; and the 1925 output excludes finished castings. Because of these shifts we did not compute an index for the period 1914–15.[5]

The NRP index for nonferrous-metal products, not elsewhere classified, begins in 1919. The index for 1919–25 is based on fragmentary Census data subjected to rather elaborate adjustments and processes of estimate. It is difficult to judge the reliability of the index for this period. The rise between 1919 and 1925 shown by the NRP index is 70 percent.

The group total. The Day-Thomas index of output of nonferrous-metal products begins in 1899. It is based for 1899–1914 on the consumption of copper, zinc, lead, silver, and gold; and for 1914–35, on the consumption of these five nonferrous metals, on the production of the five metals (primary output), and on the output of nonferrous-metal products, not elsewhere

[5] During the examination of the Day-Thomas indexes it was found that the indexes for 1921 and 1923 were based on unrevised data. Revisions published in the 1925 Census report would reduce the 1921 Day-Thomas index by about 2 percent, and the 1923 index by about 11 percent.

classified. With respect to the output of the last-named industry, see above. The change in the Day-Thomas index for 1929–35 agrees closely with the trend shown by our index.

Machinery

The several "experimental" indexes computed by Day and Thomas for electrical machinery, textile machinery, machine tools, and engines and waterwheels are based on Census data. These data are inadequate on two counts: first, they are insufficiently subclassified, and therefore appear in heterogeneous classes; second, the products for which there are quantity data constitute small fractions of the total production of the respective industries, measured in terms of value. These criticisms cannot be leveled, at least in the same degree, against the data for agricultural implements, and phonographs. For this reason, we present indexes for these two industries, although corresponding indexes by Day and Thomas are also labeled "experimental."

Transportation Equipment

The group total. Because of the diversity of trends within the group, our group index disagrees with the Day-Thomas index:

	Percentage Change				
	1899–1935	1899–1909	1909–1919	1919–1929	1929–1935
NBER index					
Adjusted	+886	+47	+468	+64	−28
Unadjusted	+932	+48	+504	+62	−29
Day-Thomas index	+958	+190	+696	−4	−52

The difference in 1899–1909 arises mainly from the greater weight assigned to automobiles in the Day-Thomas index. Day and Thomas employed the 1909 value added as the weight, whereas we used what amounts to the average of value added for 1899 and 1909. The differences between the group indexes in the next two decades arise presumably from differences between the indexes for ships and boats: our index is adjusted to cover repair work. The divergence in the last period reflects the use of 1919 value added as a component in the weights used in the Day-Thomas index. As a result the declining industries are weighted more in the latter index, and the rising industries less, than we weight them.