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A. THE UNITED STATES

Commodity Output, 1839–1899

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BETWEEN 1839 and 1899 the U.S. economy expanded at an extraordinarily high rate and, in the process, changed from a predominantly agricultural to a predominantly industrial economy. The series prepared for this paper were designed to measure an important part of this expansion—the growth of commodity output—and some features of the structural changes accompanying industrialization. The principal importance of the present series is that they extend twenty years into the pre-Civil War period. Most of the work on nineteenth century national income has been directed toward the postwar period. We have not known how well the findings for this period describe nineteenth century growth. For example, the very high rates of advance of the seventies and eighties may reflect merely a postwar surge, it has been held, not the basic character of long-term development.[1] The present series cover a sufficiently long stretch of nineteenth century history and a sufficiently large share of national product (between 60 and 70 per cent, in the postwar period) to permit some generalizations to be drawn about the speed and pattern of long-term growth.

Commodity output is taken as the sum of value added by agriculture, mining, manufacturing, and construction. Value added is defined as the value of output, at producers' prices, less the value of materials and fuels directly consumed in production, at delivered prices.[2] The

[1] See, for example, Moses Abramovitz, "Resource and Output Trends in the United States since 1870," *Papers and Proceedings of the American Economic Association*, May 1956, p. 15.

[2] The estimates fail to account for value added by fishing, forestry, precious metals mining, nonfarm home manufacturing, and the independent hand trades (see the first four sections of the Appendix), although they include most of the value of materials consumed in production by these activities and the value added to their product by agriculture, mining, manufacturing, and construction. No doubt these activities were more important, relatively, at the beginning than at the end of the period, and the present estimates overstate the rapidity of growth of total commodity output (see the sections below on sector shares and the output of capital goods).

Note: I would like to thank Simon Kuznets, Richard A. Easterlin, and Duncan McDougall for very helpful comments on earlier drafts of this paper. The revision of the paper for publication has benefited from criticisms given at Williamstown by Clark Warburton and Neal Potter. I, of course, take full responsibility for all that is found wanting in the present version.

concept has several advantages in the present context. It is relatively easy to apply empirically. It gives a commodity output total almost completely free of duplication (other than duplication over time). It organizes important information concerning industrial structure. It is more comprehensive than alternative measures, such as income originating and the value of finished commodity output.[3] This last would not constitute a virtue were adequate income or output estimates available for all other sectors for the full period. Since they are not, it is reasonable to choose the commodity output concept which includes the maximum of national product.

In addition to the sector value added series estimates were made of the value of output of manufactured producers' durables, the value of construction, and the value of improvements to farm land, which together measure the value of output of fixed reproducible capital. Further work may produce a fixed investment series. In any case, reasonable inferences as to the behavior of aggregate fixed investment can be drawn from the present series. The pre-Civil War record is particularly important, both because of the paucity of information on aggregate investment in this period and because there has been speculation that the investment rate changed significantly during these years.[4]

All of the estimates are given in current and constant prices. Division of the former by the latter yields a record of price changes for commodity output, sector value added, and fixed capital output which differs, in the weighting schemes employed, from the price records previously available. The year 1879 was chosen as price base because it is near the middle of the period (which minimized the bias imparted to the con-

[3] For example, in 1919, value added by agriculture, mining, and manufacturing was between 45 and 55 per cent larger than net income originating in each sector. Value added by construction was about 25 per cent larger than net income originating in construction from 1919 to 1938. (These are rough estimates developed from data in Simon Kuznets, *National Income and Its Composition, 1919–1938*, 1941, pp. 358–359, and *National Product since 1869*, 1946, pp. 99–100, both published by the National Bureau of Economic Research; Frederick Strauss and Louis H. Bean, *Gross Farm Income and Indices of Farm Production and Prices in the United States, 1869–1937*, Dept. of Agriculture, Tech. Bull. 703, December 1940, p. 24; Israel Borenstein, *Capital and Output Trends in Mining Industries, 1870–1948*, NBER, Occasional Paper 45, 1954, pp. 26 and 66; Simon Kuznets and Dorothy Swaine Thomas, *Population Redistribution and Economic Growth, United States, 1870–1950, I, Methodological Considerations and Reference Tables*, American Philosophical Society, 1957, p. 694.) The sum of the present series on agriculture, mining, and manufacturing is consistently larger than Shaw's series on the value of finished commodity output and construction materials. (William Howard Shaw, *Value of Commodity Output since 1869*, NBER, 1947, pp. 62–65.) A detailed reconciliation of the present estimates for 1899 with Shaw's reveals that something over half the excess arises from differences between activities considered commodity producing. The remainder (about 6 per cent of value added by agriculture, mining, and manufacturing) is due largely to differences between the two concepts, value added and value of finished commodity output and construction materials.

[4] See, for example, W. W. Rostow, "The Take-Off into Self-Sustained Growth," *Economic Journal*, March 1956, pp. 30–31.

stant price series by use of a single-year base) and because the price record was more complete and the price structure less influenced by transitory phenomena than they were in years nearer the middle of the period.

The discussion is divided into three parts. The first deals with total commodity output, the second with the industrial structure of commodity output, and the third with the output of investment goods. The Appendix gives the methods by which the estimates were made and considers the quality of the various series. Two construction series, based on different estimating assumptions, are provided. Variant A was used to make up the commodity output series, while both variants A and B are employed in the analysis of industrial structure and the output of fixed capital.

The estimates refer to census years, beginning on June 1 and ending on May 31. The first year of the two sharing the census year is used to designate the census year.

Total Commodity Output

Between 1839 and 1899 total commodity output increased elevenfold, or at an average decade rate of slightly less than 50 per cent (Table 1).[5] Actual rates varied fairly widely, high rates appearing during the decades ending with 1854 and 1884, and a very low rate during the decade ending with 1869. Interestingly, the rate of advance in the seventies, traditionally known as a period of falling prices and stagnation, was high. Indeed, no consistent association is shown between changes in the price level and output (see Appendix Table A–1). There was apparently no long-term tendency toward acceleration or retardation of the rate of increase and this becomes especially clear when the data are plotted.

Since population increased less than half as fast as commodity output, output per capita by 1899 was about two and a half times that of 1839. There were wide variations in the rate of change of output per capita and a negative rate appeared during the Civil War decade. The variations had the same timing as the fluctuations in the rate of change of total commodity output. The data of Table 1 show a clear tendency toward acceleration of the rate of advance. The three highest decade rates were after the war, the lowest, before it. The postwar average rate was about half again as large as the prewar rate.

More meaningful is a comparison of the change in commodity output

[5] Calculated from terminal year values, the average is 48.5 per cent; calculated by least squares (fit to the logarithms of the values, the logarithm for 1864 being estimated by straight line interpolation), 48.7 per cent.

TABLE 1

Commodity Output, Population, and Gainful Workers in Commodity Production, Quinquennial, 1839–1859 and 1869–1899

Year or End of Decade	*Output*[a]	*Population*[b]	*Output per Capita*	*Gainful Workers*[c]	*Output per Worker*
			ABSOLUTE FIGURES		
	(mill.)	(thous.)		(thous.)	
1839	$1,094	17,120	$64	4,484	$244
1844	1,374	20,182	68		
1849	1,657	23,261	71	6,190	268
1854	2,317	27,386	85		
1859	2,686	31,513	85	8,140	330
1869[d]	3,271	39,905	82	9,695	337
1869[e]				9,635	339
1874	4,297	45,073	95		
1879	5,304	50,262	105	12,850	413
1884	7,300	56,658	129		
1889	8,659	63,056	137	16,570	523
1894	10,258	69,580	147		
1899	11,751	76,094	154	19,512	602
			DECENNIAL RATES OF CHANGE (per cent)		
1849	52	36	11	38	10
1854	69	36	24		
1859	62	36	20	32	23
1869	23	27	−4	19	2
1874					
1879	62	26	29	33	22
1884	70	26	35		
1889	63	25	30	29	27
1894	41	23	15		
1899	36	21	13	18	15
Averages:[f]					
1839–99	49	28	16	28	16
1839–59	57	36	16	35	16
1869–99	54	24	24	27	21

[a] Appendix Table A–1, total value added in 1879 prices, variant A.

[b] *Historical Statistics*, p. 26.

[c] Solomon Fabricant, "The Changing Industrial Distribution of Gainful Workers: Comments on Decennial Statistics, 1820–1940," in Volume Eleven (1949) of *Studies in Income and Wealth*, p. 42, adjusted to remove workers in independent hand trades and precious metals mining, whose product is not recorded by the commodity output series. The adjustments change Fabricant's total by about 2 per cent in 1859 and less in other years. Blacksmithing was the only hand trade important enough to warrant attention. It was assumed that the 1869 and 1879 manufacturing censuses had reasonably complete enumerations of blacksmiths working outside factories. The 1879 figure was extrapolated to 1889 and 1899 on the returns of blacksmiths and wheelwrights. The postwar estimates were carried to 1859 and 1849 on the returns of blacksmiths in the occupational censuses. The 1849 figure was extrapolated to 1839 on the number of gainful workers in manufacturing and mining. The mining estimates were adjusted by subtracting the mining census returns of workers in the gold and silver mining industries after 1879. For 1859, 1869, and 1879 the occupational returns of miners in California, Colorado, and Nevada were subtracted. No adjustments were made for the years before 1859.

[d] Comparable with earlier years.

[e] Comparable with later years.

[f] Geometric means calculated from terminal year values.

with the number of workers in commodity production.[6] The number of gainful workers in commodity production increased at about the same rate as population. Consequently, the relative expansion of output per worker was about that of output per member of the population. Since output per worker data are available only at ten-year intervals, we cannot say whether the fluctuations of the decade rate of change matched precisely those of commodity output and output per member of the population. However, the rate for the decade ending in 1869 was the lowest, as was true of the other series. There is evidence of a long-term increase of the rate of change; the highest decade rate appeared after the war, the lowest, before it. Prewar and postwar average rates of change were 16 and 21 per cent, respectively.

VARIATIONS IN RATES

Presumably the Civil War accounts for the small gains in commodity output and output per worker and the decline of output per capita between 1859 and 1869. The differences among the remaining decade rates may be the product of random factors. Agriculture, which receives a heavy weight throughout, is subject to substantial changes from year to year due to variations in weather.

Differences among the cyclical positions of the years in the series could produce variations in decade rates. One would expect cyclical movements to have more important effects on the series after the war than before it, since the sectors most affected by cycles are more heavily weighted in the postwar period. The business cycle chronology of Burns and Mitchell indicates that the cyclical positions of the various

[6] Still more meaningful would be a comparison between commodity output and labor input. But the data available to get labor input are not strong. Apparently the standard work week fell by about 5 per cent in agriculture and 12 or 15 per cent in manufacturing and construction—perhaps 10 per cent for commodity production as a whole (see *Wholesale Prices, Wages and Transportation*, Senate Committee on Finance, 52nd Cong., 2d sess., S. Rept. 1394, 1893, Part I, pp. 178 and 179 (hereafter cited as the Aldrich Report); *Historical Statistics of the United States, 1789–1945*, Bureau of the Census, 1949, p. 67 (hereafter cited as *Historical Statistics*); and J. Frederick Dewhurst and Associates, *America's Needs and Resources*, The Twentieth Century Fund, 1947, p. 695). If these estimates are correct, labor time available to the commodity sectors increased at a decade rate of about 26 per cent and output per labor hour, over 18 per cent, assuming no variations in the rate of unemployment. There is no real basis for correcting for unemployment. In view of the heavy weight of agriculture in the total, variations in unemployment (at least of the "unconcealed" variety) should not affect the calculations much. See Fabricant, cited in the notes to Table 1, for an evaluation of the gainful worker estimates. According to Fabricant, the estimates are weak. But they are not so weak as to invalidate the broad findings discussed in the text. See, also, P. K. Whelpton, "Occupational Groups in the United States, 1820–1920," *Journal of the American Statistical Association*, September 1926, and Daniel Carson, "Changes in the Industrial Composition of Manpower since the Civil War," in Volume Eleven (1949) of *Studies in Income and Wealth* (see the list of publications of the Conference on Research in Income and Wealth at the back of this volume). These are the basic sources of Fabricant's estimates.

years in the series do not account for the variations in rates.[7] But the chronology, of course, does not show the relative severity of the various cycles. There is evidence that the booms of the fifties were stronger and the slumps less severe than those of the forties and that the cycle may help to account for the prewar fluctuations.[8] For the postwar period, however, there is little evidence that cycles were responsible for the variations observed in the present series.[9]

Long swing peaks in several series (building, railroad construction, immigration) have been located in the mid-fifties and the mid- and late eighties.[10] Further, Burns has reported a long swing peak rate of change for total production from about 1875 through 1885 which suggests that the variations among decade rates may reflect long swings.[11]

These factors have unequal bearing on the four sectors of commodity production. Further consideration of them is deferred until the individual sector series are taken up.

COMPARISON WITH TWENTIETH CENTURY GROWTH

Of greater interest is the light these series shed on trends in the rate of economic growth in the United States and on the relative rapidity of American growth in the nineteenth century as compared with the experience of other countries. Table 2 contains the series of Table 1 carried forward to 1949. The principal points of interest which emerge from a comparison of the data of the two tables are as follows:

First, the rate of increase of commodity output over the first fifty years of the twentieth century was very far below the rate for the last sixty years of the nineteenth. Even if the thirties are left out of account, it seems clear that there was marked retardation of the rate of advance. Between 1899 and 1929 commodity output grew at an average decade rate of 41 per cent, 8 percentage points below the average for 1839–99,

[7] Arthur F. Burns and Wesley C. Mitchell, *Measuring Business Cycles*, NBER, 1946, p. 78.

[8] See L. P. Ayres, *Turning Points in Business Cycles*, Macmillan, 1939, pp. 6 and 14. The index used by Ayres probably eliminates the effects of long swings more successfully than other available indexes. See pp. 204–205.

[9] *ibid.*, pp. 22 and 31.

[10] Clarence D. Long, Jr., *Building Cycles and the Theory of Investment*, Princeton University Press, 1940, pp. 135–136; Walter Isard, "Transportation Development and Building Cycles," *Quarterly Journal of Economics*, November 1942, p. 100; Brinley Thomas, *Migration and Economic Growth: A Study of Great Britain and the Atlantic Economy*, Cambridge University Press, 1954, p. 92; Simon Kuznets and Ernest Rubin, *Immigration and the Foreign Born*, NBER, Occasional Paper 46, 1954, pp. 22–23. The railroad construction peaks of the 1880's are in 1882 and 1887. Between them lies a pronounced trough. Douglass North's paper, in this volume, lists long swing peaks in the mid-1850's for foreign capital flows, incorporations and public land sales.

[11] Arthur F. Burns, *Production Trends in the United States since 1870*, NBER, 1934, pp. 180–181; but see also pp. 37–42 and 248–249.

TABLE 2

Commodity Output, Population, and Gainful Workers in Commodity Production, Decennial, 1899–1949

Year or End of Decade	*Output*[a]	*Population*[b]	*Output per Capita*	*Gainful*[c] *Workers*	*Output per Worker*
		ABSOLUTE FIGURES			
	(mill.)	(thous.)		(thous.)	
1899	$11,751	76,094	$154	19,512	$602
1909	17,190	92,407	186	22,970	748
1919	21,449	106,466	201	24,990	858
1929[d]	32,964	123,077	268	25,650	1,285
1929[e]				25,140	1,311
1939	33,487	131,970	254	24,660	1,358
1949	51,217	151,677	338	26,465	1,935
		DECENNIAL RATES OF CHANGE (per cent)			
1909	46	21	21	18	24
1919	25	15	8	9	15
1929	54	16	33	3	50
1939	2	7	−5	−2	4
1949	53	15	33	7	42
Averages:[f]					
1899–1949	34	15	17	6	26
1899–1929	41	17	20	10	28
1929–1949	25	11	13	3	22

[a] The sector series of Table A–1, in 1879 prices, were carried forward to 1949 separately and the estimates for the four sectors were summed for each year. The extrapolating series for agriculture, mining, and manufacturing were taken from Harold Barger, *Distribution's Place in the American Economy since 1869*, NBER, 1955, p. 22. Barger's agricultural series is made up of three year averages for 1939 and 1949 and five year averages for earlier years. The averages are centered on the year following the one indicated. They are very slightly different from the annual figures for the years indicated. See Harold Barger and Sam H. Schurr, *The Mining Industries, 1899–1939: A Study of Output, Employment and Productivity*, NBER, 1944, p. 14. Barger combined his indexes and found that the rate of growth of the combined indexes was insensitive to changes in the base. The construction series (variant A) was carried forward on estimates of gross construction (1929 prices) taken from Simon Kuznets, *Supplement to the Summary Volume on Capital Formation and Financing*, NBER, mimeographed, kindly supplied by Professor Kuznets.

[b] 1899–1939, *Historical Statistics*, p. 26; 1949, U.S. Bureau of the Census, *Continuation to 1952 of Historical Statistics of the United States, 1789–1945*, 1954, series B–31, p. 2.

[c] 1899–1939, Fabricant, *op. cit.*, p. 42; 1949, the sum of the sector figures for 1939 carried forward on figures in Barger, *Distribution's Place . . . , op. cit.*, p. 4.

[d] Comparable with earlier years.

[e] Comparable with later years.

[f] Geometric means calculated from terminal year values.

16 below the 1839–59 rate, and 13 below the 1869–99 rate. Five of nine nineteenth century decade rates were above the highest rate for the twentieth century.

Second, the average rate of change of commodity output per capita was about the same in the twentieth as in the nineteenth century. If the period is divided into four roughly equal segments, the pattern revealed is of a marked increase in the rate from the pre-Civil War to the post-Civil War years (as noted above), a decline in the first thirty years of the twentieth century, and a further decline in the following twenty years. But these findings may be misleading, suggesting as they do a twentieth century retardation. The depression of the thirties had a pronounced effect on the rate of advance of the last twenty years of the period. The average rate over the last three decades (1919–49) was 20 per cent, higher than the pre-Civil War rate and not far below the post-Civil War nineteenth century rate. Furthermore, the rates of 2 out of 5 of the twentieth century decades were very close to the highest rates achieved in the nineteenth century, and substantially higher than all of the pre-Civil War rates. It does not appear that a finding of retardation is inescapable.

Third, the twentieth century average decade rate of increase of gainful workers in commodity production was only about 6 per cent—slightly more than $\frac{1}{5}$ as large as that of the nineteenth. The twentieth century increases in commodity output were largely productivity increases. Output per worker advanced at a decade rate of 26 per cent—10 points higher than in the nineteenth century. Even the rate over the last two decades, including the depression and the war, was very large, exceeding both the pre- and post-Civil War rates of the nineteenth century.[12]

Productivity advance in commodity production was sufficiently high to maintain a high rate of growth of commodity output per member of the population, despite the fact that a sharply declining share of the population was engaged in commodity production. This, of course, had implications for the rate of increase of non-commodity production and national product. We turn, then, to a consideration of trends in national product between 1839 and 1949.

COMMODITY OUTPUT AND GROSS NATIONAL PRODUCT

While there are no acceptable estimates of national product for the period before 1869 the present estimates account for a large share of

[12] Compare these findings with the results of Kendrick's study of productivity change since 1899 (John W. Kendrick, "Productivity Trends: Capital and Labor," *Review of Economics and Statistics*, August 1956, p. 253). One should bear in mind that the estimates used here are gainful worker estimates. As noted above, a more appropriate comparison would be in terms of labor input. The significance of productivity advance and the contrast with the nineteenth century experience would be even greater if this were done.

national product and can be used, with other data, to infer its probable magnitude. We deal with gross national product since the commodity output series is gross of depreciation.

Between 1839 and 1899 the proportion of gainful workers in the commodity producing sectors declined; after 1869 the share of these sectors in real national product also declined, but at a much slower pace.[13] That is, worker productivity apparently increased more rapidly in the commodity than in the non-commodity sectors. Assuming that this was also true before the war, limits can be set on the magnitude of real GNP in 1839. Multiplying commodity output in 1839 by the ratio of GNP to commodity output in 1869 sets an upper limit. (This assumes that improvements in labor productivity of the commodity sectors were sufficient to offset the decline in the commodity sectors' share in gainful workers.) Allowing output per worker in non-commodity production to advance as fast as output per worker in commodity production sets a lower one.[14] The limits to the average decade rate of change of real GNP between 1839 and 1899 (calculated from terminal year values) are, then, roughly 50 and 55 per cent. This means that real GNP per capita grew at a rate of between 17 and 21 per cent per decade.

The lower limits to the rates of change are the more reasonable, judging by experience after 1869. Real GNP apparently increased only slightly faster than commodity output. In broad terms, the comparisons between nineteenth and twentieth century growth of GNP and GNP per head yield the same findings as the commodity output comparisons. It is quite clear that GNP grew at a slower pace in the twentieth century than in the nineteenth and that retardation was under way before the

[13] Simon Kuznets, "Long-Term Changes in the National Income of the United States of America since 1870," in *Income and Wealth of the United States, Trends and Structure*, International Association for Research in Income and Wealth, Income and Wealth Series II, The Johns Hopkins Press, 1952, pp. 102, 104, and 110.

[14] The roughness of the estimate should be stressed. The difference between gross national product (in prices of 1879) and value added by the commodity producing sectors in 1869 was attributed to workers in non-commodity production. (The part of GNP attributed to non-commodity production is really less than value added by non-commodity production, since value added by commodity production includes part of value added by non-commodity production.) The ratio of "product" per worker in non-commodity production to value added per worker in commodity production was then calculated and applied to value added per worker in commodity production in 1839. The result was multiplied by the number of workers in non-commodity production in 1839. This result was, in turn, added to value added by commodity production to give GNP in 1839. The gross national product estimates for 1869 and 1899 were kindly supplied by Simon Kuznets ("Supplement to the Summary Volume on Capital Formation and Financing," (NBER, mimeographed)). Here the price index base was shifted (without reweighting) to 1879. The Kuznets estimates are based, in part, on Shaw's commodity output series. The Shaw series omits certain types of commodity output included in the present series. Accordingly, the Kuznets estimates were adjusted upward to make them more nearly comparable with the present series. The 1869 estimate (in 1879 prices) was raised by about 12 per cent; the 1899 estimate, by about 2 per cent. The gainful worker data are described in the notes to Table 1.

thirties.[15] Others have suggested this possibility. The long sweep of the present series allows one to accept it with greater assurance.

Whether the rate before the Civil War was greater than that of the three decades after it is by no means certain. But, as noted above, the best guess is that GNP grew at a rate not much higher than commodity output and that, therefore, the prewar and postwar GNP rates were close together. If this is correct, there must have been some acceleration of the rate of growth of GNP per head. Indirect evidence tends to support this view. This was a period of rapid industrialization and acceleration has been a feature of industrialization. Indeed, it is a little surprising that acceleration does not appear more clearly in the series. More precisely, it is surprising that the rates for the prewar decades were so high. The records of other countries suggest that rapid increase in product per head follows the early stages of industrialization. The late forties have been viewed as the beginning of U.S. industrialization.[16] Yet in this early stage, rates of change of output per head were high—probably as high, for example, as the British rates of increase over the last four decades of the nineteenth century.[17] It does not seem reasonable to suppose that these rates were typical of experience before 1839. If commodity output per head is extrapolated backward on this assumption, the estimate for 1799 is only 60 per cent of output per capita in 1839. This level is not inconceivable, but it is highly unlikely that output per head increased by $\frac{2}{3}$ between 1799 and 1839.[18] One is inclined to believe that acceleration began with the forties or slightly before—with the early stages of industrialization or slightly before. While this may be surprising, in that it represents a departure from the pattern of development in other countries, it is not implausible, since conditions of industrialization in the United States differed so markedly from those of other countries for which we have records (England, for example). The finding underlines the need for estimates prior to 1839.

Turning back to the broader picture, it seems clear that GNP per head grew at least as rapidly in the twentieth century (21 per cent per decade) as in the nineteenth. There is some suggestion of retardation in the twentieth century, but not enough to be conclusive.[19]

[15] Between 1899 and 1954 the rate ran around 36 per cent; between 1894 and 1928, about 39 per cent (Simon Kuznets, "Quantitative Aspects of the Economic Growth of Nations, I, Levels and Variability of Rates of Growth," *Economic Development and Cultural Change*, October 1956, p. 40). The rates were calculated in a somewhat different way from that employed with the commodity output series, but not sufficiently different to affect the findings described in the text.

[16] *ibid.*, pp. 25 and 36 and Rostow, *op. cit.*, p. 31.

[17] Kuznets, "Quantitative Aspects," p. 54.

[18] See the paper by William Parker and Franklee Gilbert in this volume.

[19] Kuznets, "Quantitative Aspects," pp. 40 and 42–43.

INTERNATIONAL COMPARISONS

How does U.S. experience in the last sixty years of the nineteenth century compare with the experience of other countries? Simon Kuznets has brought together the long-term records of eighteen countries.[20] Only three (Union of South Africa, Canada, Japan) exhibit rates of increase of real national product (46–50 per cent), over periods of forty to sixty years, which are close to the probable U.S. rate. If the pre- and post-Civil War periods are considered separately, U.S. performance becomes even more impressive. Commodity output grew at rates close to 55 per cent in each of these periods, and GNP probably increased faster. None of the countries for which Kuznets has records displayed rates so high over periods of similar duration.

The U.S. rate of increase of GNP per head was not uniquely high. As noted previously, it probably fell within the range 17–21 per cent per decade. Four of the eighteen countries had rates above this range for periods of at least four decades. In 7 cases rates within the range were achieved. If the true U.S. rate fell toward the lower limit of the range, as seems likely, there were 7 cases of sustained rates much larger (21–29 per cent) and 5 of rates reasonably close (14–19 per cent).

While the U.S. per head rate was not uniquely high, the present level of product per head is. U.S. product per capita must have been high from the beginning. For example, if commodity output ran 80 per cent of GNP in 1839 (and it may have been less), real GNP per head was slightly less than $\frac{1}{5}$ of recent levels. This is probably larger than the ratio of per capita world income to U.S. income in recent years (perhaps $\frac{1}{6}$), very much larger than the ratio of African and Asian (perhaps $\frac{1}{30}$) and roughly the same as that of Soviet to U.S. income per head.[21] Granting the hazards involved in such comparisons, it seems clear that the United States began industrialization in an income position far superior to that of today's underdeveloped nations.

Sector Shares in Commodity Output

We return to commodity production and take up the individual sector series. We are concerned, principally, with the changes in the sector composition of real value added by commodity production and the forces making for these changes. Additionally, we are interested in the bearing of changes in the sector composition of the labor force on

[20] *ibid.*, pp. 10, 13, and 38–40. The countries are France (from 1841), United Kingdom, Ireland and Eire, Germany, Sweden, Italy (from the 1860's), Denmark, Russia and U.S.S.R., Canada, Japan (from the 1870's), Switzerland, Netherlands, Norway, Spain, Hungary, Australia, New Zealand (twentieth century). The rates of advance were calculated from NNP, for some countries, and GNP, for others. Apparently differences between rates calculated from net and gross national product are not large (p. 11).

[21] *ibid.*, pp. 10 and 13.

the rate of change of real value added per worker, including the acceleration of that rate of change. A question raised initially in the preceding section is further considered: How can the variations of the rate of change of commodity output be explained? We begin with this question, concentrating on the fluctuations of sector rates but noting also longer-term tendencies.

VARIATIONS OF RATES

The variations of sector rates of change over time were fairly wide (Table 3). While the discontinuity of the series renders analysis difficult, the following observations seem warranted:

First, there is some evidence that the long-term path of rates was downward. Average rates before the war were higher than those after. But this tendency was by no means pronounced for agriculture and mining and might not even appear in annual series. In any case, the long-term tendencies of the sector series are different from that of total commodity output. The roughly stable rate of the commodity output series must be a product of shifts in weights among sectors.

TABLE 3

Decennial Rates of Change of Value Added in 1879 Prices, by Sector, Quinquennial, 1839–1859 and 1869–1899

End of Decade	*Agriculture*	*Mining*	*Manufacturing*	*Construction*	
				Variant A	*Variant B*
1849	26	138	152	48	64
1854	39	86	133	137	143
1859	51	88	76	85	94
1869	15	114	26	33	46
1874					
1879	51	118	82	46	46
1884	52	117	90	64	80
1889	25	126	112	56	74
1894	9	71	71	30	50
1899	21	59	51	11	19
Averages:[a]					
1839–99	31	106	79	45	55
1839–59	38	112	113	66	78
1869–99	32	99	80	36	45

[a] Geometric means calculated from terminal year values.

Source: Calculated from data underlying Appendix Table A–1.

Second, the fluctuations of the rate of change of total commodity output did not reflect movements uniform for all sectors. For example, the very low rate of the sixties was accounted for by low rates for the

two major sectors, agriculture and manufacturing. The mining rate was high, while the construction rate was neither high nor low.

Third, the fluctuations of the rates of the construction series are reasonably consistent with the movements of annual series on building and railroad construction. As noted above, construction long-swing peaks have been located in the mid-fifties and the mid- and late eighties, which may help to explain the high rates of change of the present series over the decades ending with 1854, 1884, and 1889.

Fourth, the postwar movements of the remaining series are roughly consistent with Burns's findings concerning long swings: manufacturing and mining rates were high in the seventies and, especially, the eighties, and fell off thereafter; agricultural rates were high in the seventies and early eighties, fell off sharply thereafter, and rose somewhat at the end of the century.[22] Burns's peak rates for the nonconstruction industrial series are concentrated in decades ending around 1885, while the peak rates for the present series are over the decade ending with 1889. But this is an unimportant difference, especially since the rates of the present series for the decades ending with 1884 and 1889 are close. It may reflect the effects of the business cycle[23] or random variations on the present series or the fact that Burns dealt with output rather than value added.

Fifth, since no reliable annual series on agriculture, mining, or manufacturing for the prewar period exist, the significance of the variations in rates of change cannot be easily appraised. However, it is worth noting that mining and manufacturing were very small sectors in 1839 and the high rates of change of the forties represented small absolute increases. There does not appear to be any association between the prewar movements of these series and recorded business cycles. The fluctuations of the agricultural rate may have been due to differences in weather conditions among the years from which calculations were made. However, it seems significant that the highest rate of change was recorded over a decade during which an exceptionally large amount of new land was improved for agricultural use. The same thing was true of the postwar period. During the decade ending with 1879 a relatively large amount of land was improved and the rate of increase of real value added was especially high.[24] Since the postwar movement

[22] Burns, *op. cit.*, pp. 205 and 216–221.

[23] See Burns and Mitchell, *op. cit.*, p. 78.

[24] Land improved during each decade as a ratio of the amount of improved farm land in existence at the beginning of the decade: decade ending 1849—0.33; 1859—0.44; 1869—0.16; 1879—0.50; 1889—0.26; and 1899—0.16. The ratios were calculated from the quantities of improved land in existence at census dates. The data for the years 1849 through 1899 were taken from the census. The figure for 1839 was derived from Ezra Seaman, *Essays on the Progress of Nations*, Charles Scribner, 1852, p. 452. Since the Seaman estimate is not as firmly based as one could wish, the ratio for the decade ending with 1849 may be wrong. But there is other evidence that the rate of increase of the stock

evidently reflected a long swing, it is possible that the prewar movement also reflected one.

LONG-TERM TRENDS

The four sectors grew at widely divergent long-term rates. Agricultural real value added increased at an average decade rate of about 31 per cent; mining, 106 per cent; manufacturing, 79 per cent; construction, 45 or 55 per cent, depending on the variant chosen. While the two construction series yield rates fairly far apart the relative position of construction is clear. The sector grew considerably faster than agriculture, but much less rapidly than mining and manufacturing.

The differences among sector rates of change may be viewed as shifts in the shares of sectors in commodity output (Table 4). In 1839

TABLE 4

Sector Shares in Commodity Output, Quinquennial, 1839–1859 and 1869–1899 (per cent)

Year	*Agriculture*	*Mining*	*Manufacturing*	*Construction*	
				Variant A	*Variant B*
1839	72	1	17	10	8
1844	69	1	21	9	8
1849	60	1	30	10	9
1854	57	1	29	13	11
1859	56	1	32	11	10
1869	53	2	33	12	12
1874	46	2	39	12	12
1879	49	3	37	11	11
1884	41	3	44	12	13
1889	37	4	48	11	12
1894	32	4	53	11	13
1899	33	5	53	9	10

Source: Calculated from data (in 1879 prices) underlying Table A–1. The shares of agriculture, mining, and manufacturing were calculated from the variant A total.

agriculture accounted for about 72 per cent of commodity output and in 1899, about 33 per cent. Over the same period the mining and manufacturing share increased from about 18 per cent to about 58 per cent, while the construction share remained almost constant at around 10 per cent. These changes are common to developing nations. They reflect the operation and interaction of a wide range of forces. While there is not room here for intensive analysis, the data available can be used to throw some light on a few of these forces and their interactions.

of improved land was higher during the fifties than during the forties. For example, between calendar 1839 and calendar 1849 less than 18 million acres of public land were sold, while between 1849 and 1859 over 50 million acres were sold (*Historical Statistics*, p. 120).

We consider first the changing division of commodity output between agriculture and non-agriculture. This shift reflects, in part, differing income elasticities of demand for agricultural and nonagricultural products. As income per capita rises, per capita consumption of agricultural products tends, after a time, to rise relatively little. Thus the share of income devoted to agricultural products is reduced, while that devoted to nonagricultural products is increased. In the absence of broad international outlets for farm products, the share of agriculture in output tends to decline. Factors of production are shifted to other sectors to meet the requirements of the changing pattern of demand. That the low income elasticity of demand for agricultural products was important in the present instance is suggested by the fact that real value added by agriculture increased at a rate (31 per cent, Table 3) not much larger than the rate of increase of population (28 per cent, Table 1), during a period of substantial gains in real income per head.

Did international markets provide agriculture with relief from the pressures of the changing pattern of domestic demand? There is some evidence that agriculture was able to export an increasing share of output. For example, the ratio of the value of exports of U.S. crude materials (including foodstuffs) to current price value added by agriculture ran between 8 and 15 per cent from 1839 through 1874, with no noticeable trend. From 1879 on the ratio was somewhat higher, varying between 13 and 20 per cent. If manufactured foods are included the relevant ratios become 10 to 18 and 20 to 27 per cent.[25] However, the value of imports of crude materials and manufactured foodstuffs increased at about the same pace as the value of such exports. As a consequence, the balance of trade in these commodities (an export balance) as a ratio of value added by agriculture shows no trend.[26]

The case of manufacturing was very different. The ratio of the value of U.S. manufactured exports to current price value added by manufacturing apparently did not change much. The value of exports increased at about the same rapid pace as value added by manufacturing. But the ratio of imports to value added changed markedly. Prior to the war it ran around 33 per cent. Thereafter it fell swiftly to about 10 per cent. The balance changed from an import balance equal to about 20 per cent of value added by manufacturing to an export balance of something under 10 per cent. Changes in foreign trade, then, did

[25] Calculated from data in *Historical Statistics*, pp. 246–247. The ratios overstate the relative importance of exports, since value added is valued at producers' prices while exports are valued at export prices. Furthermore, the value of exports includes the product of sectors other than agriculture. Although, presumably, the value of agricultural products dominated the value of crude materials exported, changes in the relative importance of forest, fishing, and mining exports might affect the trends discussed. It does not seem likely, however, that the general conclusions reached would be altered much.

[26] Re-exports were relatively unimportant.

not moderate the shift of U.S. commodity output away from agriculture and toward manufacturing. Indeed, they contributed toward this shift.

New products or new uses for old products may also affect the sector composition of commodity output. We have no comprehensive statistical measure of the importance of these phenomena to the observed changes in the structure of output. However, two striking examples may be cited. The relatively very rapid advance of mining can be attributed, principally, to the growth of petroleum and coal output (Table A–4). The former was, in a sense, a new product in 1860 and rapidly replaced sources of light produced by other sectors (e.g. whale oil).[27] The latter became the principal source of power in transportation and industry and also replaced the products of other sectors (e.g. wood).

TABLE 5

Price Indexes of Value Added, Commodity Producing Sectors, Quinquennial, 1839–1859 and 1869–1899

(1879 = 100)

Year	*Agriculture*	*Mining*	*Manufacturing*	*Construction*	
				Variant A	*Variant B*
1839	91	122	126	68	66
1844	73	95	107	64	63
1849	84	98	92	68	67
1854	111	121	98	77	76
1859	100	104	95	76	75
1869	147	178	151	133	133
1874	128	144	123	124	124
1879	100	100	100	100	100
1884	95	88	95	118	117
1889	85	82	90	119	119
1894	81	75	66	116	113
1899	87	85	81	126	125

Source: Appendix Table A–1.

Changes in the structure of prices may also influence the composition of output. Other things equal, sectors with relatively declining prices should gain relatively in quantities sold.[28] The data for agriculture, mining, and manufacturing lend themselves to this interpretation (Table 5). The prices of all three sectors rose sharply between 1859 and

[27] The product had been known and used before 1860. But it had not been produced in quantity nor had it been used extensively for lighting.

[28] Of course, this factor may be associated with the changing international positions of the sectors, noted above. The growth of new products is also bound up with differential price movements and trade.

1869 and fell thereafter. But mining and manufacturing prices fell much faster than agricultural prices.[29] Further, toward the end of the century agricultural prices were at about the level of the forties and fifties, while mining and manufacturing prices were much lower. If the *ceteris paribus* assumption is relaxed a little, the significance of the price data is enhanced, since the demands for agricultural goods are commonly held to be less price-elastic than the demands for manufactured goods. The price data do not help to explain the position of construction over the period, however. Construction prices rose, relative to the prices of the other sectors, yet construction retained a roughly constant share of commodity output. The forces bearing on the growth of construction are treated below in the context of the output of fixed investment goods.

VALUE ADDED PER WORKER

At another level of analysis the changes in the sector composition of commodity output can be accounted for in terms of differential changes in sector factor supplies and/or factor productivity. For the full period only one factor—labor—can be distinguished statistically. The number of gainful workers attached to each sector is taken as the measure of the supply of this factor to each sector. Differences among sectors and years in unemployment levels and the length of the work week are ignored. Since it is difficult to make a clear distinction between gainful workers in mining and manufacturing these sectors are combined. In view of the deficiencies of the gainful worker sector estimates the data exhibited in Tables 6 through 8 must be taken as subject to wide errors. But the results of tests with the data suggest that the broad findings discussed below are firm enough to warrant mention.

Assuming that the two construction series set limits on the real performance of construction, the long-term patterns of relative sector gains in workers and productivity follow that of real value added (Tables 3, 6, and 7). The rates of increase of mining and manufacturing were highest, those of agriculture, lowest. The gaps between sector levels of productivity grew. In 1839 productivity in mining and manufacturing was roughly as high as in construction and almost twice as high as in agriculture. In 1899 it was perhaps as much as half again as high as in construction and three times as high as in agriculture. But the increase in workers was relatively more important to the growth of mining and manufacturing, accounting for over $\frac{3}{4}$ of the rise of real

[29] Compare this, and the data of Table 5, with Kindleberger's recent statement: "Deflation during this period [1873 to 1896] went further in the agricultural sector than in industry." (Charles P. Kindleberger, *Economic Development*, McGraw-Hill, 1958, p. 192.) But Kindleberger goes on to note: "Where large increases in productivity in transport occur, a country may even have increases in agricultural prices on the farm and falling prices at consuming centers. . . . Some of the deflation in the United States down to 1896 partook of this character. . . ."

TABLE 6

Gainful Workers in Commodity Production, by Sector, Decennial, 1839–1899

Year or End of Decade	*Agriculture*	*Mining and Manufacturing*	*Construction*
		GAINFUL WORKERS (thousands)	
1839	3,720	495	269
1849	4,900	932	358
1859	6,210	1,474	456
1869[a]	6,850	2,170	675
1869[b]	6,730	2,205	700
1879	8,570	3,430	850
1889	10,170	5,000	1,400
1899	10,950	6,922	1,640
		DECENNIAL RATES OF CHANGE (per cent)	
1849	32	88	33
1859	27	58	27
1869	10	47	48
1879	27	56	21
1889	19	46	65
1899	8	38	17
Averages:[c]			
1839–99	19	55	35
1839–59	29	73	30
1869–99	18	46	33

[a] Comparable with earlier years.
[b] Comparable with later years.
[c] Geometric means calculated from terminal year values.

Source: Fabricant, p. 42, adjusted as described in the notes to Table 1. Fabricant groups construction with manufacturing prior to 1869. The two sectors were separated by extrapolating the 1869 estimate of workers in construction to 1859 and 1849 on census of occupations returns of construction workers. (The extrapolator accounts for about 80 per cent of construction workers in 1869.) The estimate for 1849 was carried to 1839 on the number of gainful workers in commodity production. Tests utilizing the 1840 census returns of workers in house building and the value of houses built suggest that the 1839 estimate is roughly right.

value added. By contrast, only about $\frac{2}{3}$ of the agricultural increase can be directly attributed to increased numbers.

The data of Table 8 cast some light on the forces making for differential changes in sector labor supplies. Current price value added per worker in each sector is expressed as a ratio of current price value added per worker in commodity production. These ratios are crude measures of the relative economic attractiveness of sectors to labor.

TABLE 7

Value Added in 1879 Prices per Gainful Worker, by Sector, Decennial, 1839–1899

Year or End of Decade	*Agriculture*	*Mining and Manufacturing*	*Construction Variant A*	*Construction Variant B*
		VALUE ADDED PER GAINFUL WORKER		
1839	212	399	409	323
1849	202	542	455	399
1859	240	605	662	607
1869[a]	251	529	597	600
1869[b]	256	521	576	579
1879	303	617	694	694
1889	318	900	656	735
1899	358	984	622	746
		DECENNIAL RATES OF CHANGE (per cent)		
1849	−5	36	11	24
1859	19	12	46	52
1869	5	−13	−10	−1
1879	19	18	21	20
1889	5	46	−5	6
1899	12	9	−5	2
Averages:[c]				
1839–99	9	16	7	15
1839–59	7	25	27	37
1869–99	12	24	5	9

[a] Comparable with earlier years.
[b] Comparable with later years.
[c] Geometric means calculated from terminal year values.

Sources: Calculated from data of Table 6 and Appendix Table A–1.

TABLE 8

Value Added in Current Prices per Gainful Worker, by Sector, as Ratios of Average Value Added per Gainful Worker in Commodity Production, 1839–1899

Year	*Agriculture*	*Mining and Manufacturing*	*Construction Variant A*	*Construction Variant B*
1839	71	187	104	80
1849	67	197	121	107
1859	72	172	149	138
1869[a]	74	162	159	160
1869[b]	76	160	154	154
1879	76	154	173	173
1889	64	188	183	201
1899	68	176	173	201

[a] Comparable with earlier years.
[b] Comparable with later years.

Sources: Average value added per worker was calculated for each year by weighting value added per worker in each sector by the arithmetic mean of that sector's shares in the labor force for all years. Therefore, changes over time in the average do not reflect shifts in labor force weights among sectors. Calculated from data of Table 6 and Appendix Table A–1.

Since value added includes depreciation, income payments to factors other than labor, and some payments to other sectors, and since the cost of living no doubt varied among the three sectors, only the most pronounced differences among and trends in these ratios can be viewed as significant.

The following points of interest emerge from a consideration of Table 8. First, the sector ratios at the beginning of the period are consistent with expectations formed from a study of the rates of change of numbers attached to each sector. The sector with the highest rate of increase of gainful workers over the period (mining and manufacturing) had the highest ratio; the sector with the lowest rate of increase of workers (agriculture) had the lowest ratio. Second, the construction ratio rose strongly and consistently to at least 1879 and reached the level of the mining and manufacturing ratio by 1869. Third, the ratio for agriculture was well below the average at the beginning of the period and exhibited no strong tendency to rise.

These trends can be viewed as the product of price and productivity trends. Mining and manufacturing productivity increased relatively rapidly, but sector prices fell, relative to those of other sectors. Thus, while the gaps between productivity in this sector and others widened, the income per worker differentials did not. The striking contrast between the behavior of relative income in agriculture and in construction reflects, in part, differential productivity gains in the prewar period and, in part, the contrast between the kinds of demand pressure placed on these sectors, which helped to produce divergent price movements. Agriculture was under pressure to contract relative to other commodity sectors, construction to expand (to borrow a conclusion from the subsequent discussion of investment goods).

Two other features of the data on real value added per worker (Table 7) deserve mention. First, the highest sector average decade rate of increase for the full period (16 per cent) is equal to the average decade rate of increase of output per worker in commodity production (Table 1). This initially surprising finding can be explained by the effects of shifts in sector labor force shares on the rate of increase of output per worker in commodity production. The sectors of higher worker productivity received increasingly larger shares of the commodity producing labor force.

Second, the sector rates of increase of real value added per worker exhibit divergent long-term tendencies. The rate for agriculture shows marked acceleration, that for construction, marked retardation, that for mining and manufacturing, neither acceleration nor retardation. Since agriculture has a larger weight in the total than does construction, part of the observed acceleration of the rate of increase of output per worker in commodity production may arise from the acceleration of

the agricultural rate. Part, however, may be due to shifts of labor force weights among sectors.

It is possible to measure the effects of the changes of gainful worker weights on the average rate of growth of commodity output per worker.[30] Table 9 contains four indexes of output per worker in commodity production. Index 1 reflects only the improvements in labor productivity arising within sectors (improvements due to increased supplies of other factors per laborer, technical changes, better workers, a more

TABLE 9

Indexes of Output per Gainful Worker in Commodity Production, Decennial, 1839–1899

(1869 = 100)

Year	*Index 1*[a]	*Index 2*[b]	*Index 3*[c]	*Index 4*[d]
1839	79	88	69	72
1849	88	92	80	80
1859	104	94	98	98
1869	100	100	100	100
1879	119	104	124	123
1889	140	109	153	155
1899	153	114	175	179

[a] Constructed by weighting value added per worker in each sector with a constant share in gainful workers (the arithmetic mean of the sector's share for all years).

[b] Constructed by weighting each sector's share in gainful workers with a constant value added weight (the arithmetic mean of real value added per worker in the sector for all years).

[c] Product of indexes 1 and 2.

[d] Derived directly from the series on real value added per worker in commodity production.

Sources: Tables 1, 6, and 7.

economic allocation of workers within each sector, etc.); index 2, only improvements in labor productivity arising from increases in the shares of the more productive sectors in gainful workers. Index 3 is the product of 1 and 2, and index 4 is derived directly from the series on real value added per worker in commodity production (Table 1). Index 3 has the same character as an index of value of output constructed by multiplying a price index, with constant quantity weights, by an output index, with constant price weights. It differs from index 4 for the same reasons that a value of output index made in the way described above will differ from one made directly with data on the value of output.

Comparison of indexes 3 and 4 shows how far the measured effects of the two sources of productivity gain, taken together, approximate the total productivity gain. Only indexes 1 and 2 are needed to allocate responsibility for the improved productivity between the two sources

[30] The method is described in Kuznets, "Long-Term Changes," *op. cit.*, pp. 124–126.

identified here.[31] Taken together they record an increase of 100 points, of which the second contributes a little over one-quarter. The position of the base helps to determine the result. For example, the contribution of index 2 would have been under $\frac{1}{4}$, had 1839 been used as base, and about $\frac{1}{3}$, had 1899 been selected. But regardless of the base chosen, shifts in gainful worker weights among sectors are of decidedly secondary importance in accounting for the rate of growth of real value added per worker in commodity production. This seems, at first, surprising, in view of the pronounced changes in the distribution of workers among sectors between 1839 and 1899 and the marked differences among sectors with respect to real value added per worker. On reflection it becomes an indication of the magnitude of the increase of value added per worker within each sector; that is, the effects of changes in sector shares of gainful workers were unimportant only relative to the effects of intrasector growth of productivity.[32] Some of the factors making for intrasector advance have been enumerated above. The data necessary to submit them to the kind of analysis conducted above are not now available. Indeed, the collection of such data presents serious problems.

The conclusions drawn as to the effects of factors accounting for the rise in total commodity output may now be summarized. Three factors have been distinguished: the supply of labor, increased labor productivity arising from changing sector labor force weights, and increased labor productivity arising within sectors. The first factor accounted for 64 per cent of the rise in output, the second, about 10 per cent, the third, about 26 per cent. By contrast, the three factors accounted for 19 per cent, 17 per cent, and 64 per cent, respectively, of the rise of commodity output between 1899 and 1949.[33] The contrast lies principally in the significance of increased numbers and the intrasector advance of productivity. The latter—a complex factor and one especially difficult to deal with—has grown in relative importance over time.

The index numbers for the individual years are of some interest. Index 2 shows gradual and fairly steady advance. The gains after the war are somewhat larger than those before it. This becomes clear when the changes registered by the index are expressed as decade rates of change:

[31] Needless to say, responsibility is allocated in precisely the same sense as the effect of prices on the value of output is measured by a price index. All the reservations surrounding the use of a price index surround the use of the indexes described in the text.

[32] However, the effect of the shifts in gainful worker weights was pronounced when compared with subsequent experience. Between 1899 and 1949 shifting labor force weights accounted for between 14 per cent (1899 base) and 25 per cent (1949 base) of productivity gains in commodity production.

[33] Calculated from data described in the notes to Table 2. The indexes are on the base 1929.

COMMODITY OUTPUT, 1839–1899

Decade ending:	*Index 1*	*Index 2*
	(per cent)	
1849	9.7	3.5
1859	15.8	3.1
1869	−4.0	5.7
1879	18.8	4.0
1889	18.0	4.8
1899	9.4	5.0

Apparently shifts in gainful worker weights among sectors help to account for the observed acceleration of the rate of increase of output per worker in commodity production,[34] but not directly for the shorter-term variations. On the contrary, except for the decade ending in 1889 the fluctuations of the decade rates of change registered by index 2 are opposite in direction from those of the decade rate of change of output per worker in commodity production (see Table 1).[35] Further, Table 7 shows that in each decade during which the rate of change of index 2 declined, the rates of change of two or more sector value added per worker series rose, and vice versa. The largest variations in the rate of change of index 2 occurred during the decades ending with 1869 and 1879, and it was over these decades (and only these decades) that the rates of change of all three sector output per worker series moved in the same direction.

Index 2 reflects only the direct effects of changes in the sector distribution of gainful workers. Could these findings arise from very short-term phenomena? For example, could they represent the movement of common laborers into and out of agriculture in response to good and bad crop years? A study of the estimating techniques underlying the basic gainful worker series indicates that the answer is no.[36] The effects of short-term phenomena (including business cycles) are concentrated in index 1. There would appear to be some grounds for believing that there was an inverse association between intrasector advance in output per worker and shifts in sector shares in gainful workers. But this point cannot be pressed with vigor. In view of the character of the data the association may be entirely illusory. For example, a major change in the allocation of workers between the two principal sectors in a given year would change the movements of *both* indexes over the decades preceding and following that year and could easily (although not necessarily) change them in opposite directions. Since the allocation of workers among sectors cannot be assumed to be

[34] This is apparently not true of the period 1899–1949.

[35] This is also true, up to the last decade, for the period 1899–1949. Over the last decade the rates of change of both indexes and of commodity output per worker move up.

[36] See Whelpton and Carson, *op. cit.*

free of error, great significance should not be assigned to the decade-to-decade movements of the indexes.

The Output of Fixed Capital

The series underlying the estimates of value added by construction and one of the components of the agricultural series, the value of the improvement of farm lands, measure the bulk of investment in fixed capital. To these series have been added decennial estimates of the value of output of manufactured producers' durables, the three together giving an approximation to the value of output of fixed capital. It is no more than an approximation for three reasons. First, the estimates of the value of construction include the value of repairs and maintenance. According to Kuznets, maintenance and repairs averaged about $\frac{1}{4}$ of the value of construction (constant prices) in the postwar period.[37] Seaman's estimate of housing maintenance and repairs in 1839 amounts to roughly the same share of housing construction (current prices).[38] No doubt the share varied over the course of the building cycle. If it changed only with the cycle, the long-term effect of the inclusion of this item is to give the rate of change of the total series a slight downward bias, since the construction series exhibits a rate of increase lower than that of the total series (Table 10).

TABLE 10

Shares of Manufactured Producers' Durables, Farm Improvements, and Total Construction in Output of Capital Goods, Decennial, 1839–1899

(per cent)

Year	*Manufactured Producers' Durables*[a]	*Farm Improvements*[a]	*Total Construction*	
			Variant A	*Variant B*
1839	10	11	79	77
1849	14	8	79	77
1859	15	6	79	78
1869	18	8	74	74
1879	20	9	72	72
1889	26	3	72	73
1899	31	2	67	69

[a] Shares in variant A total.

Sources: See note to Table 12.

Second, there may be some duplication within the aggregate series. The estimates of the value of construction were built up from the value of output of construction materials. It was assumed that all materials

[37] *National Product since 1869*, *op. cit.*, pp. 99–100.

[38] *op. cit.*, p. 455.

used in improving farm lands were of farm origin and did not enter into the recorded flow of construction materials. The assumption is probably more appropriate to the early than the later years. If there is duplication it imparts an upward bias to the rate of change of the aggregate series. The bias could not be great, since farm improvements were not an important part of the total, especially in the later years (Table 10).

Third, the series on manufactured producers' durables does not include the product of those in the independent hand trades. These craftsmen produced tools, and it may be that they were relatively important tool-makers in the early years. If they were, the rate of change of the present series has an upward bias, reflecting the displacement of the hand trades by the manufacturing sector. But again, the bias transmitted to the rate of change of the total series could not be large, since the share of durables in fixed capital was small throughout (Table 10) and the rise in that share could be expected on other grounds.

Estimates were made at ten-year intervals only. This limits the utility of the series, in the light of the fact that investment series are especially sensitive to cyclical movements. For this reason only the more striking long-term movements are dealt with here.

The output of fixed capital increased at an average decade rate of either 54 or 58 per cent, depending on the variant chosen (Table 11). These rates are higher than the rate of increase of commodity output. The share of fixed capital in commodity output increased from under 23 per cent, in 1839, to about 27 per cent, in 1859, and over 30 per cent,

TABLE 11

Output of Fixed Capital, Decennial, 1839–1899

Year	*Variant A*[a] (mill.)	*Decennial Rate of Growth* (per cent)	*Variant B*[a] (mill.)	*Decennial Rate of Growth* (per cent)
1839	$249	—	$226	—
1849	390	57	370	64
1859	733	88	708	91
1869	1,090	49	1,092	54
1879	1,642	50	1,642	50
1889	2,720	65	2,830	73
1899	3,353	23	3,557	26
Averages:[b]				
1839–99		54		58
1839–59		72		77
1869–99		45		48

[a] Taken from Tables A–2, A–10, and A–12, prices of 1879.
[b] Geometric means calculated from terminal year values.

TABLE 12

Share of Capital Goods in Commodity Output, Decennial, 1839–1899
(per cent)

Year	*Variant A*	*Variant B*
1839	23	21
1849	24	23
1859	27	27
1869	33	33
1879	31	31
1889	31	32
1899	29	30

Sources: Calculated from constant price data in Appendix Tables A–1, A–2, A–10, and A–12 (see text). The average of the two estimates of the value of manufactured producers' durables in 1839 was used.

in 1869. Thereafter it remained near the level of 30 per cent (Table 12).[39] Since construction dominates the fixed capital output series, decade-to-decade movements no doubt bear the mark of the construction cycle. But the general upward drift of the share of fixed capital output in commodity output is probably a long-term development.

One of the features of industrialization is a rise in the share of national product devoted to net investment.[40] The rise reflects increased capital requirements imposed by industrialization. If industrialization is accompanied by acceleration of the rate of increase of national product, the share of net investment in product must rise if the existing capital-output ratio is to be merely maintained. But one would expect that the capital-output ratio would actually rise. There are two reasons for this. First, industrialization has meant increasing capital-output ratios within sectors. Second (and more important), it has meant a shift in the relative importance of sectors, as measured by net product. Transportation and public utilities, sectors with very high capital-output ratios, have grown in relative importance at the expense,

[39] In current prices the rise was even more striking:

Year	*Variant A*	*Variant B*
1839	20%	18%
1849	22	21
1859	24	23
1869	31	31
1879	31	31
1889	36	37
1899	34	36

[40] See, for example, Rostow, *op. cit.*, p. 30, and W. Arthur Lewis, *The Theory of Economic Growth*, George Allen and Unwin, 1955, p. 208.

principally, of agriculture.[41] The rising share of fixed capital in commodity output, shown by the present data, may reflect an increasing share of net investment in national product. Since there is no evidence to suggest an acceleration of the rate of change of national product over this period, a growing share of net investment in national product would mean an increasing capital-output ratio.

Commodity output composed a large and only gradually changing share of national product. Accordingly, the commodity output series can be taken as a rough index of the long-term growth of national product. Goldsmith's estimates of the real value of fixed capital stock are available for the census dates 1849, 1879, 1889, and 1899.[42] The ratios of Goldsmith's estimates (converted to the price base 1879, without reweighting) to the commodity output estimates are: 1849, 2.1; 1879, 3.1; 1889, 3.7; and 1899, 3.9. In view of the fairly wide margins for error assigned by Goldsmith to his estimates, the difficulties involved in deflating a capital stock estimate, the fact that the output series does not cover all of national product, and the responsiveness of annual capital-output ratios to transitory phenomena, the ratios should be taken as only roughly indicative of the trend in the fixed capital-national product ratio. Even so, the evidence points to a substantial increase between 1849 and 1879. The continued rise after 1879 is supported by Kuznets' findings.[43]

Fixed capital accounted for about 80 per cent of total reproducible capital in 1849. Commodity output was probably somewhat less than 80 per cent of national product. This suggests that the capital-national product ratio in 1849 was less than 2—perhaps not much larger than the postwar ratio for agriculture.[44] It is difficult to conceive of a ratio much smaller in earlier years. There is some reason for believing, then, that the period under review includes the major upward movement in the capital-output ratio which various scholars have associated with industrialization. As noted earlier, there is also evidence of acceleration of the rate of change of national product per capita (although it does not appear that this period includes the full sweep of this acceleration), a second development which scholars have looked for in the early stages of industrialization. These findings appear roughly consistent with one another and with the changing industrial structure of the economy reflected in the sector series and in the composition of fixed capital output (Table 10).

[41] Kuznets, "Long-Term Changes," pp. 127–128.

[42] Raymond Goldsmith, "The Growth of Reproducible Wealth of the United States of America from 1805 to 1950," in *Income and Wealth of the United States, Trends and Structure*, International Association for Research in Income and Wealth, Income and Wealth Series II, The Johns Hopkins Press, 1952, p. 307, structures and equipment of agriculture, "non-agriculture," and government and residences.

[43] "Long-Term Changes," p. 127.

[44] *ibid.*, pp. 122 and 127.

Summary

Over the last six decades of the nineteenth century American commodity output increased eleven-fold, or at an average decade rate of nearly 50 per cent. The rate of growth of national product was probably slightly higher, and may have been uniquely high for so extended a period. The pace of American twentieth century growth has been slower. The highest sustained rate appearing in the records of other countries is 50 per cent and only two countries have achieved this level.

At the beginning of U.S. industrialization, in the 1840's, the United States was already a wealthy nation. While income comparisons across international boundaries and across long reaches of time are hazardous, it seems clear that by 1839 the United States had reached a level of income per head much higher than that existing in the underdeveloped regions of the world today. Growth since that time has been rapid, but not uniquely rapid. Many nations have had rates of growth as high, and some, higher.

The rates of change of both commodity output per head and national product per head increased in the decades following 1839. There is some evidence of retardation in the twentieth century, but it is not conclusive. The beginning and end of the phase of acceleration cannot be dated with the existing data, but it appears that acceleration began in or before the forties; that is, in or before the period commonly associated with the early stages of industrialization.

Worker productivity in commodity production increased at an accelerating rate, while the number of workers in these sectors grew at a rapidly diminishing rate. In the nineteenth century about 64 per cent of the rise in commodity output can be accounted for (in a statistical sense) by increasing numbers of workers; in the twentieth century, only about 19 per cent. Gains in worker productivity can be traced, in part, to shifts in sector shares of the work force. The more productive sectors increased their shares, thus increasing average productivity in commodity production. About $\frac{1}{4}$ of the nineteenth and $\frac{1}{5}$ of the twentieth century productivity gains proceeded from this source. The remainder (accounting for about $\frac{1}{4}$ of the nineteenth and almost $\frac{2}{3}$ of the twentieth century increases in commodity output) arose within sectors, from increased supplies of other factors, improved technology, a better disposition of workers within each sector, improved workers, etc. The data necessary to carry out a detailed analysis of the importance of these intrasector sources of productivity gain for the full period are not presently available.

Sector shares of the work force responded to income differentials among sectors. In 1839 income per worker in mining and manufacturing (taken together) was much higher than income per worker in the

other sectors. The number of workers attached to mining and manufacturing increased at a relatively rapid pace. The income differential between mining and manufacturing and construction narrowed consistently and was eliminated by 1869. Agricultural income per worker, however, did not rise toward the levels in the other sectors.

Income trends can be resolved into productivity and price trends. Productivity increased fastest in mining and manufacturing. By 1899 real value added per worker in this sector was about three times the agricultural level and perhaps half again as large as in construction. But the prices of this sector fell, relative to prices in agriculture, and this prevented the income per worker gap between agriculture and mining and manufacturing from widening. Construction prices rose sharply, compared with prices in the other sectors, and this factor, coupled with pronounced prewar construction productivity gains, accounted for the relative rise in construction income per worker.

The differential price and income trends of agriculture and construction are partly explicable in terms of the pressures placed on these sectors by demand. It is commonly held that the income elasticity of demand for the output of agriculture is low. As the real income of a nation rises, the share of income devoted to agricultural products tends to decline. Unless broad international outlets are found for agricultural production, pressure is placed on the sector to contract, relative to other sectors. Foreign trade did not relieve U.S. agriculture of this pressure, and the output of the sector increased only slightly faster than population. Agricultural real value added fell from $\frac{7}{10}$ of commodity output in 1839 to less than $\frac{1}{3}$ in 1899.

In contrast, the demand for the products of construction tended to rise faster than the demand for total output. Construction was the most important component of investment. The process of industrialization commonly generates a rapidly increasing demand for investment goods. A rising share of output goes to investment and the capital-output ratio increases. This was the case in the United States in the period under review. The share of the output of fixed investment goods in commodity output rose from under $\frac{1}{4}$ to almost $\frac{1}{3}$. The capital-national product ratio increased markedly between 1849 and 1879 and continued to grow to the end of the century. Construction prices rose with growing demand and the gap between per worker income in construction and mining and manufacturing was eliminated.

The course of industrialization is reflected in the changing share of manufacturing in commodity output. In 1839 it was less than $\frac{1}{5}$. It rose to $\frac{1}{3}$ by 1859 and to over $\frac{1}{2}$ by 1899. Manufacturing prices fell, compared with agricultural and construction prices, and this may have contributed toward the relatively rapid extension of markets for manufactured goods. Manufacturing growth was also bound up with

international markets. In 1839 there was a substantial import balance in manufactured goods; in 1899, a substantial export balance. But Americans also absorbed larger quantities of manufactured goods per capita. Manufacturing output shared in the growth of investment. Indeed, the proportion of total output of fixed investment goods accounted for by manufactured producers' durables increased from about $\frac{1}{10}$ to about $\frac{3}{10}$.

Declining relative prices also helped to extend mining markets. But the comparatively rapid expansion of mining (real value added accounted for about 1 per cent of commodity output before the war and almost 5 per cent in 1899) can be best understood in terms of the growth of petroleum and coal output. Petroleum production in any appreciable volume began in the sixties. The product quickly displaced sources of light produced by other sectors. Coal became the principal source of power in industry and transportation. Output grew with industrialization and the extension of rail transportation. Sources of power produced by other sectors were also displaced.

Decade rates of increase varied fairly widely over time. The Civil War decade was one of very small advance for agriculture, manufacturing, and aggregate commodity output. Mining experienced rapid growth and construction, moderate growth. After the war the variations fit the recorded sector patterns of long swings. The variations of the construction rate before the war are also consistent with recorded construction cycles. There is a suggestion that the movements of the prewar agricultural series reflect a long swing, but the data are not adequate for reaching a final judgment on this. It is also impossible to reach a firm conclusion as to the factors accounting for the prewar variations of the mining and manufacturing rates of change.

Variations in rates of advance appear in the commodity output per worker series. These variations arise from the individual sector series. Shifts in the sector composition of the work force apparently did not directly contribute to them. Indeed, it appears that the most significant shifts occurred over decades during which productivity advance was relatively slight. However, the data used to establish this pattern are not beyond criticism and the pattern should be accepted only tentatively.

APPENDIX

This appendix discusses the estimating techniques used to get the series analyzed in the body of the paper. The text briefly describes each step in the estimating process and a few of the tests applied to the estimates. Details are confined to table notes. The author's doctoral dissertation contains evaluations of the sources of data and descriptions of additional tests applied to the agricultural, mining, and manufacturing

TABLE A–1

Value Added by Agriculture, Mining, Manufacturing, and Construction, Quinquennial, 1839–1859 and 1869–1899
(dollar figures in millions)

Year	*Agriculture*	*Mining*	*Manufacturing*	*Construction* Variant A	*Construction* Variant B	*Total* Variant A	*Total* Variant B
			CURRENT PRICES				
1839	$713	$9	$240	$75	$57	$1,037	$1,019
1844	685	14	311	81	66	1,091	1,076
1849	828	17	447	110	96	1,402	1,388
1854	1,461	32	663	229	194	2,385	2,350
1859	1,495	34	815	228	208	2,572	2,552
1869	2,535	125	1,631	536	539	4,827	4,830
1874	2,531	150	2,072	646	650	5,399	5,403
1879	2,599	153	1,962	590	590	5,304	5,304
1884	2,837	199	3,047	1,008	1,107	7,091	7,190
1889	2,765	283	3,727	1,096	1,219	7,871	7,994
1894	2,644	291	3,598	1,298	1,607	7,831	8,140
1899	3,397	467	5,044	1,288	1,525	10,196	10,433
			1879 PRICES				
1839	$787	$7	$190	$110	$87	$1,094	$1,071
1844	944	14	290	126	105	1,374	1,353
1849	989	17	488	163	143	1,657	1,637
1854	1,316	26	677	298	255	2,317	2,274
1859	1,492	33	859	302	277	2,686	2,661
1869	1,720	70	1,078	403	405	3,271	3,273
1874	1,977	105	1,692	523	526	4,297	4,300
1879	2,599	153	1,962	590	590	5,304	5,304
1884	3,001	227	3,215	857	946	7,300	7,389
1889	3,238	346	4,156	919	1,029	8,659	8,769
1894	3,273	389	5,480	1,116	1,417	10,258	10,559
1899	3,918	551	6,262	1,020	1,224	11,751	11,995
			IMPLICIT PRICE INDEXES (1879 = 100)				
1839	91	122	126	68	66	95	95
1844	73	95	107	64	63	79	80
1849	84	98	92	68	67	85	85
1854	111	121	98	77	76	103	103
1859	100	104	95	76	75	96	96
1869	147	178	151	133	133	148	148
1874	128	144	122	124	124	126	126
1879	100	100	100	100	100	100	100
1884	94	88	95	118	117	97	97
1889	85	82	90	119	118	91	91
1894	81	75	66	116	113	76	77
1899	87	85	80	126	125	87	88

Sources: Tables A–2, A–4, A–5, and A–10. The third panel was calculated from data forming the basis for the first two panels.

series.[45] Since the dissertation does not cover construction and manufactured producers' durables, these estimates are given special attention here. The tables give detailed data. These data are not uniformly reliable, and the reader is advised to study the table notes with care before using them. The notation "census data," without further citation, refers to the census volume devoted to the sector under review. Table A–1 presents a summary of the series.

AGRICULTURE

The agricultural estimates were made in four steps. The output of each product was estimated, output used in production within the agricultural sector was subtracted, the results (output entering gross income) were valued (in current and constant prices) and summed, and the value of fertilizer purchased from other sectors was subtracted. The resulting estimates are conceptually close, and quantitatively almost identical, to gross value added estimates.

The prewar estimates are based largely on federal and state census materials, while the postwar estimates represent a re-working of the Strauss and Bean gross income series.

To treat the postwar estimates first, four kinds of changes were made in the Strauss and Bean series:

1. Certain estimates were dropped and others were added.
2. Estimates were adjusted to refer more precisely to the census year.
3. The base for the constant price series was shifted to 1879.
4. The value of purchases of fertilizer from other sectors was subtracted.

1. In Strauss and Bean (page 14), the income from twenty-five products accounting for about 11 per cent of agricultural gross income was extrapolated from 1929 on gross income from other sources. These estimates were dropped and new estimates for 7 of the more important products (accounting for about 6 per cent of agricultural gross income in 1879) were added. Estimates of the value of improvements to farm land, home manufactures, flax, honey and wax, and wine (omitted by Strauss and Bean) were also made. Changes in inventory values of animals (between −3 and +4 per cent of gross income during the years 1869–99) were omitted because of the difficulty of making comparable prewar estimates.

2. For the estimates to be comparable over time and with estimates for other commodity producing sectors, they had to refer specifically to the census year. The census year is quite close to the crop year for most

[45] Robert E. Gallman, "Value Added by Agriculture, Mining, and Manufacturing in the United States, *1840–1880*," Ph.D. thesis, University of Pennsylvania, 1956. Some of the estimates have been revised slightly for the present paper.

crops.[46] And it is clear that census enumerators most often returned the product of the crop year.[47] Accordingly, where possible, crop year data were used. In some instances Strauss and Bean give crop and calendar year output, but only calendar year prices. Here the mean price of the calendar years sharing the census year was taken as the census year price. Where calendar year data alone were available, average income in the two calendar years sharing the census year was used. There were exceptions, however. For example, cane sugar was harvested in the late fall and sold in the early spring. Calendar year output for, say, 1869, multiplied by calendar year price of 1870, gives the best approximation to census year income. To make the estimates of income from animal slaughter as comparable as possible with the estimates for the earlier years, calendar year (1870, etc.) output estimates weighted by census year (mean of calendar 1869 and 1870) prices were used.[48] Further details are contained in the notes to Table A–2, which also cover points 3 and 4, discussing the price adjustment and the fertilizer estimates fully.

The following tabulation compares the present estimates with those of Strauss and Bean:[49]

	1869	*1874*	*1879*	*1884*	*1889*	*1894*	*1899*
Gross farm income ($mill.)	2,601	2,480	2,475	3,129	2,905	2,707	3,565
Gross value added by agriculture ($mill.)	2,535	2,531	2,599	2,837	2,765	2,644	3,397
Ratio of income to value added	1.03	0.98	0.95	1.10	1.05	1.02	1.05

The basic data for the prewar period were taken from federal and state censuses. The manipulations of these data are described in the notes to Table A–2. Estimates were checked against Seaman's estimates for 1839 and 1849. They were also checked for internal consistency. For example, the pork output estimates were converted into feed requirements and checked against the estimates of corn output, minus exports and consumption by humans. The wool estimates were checked against the census returns of wool used in manufacturing (1849, 1859) plus net exports. The interpolating series used to get estimates for 1844 and 1854 rarely accounted for less than 25 per cent of national output.

[46] See *Crops and Markets*, Dept. of Agriculture, Vol. 14, no. 11, November 1937, pp. 229–230.

[47] For example, the Strauss and Bean crop year output estimates are very close (often identical) to the returns of the 1870 census.

[48] There is little practical difference between this method and an averaging of gross income for two calendar years, since price changes dominate the short-term fluctuations of the series on income from animal slaughter.

[49] Gross farm income is from Strauss and Bean (p. 23), and refers to a combination of crop and calendar years; gross value added is from Table A–2 and refers to census years (see text, below).

TABLE A-2

Gross Income from Agriculture, by Source of Income, and Value Added by Agriculture, Quinquennial, 1839–1859 and 1869–1899

(millions of dollars)

Product	*1839*	*1844*	*1849*	*1854*	*1859*	*1869*	*1874*	*1879*	*1884*	*1889*	*1894*	*1899*
						CURRENT PRICES						
1. Wheat	59.4[a]	61.7	69.2	164.0	140.3	222	280	434	315	301	220	329
2. Corn	27.2[a]	32.9	47.9	100.9	85.1	106	141	148	141	140	145	198
3. Oats	10.5[a]	11.0	13.0	22.0	17.8	39	43	41	52	55	72	69
4. Barley	1.6[a]	1.6	2.0	6.2	6.4	18	23	15	18	17	16	23
5. Rye	6.8[a]	5.6	4.9	9.7	10.9	12	11	10	10	9	10	9
6. Buckwheat	2.3[a]	2.7	2.9	3.9	6.6	5	5	4	4	4	4	4
7. Hay	14.4	21.3	19.9	31.2	37.6	57	58	56	80	79	81	94
8. Irish potatoes	16.3	18.2	22.4	43.1	35.9	61	73	60	65	65	88	90
9. Sweet potatoes	15.2	14.7	19.3	35.4	20.2	24	22	17	17	21	19	20
10. Cotton	60.3[a]	50.8	85.5	95.3	199.7	248	234	269	252	319	230	326
11. Cottonseed							2	4	7	11	17	28
12. Tobacco	18.1[a]	5.6	11.6	12.5	31.7	29	30	29	47	35	51	62
13. Orchard fruits	7.2	6.4	7.7	16.7	20.0	47	54	51	74	75	53	84
14. Flaxseed	0.2[a]	0.3	0.5	0.6	0.6	3	6	8	9	12	10	22
15. Rice	1.0	2.2	3.1	2.4	3.4	4	4	5	3	4	3	7
16. Cane sugar	4.7	8.4	7.3	11.3	8.5	5	6	7	6	9	11	6
17. Wool	5.5	9.1	9.0	8.9	12.6	36	46	54	44	47	30	39
18. Beef	64.3[a]	65.3	98.2	127.7	176.9	255	240	210	381	303	277	395
19. Pork	165.5[a]	160.4	170.8	224.3	301.8	646	489	482	500	422	446	470
20. Veal	2.3[a]	2.3	3.5	5.4	6.3	8	14	12	24	24	17	31
21. Lamb and mutton	0.6[a]	0.8	1.1	3.3	3.6	10	13	13	18	22	25	40
22. Peanuts						2	3	2	4	6	6	11
23. Chickens	22.0	21.9	30.0	55.2	59.9	56	57	49	67	77	93	108
24. Eggs						59	68	66	110	127	154	192
25. Dairy products	53.8	70.2	76.7	115.2	118.7	249	293	255	321	341	340	444
26. Beet sugar											1	4
27. Citrus fruits											2	8
28. Grapes										10	11	17

continued on next page

TABLE A–2, continued

Product	*1839*	*1844*	*1849*	*1854*	*1859*	*1869*	*1874*	*1879*	*1884*	*1889*	*1894*	*1899*
						CURRENT PRICES						
29. Farm and market garden products	8.3	9.6	14.7	20.7	40.1	44	43	43				120
30. Hemp	4.2[a]	2.7	5.0	6.6	6.4	1	1	[b]				[b]
31. Peas and beans	4.8	3.1	4.0	6.6	8.6	5	11	6				11
32. Hops	0.3	0.2	0.3	2.2	1.2	4	3	3	210	203	199	4
33. Molasses and maple syrup	1.0	1.4	1.7	4.3	5.8	10	15	12				8
34. Maple sugar	2.2	2.0	2.7	1.6	4.0	3	4	3				1
35. Forest products	26.4[a]	31.7	37.2	46.8	50.4	90	97	96				110
36. Improvements to land made by farm labor	26.3	26.2	25.3	245.4	43.3	141	126	139	93	65	53	67
37. Home manufactures	29.0	32.1	27.5	24.1	24.5	23	20	14				
38. Flax	0.7[a]	0.9	0.6	0.9	0.3	4	2	[b]				
39. Honey and wax	1.9	1.3	1.8	4.5	3.6	3	3	4				
40. Wine	0.1	0.1	0.2	1.1	3.0	9	8	9				
Total gross income	713	685	828	1,461	1,496	2,541	2,546	2,628	2,872	2,803	2,684	3,452
Purchases of fertilizer					1	6	15	29	35	38	40	55
Gross value added	713	685	828	1,461	1,495	2,535	2,531	2,599	2,837	2,765	2,644	3,397
						1879 PRICES						
1. Wheat	79.2	93.3	96.3	115.5	166.6	266	326	434	541	477	498	619
2. Corn	25.6	35.9	41.8	58.8	57.5	53	80	148	147	185	117	242
3. Oats	12.0	14.6	14.4	15.3	16.8	28	27	41	62	82	73	92
4. Barley	2.1	2.4	2.6	4.4	7.1	12	14	15	22	25	22	36
5. Rye	9.2	7.1	7.1	6.3	10.5	9	9	10	13	14	14	12
6. Buckwheat	2.6	3.6	3.2	2.8	6.3	4	4	4	4	5	4	4
7. Hay	16.4	28.4	22.1	22.7	30.5	44	44	56	76	92	86	99
8. Irish potatoes	22.7	24.9	23.6	26.0	39.7	52	47	60	74	78	71	97
9. Sweet potatoes	18.7	18.9	19.1	20.0	21.0	11	15	17	16	22	25	21
10. Cotton	81.3	102.2	101.5	133.1	221.5	124	173	269	281	384	515	480
11. Cottonseed							1	4	8	14	26	39
12. Tobacco	13.4	9.2	12.2	12.1	26.5	16	13	29	35	32	47	53
13. Orchard fruits	7.2	9.1	6.7	15.0	19.4	25	39	51	63	60	46	69
14. Flaxseed	0.2	0.4	0.6	0.6	0.6	2	5	8	9	11	11	21
15. Rice	3.9	5.4	6.4	3.6	5.5	4	3	5	4	5	4	9

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TABLE A–2, concluded

Product	*1839*	*1844*	*1849*	*1854*	*1859*	*1869*	*1874*	*1879*	*1884*	*1889*	*1894*	*1899*
						1879 PRICES						
16. Cane sugar	4.4	7.3	8.3	12.4	7.7	3	5	7	8	11	27	12
17. Wool	8.3	14.1	12.2	12.2	13.9	37	42	54	70	63	67	66
18. Beef	83.0	91.9	101.8	120.3	142.0	144	167	210	302	353	298	369
19. Pork	183.4	197.0	222.2	233.5	276.0	416	412	482	521	506	488	512
20. Veal	2.8	3.1	3.4	4.1	4.8	5	8	12	17	22	18	26
21. Lamb and mutton	1.4	1.9	2.4	3.3	4.3	8	10	13	16	19	25	33
22. Peanuts						1	1	2	3	5	9	16
23. Chickens	30.5	41.6	39.1	64.6	64.7	35	41	49	57	67	78	89
24. Eggs						37	50	66	88	117	147	184
25. Dairy products	72.2	99.1	104.0	115.2	143.7	143	190	255	302	354	356	473
26. Beet sugar											2	7
27. Citrus fruits											2	7
28. Grapes										8	10	14
29. Farm and market garden products	10.8	13.2	15.7	12.5	44.3	38	28	43				
30. Hemp	5.1	5.1	5.3	5.8	6.3	1	1	[b]				
31. Peas and beans	4.1	4.9	5.7	6.4	9.3	4	8	6				
32. Hops	0.1	0.2	0.4	1.0	1.2	3	2	3				
33. Molasses and maple syrup	1.7	2.5	3.3	7.1	6.1	6	12	12	211	209	184	247
34. Maple sugar	2.2	2.6	3.1	1.6	3.6	3	3	3				
35. Forest products	32.7	38.6	44.4	52.3	60.1	74	85	96				
36. Improvements to land made by farm labor	28.0	38.5	29.3	193.5	42.6	90	96	139	92	72	64	75
37. Home manufactures	18.9	23.7	28.4	27.4	26.3	19	17	14				
38. Flax	1.0	1.0	0.7	1.0	0.3	2	1	[b]				
39. Honey and wax	2.0	2.0	2.2	3.6	3.6	2	3	4				
40. Wine	0.2	0.3	0.4	1.7	2.9	6	7	8				
Total gross income	787	944	989	1,316	1,493	1,724	1,989	2,628	3,043	3,292	3,334	4,023
Purchases of fertilizer					1	4	12	29	42	54	61	105
Gross value added	787	944	989	1,316	1,492	1,720	1,977	2,599	3,001	3,238	3,273	3,918

Details may not add to totals because of rounding.

[a] 1840 values. The total of these items was adjusted to the level of 1839 prices (in the manner described in the text) before it was added to total agricultural gross income.

[b] Less than $500,000.

Current Prices, 1839–1859

See text for methods of calculating gross income. The following notes give the sources of data and methods of calculating output, value of output, and price. (See also sources given in footnote 50.)

Output—1839, 1849, 1859

Lines 1–12, 16, 17, 32, 34, 40: Census data (the figure for 1 for 1839 was reduced slightly, on the authority of Seaman, p. 453).

Lines 14, 31, 33, 39: Census data for 1849 and 1859, extrapolated to 1839 (lines 14, 31, straight line extrapolation; line 33, extrapolation on lines 16 and 34; line 39, extrapolation of honey on wax production).

Lines 18, 19: Estimated from census inventory data in the following manner—January 1 inventories were estimated by applying to June 1 inventories the ratios of January 1 to June 1 inventories, worked out from data in *Agriculture Yearbook, 1924* (Dept. of Agriculture, 1924), pp. 838, 899. The ratio of animals slaughtered to animals in inventory on January 1 was applied to January 1 inventories. The slaughter ratio for swine (very stable over time) was taken from Strauss and Bean. The ratio for cattle was extrapolated from their postwar data, on the assumption that the observed postwar trend was in evidence in the prewar period. Numbers slaughtered were then multiplied by average slaughter weights. Postwar cattle weights (very stable over time) were used. Swine weights were extrapolated from the postwar period (Strauss and Bean) to 1859 on Cincinnati slaughter weights (*Annual Report of the Secretary of State to the Governor of the State of Ohio, including the Statistical Report to the General Assembly, for the Year 1877*, Nevens and Meyers, 1878, p. 602). Estimates for the earlier years were based on Cincinnati weights pieced together from data given by Berry, DeBow, and Seaman (Thomas Senior Berry, *Western Prices before 1861*, Harvard Economic Studies, Vol. 74, Harvard University Press, 1943, p. 231; "The Hog Business of the West," *DeBow's Review*, May 1854, pp. 539–540; Seaman, p. 352), and information on the size of the hog crop in the annual report of the Secretary of State of Ohio (p. 603). Average hog weights varied with the size of the hog crop during this period (Berry, p. 231).

Lines 20, 21: Extrapolated from the postwar period on population, on the assumption that consumption per head rose between 1839 and 1869 at about the rate observed after 1869.

Line 25: "Butter" and "cheese" from census data; "fluid milk" extrapolated from the postwar period on "butter and cheese," in milk equivalents.

Line 35: "Cordwood" interpolated on population between 1839 and 1879. The 1839 figure was estimated from the census return of wood sold off farms. It was assumed that (1) sales of wood off farms were made to the nonfarm population, (2) the population in 1839 was divided between farm and nonfarm as the labor force was divided between agriculture and nonagriculture, (3) per-head consumption of cordwood was the same on and off farms.

Line 36: "Acres of land improved" in each decade, divided among years of the decade on the basis of federal direct land sales and homestead grants. "Acres improved" in each decade were estimated from census returns of the number of improved acres in 1850 and 1860 and an estimate by Seaman (pp. 452, 453) for 1840. Direct sales and homestead grants were taken from Benjamin H. Hibbard, *A History of the Public Land Policies*, Peter Smith, 1939, with a few adjustments.

Output—1844, 1854

Lines 1, 3–6, 8, 14 (1854), *17, 25* ("butter" and "cheese"—fluid milk estimated in the manner described for the federal census years), *31* (1854), *32* (1854), *34, 39* (1854): Interpolated on data of the state censuses of Ark., Conn., Iowa, Mass., Mich., N.Y., and the report of the Auditor of the State of Ohio.

Lines 2, 7 (1844): Estimates of the Commissioner of Patents (28th Cong., 2d Sess., S. Doc. 75, p. 75).

Lines 10, 12, 15 (1844), *32* (1844): Dept. of Agriculture Circulars 32, 33, 34, 35, all published in 1912.

Line 15 (1854): Interpolated on the marketed crop of Georgia and the Carolinas (Dept. of Agriculture, Circular 34).

Line 16: Interpolated on estimates of P. A. Champonier, "Estimates of Louisiana Sugar Production," appended to Edmund J. Forstall's "Report on Louisiana Sugar Production," Appendix M to the *Report of the Secretary of the Treasury of the United States on Finances for 1845*, John C. Rives, 1851, p. 478, and Bouchereau, *Statistical Abstract of the United States*, Treasury Dept., Third Number, 1880, p. 134.

Line 33: Interpolated on sugar output.

Lines 18, 19: Estimated from inventories, in the manner described for the federal census years. Inventories were estimated by assuming a constant annual rate of change between federal censuses.

Lines 9, 14 (1844), *20, 21, 30, 31* (1844), *35* ("cordwood"), *39* (1854), *40:* Straight-line interpolation.

Line 36: Estimated in the manner described for the federal census years.

Value of Output—1839, 1849, 1859

Lines 13, 29 ("market garden products"), *37:* Census data.

Line 29 ("farm garden products"): Estimated by assuming that consumption of garden products per head of the farm population was the same in dollar value as consumption per head of the nonfarm population and that all sales of market garden produce went to the nonfarm population. The share of the nonfarm population in the total population was taken to be the same as the share of the nonagricultural labor force in the total labor force.

Line 23 (1839, 1849): Estimated by applying to the value of flocks the postwar ratio of animals slaughtered to animals in inventory (from Strauss and Bean). The value of flocks for 1839 was taken from the census; for *1849*, from estimates of Seaman and DeBow (Seaman, pp. 454, 626; *Compendium, 1850 Census of the United States*, J. D. B. DeBow, p. 176).

Line 24 (1839, 1849): Extrapolated from the postwar period on line 23.

Lines 23, 24 (1859): Interpolated on gross income.

Line 35 (value of forest products other than cordwood): Extrapolated from 1879 on the value of cordwood.

Value of Output—1844, 1854

Lines 13, 23, 24, 29 (1844): Interpolated on gross income.

Line 29 (1854): "Market garden products" interpolated on data in the N.Y. and Mass. censuses; "farm garden products" estimated in the manner described for the federal census years.

Line 35 (value of forest products other than cordwood): Extrapolated from 1879 on the value of cordwood.

Line 37: Straight-line interpolation in constant prices.

Prices

Lines 1–5, 10, 12, 14, 15 (except 1839, 1844), *17* (except 1839, 1844), *18, 19, 21, 25:* Extrapolated from postwar farm prices (Strauss and Bean) on prices of the Aldrich Report.

Line 15 (1839, 1844): Dept. of Agriculture, Circular 34.

Line 17 (1839, 1844): Extrapolated from 1849 on Cole, "Wool, common, New York."

Lines 16, 33 (1839, 1844): Estimates of Forstall of prices on Louisiana plantations (p. 451); 1849, 1854, 1859, interpolation on Cole, "New Orleans, at New York."

The following items were extrapolated from the postwar period on state farm price series: 7 (Vt., Ind., Me., N.Y., Wis.), 8 (Vt., Ind., Me., N.Y., Wis., Iowa, Md.), 31 (N.Y., Wis., Va.).

The Vermont price for line 34 was used as the national average price.

Line 6, extrapolated from the postwar period on the prices of oats; *line 9*, on the price of Irish potatoes; *line 20*, on the price of beef.

Lines 30, 32, 35 (cordwood), *36, 38, 39, 40, 1849*, Seaman (pp. 453, 457, 625, 626), extrapolated to 1844 and 1839 on prices of the Aldrich Report, *lines 30, 35, 38*, Cole, *lines 32, 39, 40*, and the Warren and Pearson wholesale price index of farm products, *line 36* (G. F. Warren and F. A. Pearson, "Wholesale Prices in the United States for 135 Years, 1797 to 1932," in *Wholesale Prices for 213 Years, 1709 to 1932*, Cornell University Agricultural Experiment Station, Memoir 142, November 1932).

Current Prices, 1869–1899

Lines 1–13: Crop year gross income (Strauss and Bean), with the following exceptions—For line 4, the share of the crop entering gross income was taken to be 70, 65, and 60 per cent for the years 1869, 1874, and 1879, instead of the 50 per cent given by Strauss and Bean. The prices used for lines 10 for 1869 and 1874 are mean prices for calendar years 1869 and 1870, 1874 and 1875. The estimate for line 10 appearing in Strauss and Bean is in error and is corrected here.

Lines 14, 15: Crop year output entering gross income times the mean price for the two calendar years sharing the census year (Strauss and Bean).

Line 16: Calendar year output (1869, 1874, etc.) times price for the following calendar year (1870, 1875, etc.).

Line 17: Calendar year gross income (1870, etc.).

Lines 18–21: Calendar year output (1870, etc.) times the mean price for the two years sharing the census year.

Lines 22–28: Mean of gross income for the calendar years sharing the census year, except for line 27 for 1894, which refers to calendar year 1895. No data are available for 1894.

Lines 29–35: 1869, 1879, 1899, estimated from census returns; 1884, 1889, 1894, interpolated on the sum of the "omitted products" and "dried beans" series of Strauss and Bean; 1874, interpolated from data on the N.Y. census of 1875 (lines 32, 34), on line 16 (line 33), on the "dried beans" series of Strauss and Bean (line 31), on total gross income (line 29) and by straight line interpolation (lines 30, 35).

Line 36: See the prewar estimates.

Line 37, 1869, *and lines 38–40*, 1869 and 1879: Estimated from census returns. *Line 37*, 1874 and 1879: Straight line extrapolation in constant prices. *Lines 38, 39*, 1874: Straight line interpolation. *Line 40*, 1874, interpolation on gross income.

Fertilizer purchases: 1879, 1889, 1899, census returns; 1869, census return of the value of manufactured fertilizer; 1874, 1884, 1894, interpolated on gross income.

1879 Prices, 1839–1859

Current price data deflated by use of price data indicated above. The following price data were used to deflate lines 13, 23, 24, 29, 37.

Lines 13, 23, 24: Price indexes made up from state farm price data—Vt., Ind., N.Y., Me., Md. (lines 13, 24 only), Wis. (lines 23, 24 only), Iowa (line 24 only).

Line 29: Irish potato prices, converted to price relatives.

Line 37: Price index made up from cloth prices of the Aldrich Report.

1879 Prices, 1869–1899

Current data converted to 1879 prices by use of price series of Strauss and Bean.

Line 26: Cane sugar prices were used to deflate gross income from beet sugar.

Lines 27, 28: Orchard fruits price relatives were used to deflate gross income from citrus fruits and grapes.

See notes relating to the prewar estimates for the methods used to deflate *lines 29–40* for 1869, 1874, 1879, and *line 36*, 1884–1899. *Lines 29, 35*, 1884–1899, were deflated by use of a weighted index made up from the prices of Irish potatoes, cane sugar, beans (all from Strauss and Bean) and the Warren and Pearson lumber price index (pp. 118, 119).

The cost of purchased fertilizer in 1879 is from the census. It was assumed that the cost of fertilizer in 1869 and 1874, in constant prices, took the same share of gross income as the cost of fertilizer in current prices. The estimates for 1889, 1894, and 1899 were extrapolated from 1879 on the quantity of commercial fertilizer consumed in the U.S. (*Historical Statistics*, p. 100). The estimate for 1884 was interpolated on gross income in constant prices.

TABLE A-3

Ratio of Output Entering Gross Income to Output, Selected Crops, Quinquennial, 1839–1859

Crop	*1839*	*1844*	*1849*	*1854*	*1859*
Wheat	0.85	0.87	0.87	0.87	0.87
Corn[a]	.185	.185	.185	.185	.185
Oats	.30	.30	.30	.30	.30
Barley	.85	.85	.85	.80	.75
Rye	.737	.737	.737	.737	.737
Buckwheat	.60	.60	.60	.60	.60
Hay	.18	.18	.18	.18	.18
Irish potatoes	.77	.77	.825	.825	.825
Sweet potatoes	.85	.85	.908	.908	.908
Flaxseed	.911	.911	.911	.911	.911
Peas and Beans	.60	.60	.60	.60	.60

[a] Ratio of output entering gross income to output minus exports.

Sources: *Peas and beans*—A rough approximation based on information in the 1860 census, *Agriculture*, p. lxxv. *All others*—Strauss and Bean, with the following modifications: The barley ratio was adjusted upward because census returns for 1849 indicated that a large part of the crop was used in brewing. The feed allowances of wheat and potatoes were varied with the sizes of these crops relative to the corn crop; e.g. it was assumed that when the potato crop was relatively large a larger share would be used for feed, and vice versa.

The ratios of output entering gross income to output reported by Strauss and Bean were used for the prewar period, with some modifications (Table A–3). They were checked against Seaman's estimates (pages 625–626) and were found to be generally appropriate.

Farm prices for the postwar period were carried back on wholesale prices and on various farm price series.[50] The estimates for 1849 agree closely with Seaman's. Prices of 1840 had to be used in place of those

[50] Wholesale prices were taken mainly from the Aldrich Report and from Arthur Harrison Cole, *Wholesale Commodity Prices in the United States, 1700–1861, Statistical Supplement*, Harvard University Press, 1938. The sources of the state data were as follows:

State Censuses and Other Statistical Reports. (1) *Abstract of the Census of Arkansas for the Year 1854*, Secretary of State of Arkansas, Journal of the House of Representatives for the Tenth Session of the General Assembly, Johnson and Yerkes, 1855, Appendix, pp. 111–113; (2) *Statistics of the Condition and Products of Certain Branches of Industry in Connecticut for the Year Ending October 1, 1845*, Secretary of State of Connecticut, John L. Boswell, 1846; (3) *Thirteenth State Census*, Executive Council of Iowa, R. P. Clarkson, November 1, 1875 (contains the returns of the census of 1856); (4) *Statistics of the Condition and Products of Certain Branches of Industry in Massachusetts for the Year Ending April 1, 1845*, Secretary of the Commonwealth of Massachusetts, Dutton and Wentworth, 1846, and *Statistical Information Relating to Certain Branches of Industry in Massachusetts for the Year Ending June 1, 1855*, William White, 1856; (5) *Census and Statistics of Michigan, May 1854*, Secretary of State of Michigan, George W. Peck, 1854; (6) *Census of the State of New York for 1845*, Secretary of State of New York, Carroll and Cook, 1846, and *Census of the State of New York for 1855*, Charles Van Benthuysen, 1857; and (7) *Annual Report on the Condition of Finances of Ohio for the Year 1855*, Auditor of the State of Ohio, Statesman Steam Press, 1856.

Bulletins of the Agricultural Experiment Stations. (1) University of Vermont, Bull. 507, Free Press, 1944; (2) University of Maryland, Bull. 321, N.P., September 1930; (3)

of 1839 in some cases, since several of the extrapolating series did not run back past 1840. The total of these estimates was adjusted to the level of census year 1839 prices. The adjustment was based on the Warren and Pearson (p. 85) index of agricultural prices.

The constant price estimates were made, most often, by applying 1879 prices directly to the estimates of output entering gross income.

MINING

Three steps were required to make the mining estimates (Table A–4). The output of each product was estimated, valued in current and in 1879 prices, and reduced by the value of materials and fuels consumed in the process of production. The ratio of value added to value of output was assumed to be the same in constant as in current prices (i.e. it was assumed that the prices of materials and fuels consumed changed with the prices of output). The value of materials and fuels consumed was a very small share of value of output, ranging from about 12 to 16 per cent for all mining.

The basic output data are from the federal and state censuses and the various volumes of *Mineral Resources*. Most of the *Mineral Resources* series appear in *Historical Statistics* and in the table notes this more familiar source is cited. As in the case of agriculture, calendar year data were sometimes averaged to approximate census year output.

The precious metals industries were omitted because the available data are quite poor. For example, the 1860 census reports $47 million of gold output in 1859, a figure quite generally accepted.[51] But according to General Walker this aggregate includes duplications and triplications, and the true total is nearer $17 million.[52] Whichever estimate is correct, it is clear that the industries left out were important. They probably contributed between 15 and 25 per cent of mining value added after 1849.

Several other minor sources of income have been omitted. For example, the 1880 census lists some eighteen "minor minerals." Value added by their production was less than 1 per cent of the total mining estimate for 1879.

Census year producers' prices were interpolated and extrapolated on data from the Aldrich Report, Cole, and *Mineral Resources*.

Purdue University, Bull. 476, N.P., January 1943; (4) University of Maine, Bull. 364, N.P., March 1933; (5) University of Wisconsin, Res. Bull. 119, N.P., November 1933; (6) Virginia Polytechnic Institute, Tech. Bull. 37, N.P., March 1929; (7) Cornell University, Bull. 643, Cornell University Agricultural Experiment Station, March 1936; and (8) Iowa State College of Agriculture and Mechanic Arts, Res. Bull. 303, N.P., November 1932.

[51] For example, see *Historical Statistics*, p. 152 and also p. 137.

[52] The Census Office in 1859 apparently added the value of output returns of gold mining and processing firms to get the value of gold output (*1870 Census of the United States*, Vol. III, *The Statistics of the Wealth and Industry of the United States*, pp. 750–753).

TABLE A–4

Value Added by Mining, Current and 1879 Prices, Quinquennial, 1839–1859 and 1869–1899
(millions of dollars)

Product	*1839*	*1844*	*1849*	*1854*	*1859*	*1869*	*1874*	*1879*	*1884*	*1889*	*1894*	*1899*
						CURRENT PRICES						
Anthracite	1.6	3.1	5.6	13.3	10.2	34.9	50.6	35.5	51.5	55.8	67.4	73.0
Bituminous	1.6	1.7	2.9	5.6	7.6	33.3	47.9	48.7	67.9	92.2	101.1	174.3
Iron	2.4	4.5	3.7	5.8	4.3	15.1	12.2	19.9	16.8	30.9	17.0	39.8
Petroleum					2.2	20.5	11.4	19.4	18.5	28.9	43.2	65.2
Natural gas									2.0	8.2	10.6	17.2
Copper		[a]	0.2	1.3	2.9	4.6	5.9	5.8	9.1	17.6	18.4	49.0
Lead	0.8	1.1	1.0	1.0	0.9	0.7	2.0	3.5	4.3	6.5	5.5	11.2
Zinc					0.1	0.7	1.4					
Cinnabar			0.4	0.8	0.3	0.8	1.7	1.0	0.5	0.6	0.5	0.7
Quarry products	1.5	2.2	2.1	2.7	4.1	11.0	15.3	16.6	25.5	39.6	24.7	32.5
Salt	0.9	0.9	1.1	1.3	1.3	3.1	1.5	2.8	2.6	2.6	2.6	3.9
Total	8.9	13.5	16.9	31.9	34.0	124.7	150.0	153.1	198.5	282.7	291.1	466.7
						1879 PRICES						
Anthracite	1.2	3.1	5.3	10.3	10.3	20.9	28.9	35.5	46.7	56.9	68.0	72.9
Bituminous	1.2	2.0	3.1	5.2	7.1	20.5	34.6	48.7	86.3	114.7	140.7	224.7
Iron	2.5	4.7	4.9	5.2	5.5	11.3	11.5	19.9	22.1	42.7	38.9	73.1
Petroleum					0.2	4.0	8.2	19.4	19.3	34.0	42.9	50.6
Natural gas									2.3	9.9	12.9	17.8
Copper		[b]	0.3	1.0	2.5	4.2	5.1	5.8	15.6	23.5	34.3	53.4
Lead	0.8	1.3	1.1	0.8	0.8	0.4	1.2	3.5	5.3	7.3	8.7	12.5
Zinc					0.1	0.4	1.2					
Cinnabar			0.1	0.5	0.2	0.5	0.5	1.0	0.5	0.4	0.5	0.4
Quarry products	1.0	2.3	1.9	2.3	4.9	6.1	11.5	16.6	25.7	53.1	36.0	36.4
Salt	0.5	0.7	0.8	1.0	1.2	1.8	1.7	2.8	3.1	3.9	6.2	9.4
Total	7.3	14.2	17.4	26.4	32.7	70.1	104.5	153.1	227.0	346.3	389.0	551.2

Details may not add to totals because of rounding.

[a] $33,000.

[b] $37,000.

Sources: *Current price estimates*: Based on federal census data for various years interpolated or extrapolated to other years, principally on value of output estimates. Federal census data for the following census years were used: 1859–89, 1902, coal; 1849–89, 1902, iron; 1869, petroleum; 1902, natural gas; 1859, 69, 1902, copper; 1859–79, 1902, lead and zinc; 1869, 1902, cinnabar; 1869, 79, quarry products; 1849–79, salt. The series used for interpolation and extrapolation follow.

Anthracite and bituminous coal: The product of output and price series. Output—*Historical Statistics*, p. 142, figures for the second year sharing the census year (1840, etc.) through 1880 and the means of the two years sharing the census year thereafter (in this way census and *Historical Statistics* data are made most nearly consistent). Price—Census unit values (1859, 69, 79) interpolated and extrapolated on prices from the Aldrich Report, Part II, pp. 176, 178, Cole ("anthracite, New York" and "Western, New Orleans"), and *Historical Statistics*, p. 142.

Iron: The product of output and price series. Output—1869–99, *Historical Statistics*, p. 149, figures for the second year sharing the census year through 1880 and means of the two years sharing the census year thereafter (see notes on coal); 1849, 59, census returns of ore consumption by pig iron producers (the 1860 census return of output was not used because it is an estimate which overstates output, since it includes the output of independent mines and the ore consumption of all pig iron producers); 1839, 44, 54, interpolated and extrapolated from federal census year estimates on pig iron output. See *Historical Statistics*, p. 149, and Seaman, p. 158. Price—Census unit values (1859, 69, 79) interpolated and extrapolated on prices in *Mineral Resources*, 1883, pp. 142 and 143, and the *Statistical Abstract*, 1902, p. 464.

Petroleum: Value of output. 1859–79, *1880 Census*, Vol. X, *Petroleum . . .*, pp. 148, 149, means of calendar year data. 1884–99, *Historical Statistics*, p. 146, means of calendar year data. (Census and *Historical Statistics* output and unit value estimates differ, but the value of output estimates are almost identical in the years in which the series overlap.)

Natural gas: Value of output, 1889–99, and value of fuel displaced, 1884, *1900 Census*, *Mines and Quarries*, p. 770.

Copper, lead, zinc: 1879–99, value of output of smelters, *Historical Statistics*, pp. 149–151. Years before 1879, the product of smelter output and price series, *Historical Statistics*, p. 151, Aldrich Report, Part II, pp. 185, 192, 213, 214, *Summarized Data of Zinc Production*, Bureau of Mines, Economic Paper No. 2, 1929, p. 19.

Cinnabar: Value of output of smelters, *Historical Statistics*, p. 149.

Quarry products: 1849–59, census value added by quarrying and stoneworking. 1839, census value of output of quarrying and stoneworking. 1844, 54, 74, value of output of quarrying and stoneworking returned in the Conn. (1844 only), Mass., N.Y. (1854 only) censuses. 1884–99, value of output of stone (less limestone) and slate, *Mineral Resources*, 1914, Part II, p. 822, and *Historical Statistics*, p. 147.

Salt: 1879–99, value of output, *Historical Statistics*, p. 148 (means of the two years sharing the census year). 1839–74, the product of output in various states, *Mineral Resources*, 1883, pp. 536–541, and price, Aldrich Report, Part II, p. 98.

Constant price estimates: Current price data deflated by use of price or unit value series noted above and the following: petroleum, cinnabar, salt (1879–99), same source as value of output; natural gas, petroleum unit values; copper, lead, zinc, 1879–99, ingot prices or unit values, same source as value of smelter output; quarry products, price index made up from the prices of cement (Rosendale) and lime (Rockland), 1839–79, Aldrich Report, Part II, pp. 223, 226, unit values of hydraulic cement, 1879–99, *Historical Statistics*, p. 147.

MANUFACTURING

The manufacturing estimates were originally made for 1839 through 1879 (as were the agricultural and mining estimates). Subsequently they were extrapolated to 1899 (see Table A–5).

TABLE A–5

Value Added by Manufacturing, Current and 1879 Prices, Quinquennial, 1839–1859 and 1869–1899
(dollar figures in millions)

Year	*Current Prices*[a]	*Price Index*[b] (1879 = 100)	*1879 Prices*[c]
1839	$ 240	126.3	$ 190
1844	311	107.2	290
1849	447	91.6	488
1854	663	97.9	677
1859	815	94.8	859
1869	1,631	151.3	1,078
1874	2,072	122.5	1,692
1879	1,962	100.0	1,962
1884	3,047	94.8	3,215
1889	3,727	89.7	4,156
1894	3,598	65.7	5,480
1899	5,044	80.5	6,252

[a] *1839:* Table A–7. *1849, 59, 69:* Census returns less totals of the nonmanufacturing industries (see text) plus totals of Table A–6. *1879:* Same less allowance for duplication of textile returns ($10.8 million, see text). *1844, 54, 74:* Interpolated on the returns of the Conn. (1844), Mass. (1844–74), N.Y. (1844 and 54) and R.I. (1874) censuses. *1889, 99:* Extrapolated from 1879 on estimates appearing in Kuznets and Thomas, p. 694. *1884, 94:* Interpolated on Kuznets' new estimates of flow of goods to consumers, less services (Variant I) and gross producers' durables (*Supplement to the Summary Volume*).

[b] Value of output, current prices, minus value of materials and fuels purchased from other sectors, current prices, divided by the same, in prices of 1879.

Price index of value of output: *1839–74*—Warren and Pearson group price indexes (less "farm products," "fuel and lighting," "spirits," "hides and leather"), shifted to the base 1879 (without reweighting), and a leather index made up from data of the Aldrich Report, Part II, pp. 147, 163, weighted by shares of appropriate industrial groups in the value of manufacturing output (constant prices). Weights were worked out from census data (1849, 1859, 1869), deflated by use of the group price index numbers. *1884–99*—same except that the Warren and Pearson group price index, "hides and leather," was substituted for the leather price index.

Price index of purchases from other sectors: Made up from price data used in making the agricultural and mining estimates and hide prices from the Aldrich Report Part II, pp. 17, 18, 20, 21, 141, with appropriate weights made up from data on purchases by the manufacturing sector appearing in the federal census reports. The prices of wheat, cotton, and hides dominate the index before 1879. After 1879 only the prices of wheat, cotton, and meat animals (live weight prices) were used.

[c] Value of output minus value of materials and fuels purchased from other sectors, in prices of 1879. See note b.

The sources of data for 1839–79 were federal and state censuses. Census manufacturing totals were adjusted to exclude nonmanufacturing industries. Reports on the following nonmanufacturing industries were included in the censuses of manufactures of 1849 through 1879. Their total value added was (in millions of dollars):

1849–54; 1859–92; 1869–140; and 1879–135.

Mining

1849, 59, 69, 79–salt.
1849, 59–iron, anthracite and bituminous coal, gold, stone and marble, chrome.
1849–mica, ocher, slate.
1859–copper, zinc, silver, barytes, clay and fire and paper clay, corundum, granular fuel, scythestones, whetstones, magnesia, manganese, nickel, nickel and cobalt, oil stones, plumbago, glass and moulding and washed sand, soapstone.

Fisheries

1849, 59–fisheries.
1859–sponges.
1869–whale fisheries.

Forestry

1859, 69, 79–kindling wood.
1849, 59–timber hewing, wood cutting.

Construction

1849, 59, 69, 79–carpentering (including building in 1849 and 1869), plumbing.
1849, 59, 69–millwrighting.
1859, 69, 79–gasfitting, bridges.
1859, 69–plastering.
1859, 79–windmills.
1869, 79–painting, paper hanging, masonry.
1859–stucco and stucco work, asphaltum work, stair building.

Agriculture

1859, 79–cotton compressing.
1859–cotton ginning, grain threshing, hay pressing, clover hulling, clover seed cleaning, flower and garden seed, flowers.
1879–tobacco stemming.

Services

1849, 59, 69, 79–photography.
1859, 69, 79–dentistry, taxidermy, watch and clock repairing.
1859–carpet cleaning, laundry work, watch engraving.
1879– dyeing and cleaning.

Hand Trades

1849, 59, 69, 79–blacksmithing, locksmithing.
1859, 69, 79–coppersmithing.
1849, 59–whitesmithing.
1869, 79–gunsmithing.
1859–carriagesmithing.

Also an attempt was made to correct for industries omitted or poorly returned in the various censuses (Tables A–6 and A–7).[53]

TABLE A–6

Additions to Manufacturing Census Returns of Value Added, in Current Prices, Decennial, 1849–1879

(millions of dollars)

Industries	*1849*	*1859*	*1869*	*1879*
The periodical press[a]	18	31	10	58
Coopering[b]	10	13	9	11
Wheelwrighting[c]	8	9	8	
Other[d]				56
Total	36	53	27	125

[a] *1849:* Extrapolated from 1859 on value added by publishing other than periodicals. *1859:* The difference between value added by all publishing, interpolated on value added by "paper, unspecified," and the census return of value added by all publishing. *1869:* The difference between value added, extrapolated from 1879 on value added by publishing, other than periodical publishing, and the census return of value added by periodical publishing. *1879:* Value of output (*1880 Census*, Vol. VIII, S. N. D. North, *The Newspaper and Periodical Press*, p. 179) times the ratio of value added to value of output in 1869.

[b] Value added per worker (manufacturing census) times the number of coopers (occupational census), minus the census return of value added by coopers.

[c] *1849, 1869:* Value added per worker (manufacturing census) times the number of wheelwrights (occupational census), minus the census return of value added by wheelwrights. *1859:* The estimates for 1849 and 1869 interpolated on manufacturing value added.

[d] Includes the manufacturing of gas ($19 million) interpolated on value added by manufacturing; steam railroad company shops ($18 million), extrapolated from 1889 on value added by all other railroad shops; fish curing and packing ($2 million) interpolated on value added by all other canning; and from the *1880 Census*, Vol. X, S. F. Peckman, *Production Technology, and Uses of Petroleum and Its Products*, p. 192, petroleum refining ($9 million), and Vol. XV, Raphael Pumpelly, *Report on the Mining Industries of the United States*, p. 812, smelting of nonferrous, nonprecious ore ($6 million), and p. 841. manufacture of hydraulic line and cement ($2 million).

The literature on federal census enumerations indicates that each census up to 1879 or 1889 was more complete than the one preceding it. However, a close reading of the literature reveals that the principal deficiencies of the earlier censuses were in the returns of the construction and independent hand trades, returns which were not used in making the present estimates.

[53] One correction for "overreporting" was made. The returns of the 1880 census relating to textile industries involved duplications amounting to about $10.8 million. *1890 Census, Report on Manufacturing Industries . . .*, Part I, pp. 2, 4.

TABLE A–7

Value Added by Manufacturing, in Current Prices, by Industry Group and by Source of Data, 1839

(dollar figures in millions)

Industry	*Based on Value of Product Data of Census Report*[a]	*Based on Output Data of Census Report and Estimated Prices*[b]	*Taken from Seaman*[c]	*Extrapolated or Interpolated*[d]	*Total*
Ordnance		1		[e]	1
Food products	10	8	4	4	26
Tobacco	3				3
Textile products	30			4	34
Apparel	5			6	11
Lumber and wood products	12		4	10	25
Furniture and fixtures	5				5
Pulp, paper, and paper products	3				3
Printing and publishing				15	15
Chemicals	2	8		3	12
Products of coal				1	1
Leather and leather products	18	6		6	31
Stone, clay and glass products	12[f]			[e]	12
Metals	7	14		4	25
Machinery	7				7
Transport machinery	11			9	20
Professional instruments				1	1
Musical instruments	1				1
Miscellaneous				10	10
Total	125	36	8	71	240
Percentage of total value added	52	15	3	30	100

Details may not add to totals because of rounding.

[a] Census value of output returns times the 1850 census ratios of value added to value of output, by industry group. (Same method used throughout to get manufacturing value added in 1839 from value of output.)

[b] Prices: Producers' prices extrapolated from later censuses on wholesale prices from Cole (pig iron, bar iron, domestic whiskey) and the Aldrich Report, Part II (pig lead, p. 163, sole leather, p. 192); Seaman's prices of soap, candles, gunpowder, ashes, tar, pitch, rosin, turpentine (pp. 455, 457). Cannon and small arms prices of the Mass. census for 1844.

[c] Value of output: Seaman, p. 456 (products of mills) divided between "food products" and "wood products" as in 1849.

[d] Textile products and leather and leather products estimated from data in the Mass. censuses for 1836 and 1844 and the 1850 federal census. Other items extrapolated from 1849 on value added by the relevant industrial groups.

[e] Less than $500,000.

[f] Including stoneworking, which was partly estimated.

The completeness of the federal census returns was checked indirectly. The manufacturing censuses contain data on numbers employed, collected from employers. The occupational censuses contain data on gainful workers, collected from households. The Fabricant estimates of gainful workers rest on the data of the occupational censuses. The numbers employed in the manufacturing industries represented in the present series were compared with the Fabricant estimates of gainful workers in manufacturing (adjusted as described in the notes to Table 1) for 1859, 1869, 1879, and 1889. The census occupational data were also used directly to check the manufacturing census returns of 1849, 1859, 1869, and 1879. The tests turn up no evidence that the later manufacturing censuses were more complete than the earlier censuses.

The interpolating series (for the intercensal dates) accounted for about a quarter of national manufacturing value added in the forties, about a third in the fifties, and about 15 per cent in the seventies.

CONSTRUCTION

The construction estimates are the result of (1) estimating the flow of construction materials into domestic construction, at producers' prices, (2) marking up these values for transportation and distribution, and (3) marking up the values in delivered prices for value added by construction. For 1874 and 1884, however, value added was interpolated on Kuznets' new estimates of gross construction.[54]

Flow of Materials

For 1869, 1879, 1889, 1894, and 1899 Shaw's estimates (pages 64, 65) were used. The estimating technique for the remaining years is given in the notes to Table A–8.

Transportation and Merchandising Markup

The transportation and merchandising markup was worked out from Barger's data for 1869, 1879, 1889, and 1899 and extrapolated to the earlier years on the assumption that the postwar trend in the ratio of transportation and distribution costs to the value of construction materials entering domestic consumption existed in the prewar period as well. The notes to Table A–9 give the details of the method.

Markup for Value Added

Two construction series were produced (Table A–10), the difference between them lying in the assumptions made in marking up the value of materials flowing into domestic consumption for value added by construction. Variant A series rests on the assumption that the trend

[54] Kuznets, *Supplement to the Summary Volume.*

TABLE A–8

Value of Construction Materials Flowing into Domestic Consumption, in Current Prices, Quinquennial, 1839–1859
(millions of dollars)

Type of Material	*1839*	*1844*	*1849*	*1854*	*1859*
Railroad rails[a]	4	3	6	20	17
Railroad ties[b]	[d]	[d]	1	2	1
Other[c]	45	49	67	133	138
Total	48	53	73	155	156

Figures may not add to totals because of rounding.

[a] *1854, 1859:* Output plus net imports times price. Output—*Mineral Resources*, 1883, p. 138. Net imports—*Commerce and Navigation*, Secretary of the Treasury, 1855, p. 199, 1860, pp. 104, 377, and 460. Price—Unit value in 1869 (Shaw's value of output divided by census return of output) extrapolated on a wholesale price of iron rails (Aldrich Report, Part II, p. 189). *1839–1849:* Consumption of rails times price. Consumption—Extrapolated from 1854 on estimates of new track and replacement track laid each year, based on data on new track laid, track in use, and average life of track, taken from the *1880 Census*, Vol. IV, *Report on the Agencies of Transportation in the United States*, Part I. Price—Unit value in 1869 extrapolated to 1849 on a wholesale price of iron rails (see note for 1854 and 1859) and to 1844 and 1839 on Cole's price "bar iron, common, English."

[b] Extrapolated from Shaw's estimate of value of output in 1869 (assumed to equal consumption) on the product of indexes representing tie requirements (see note a) and tie prices (Aldrich Report, Part II, p. 228, oak board, and Cole, "pine, New York").

[c] Value of output plus the net value of imports. *Value of output:* 1839, 1849, 1859—The sum of detailed estimates made by extrapolating Shaw's 1869 estimates (pp. 64–65) on data of the federal censuses. 1844, 1854—Interpolations of estimates for 1839, 1849, 1859 on data of the Conn. (1844 only), Mass., and N.Y. censuses (accounting for about 10 per cent and 15 per cent of national value of output of construction materials in 1844 and 1854, respectively). *Value of net imports:* Rough estimates worked out from the reports of the Secretary of the Treasury. (Net imports amount to less than $2 million in every year.)

[d] Less than $500,000.

in the ratio of the value of construction output to the value of construction materials was zero. This assumption is supported by the returns of the construction hand trades in the censuses of 1869, 1879, 1889, and 1899, which show ratios of value of output to value of materials of 2.06, 1.93, 2.13, 2.28. Seaman (page 456) estimates that the value of houses built in 1839 was about 2.22 times the value of materials consumed. The census of construction for 1939 shows a ratio of 2.21. The ratio 2.0 was used to get value of output from value of materials.

In *National Product since 1869* (page 100) Kuznets assumes that the ratio of the value of construction output to the value of materials *in constant prices* had a zero trend. Variant B series is based on this assumption.

The basic flow-of-materials data on which the estimates rest are reasonably sound. But quite clearly the evidence to guide one in estimating the total value of construction from these data was scanty,

TABLE A–9

Cost of Transportation and Distribution of Construction Materials Flowing into Domestic Consumption, in Current Prices, Decennial, 1869–1899

Type of Cost	*1869*	*1879*	*1889*	*1899*
Wholesale Markup				
Lumber outlets:				
Markup (%)[a]	11.1	11.1	11.1	11.1
Weight[b]	22	26	31	35
Hardware outlets:				
Markup (%)[a]	23.5	23.5	23.5	23.5
Weight[b]	45	40	35	31
Weighted mean markup (%)	19.4	18.6	17.7	16.9
Retail Markup				
Coal and lumber yards:				
Markup (%)[a]	22.0	22.7	23.5	24.2
Weight[b]	27	34	43	48
Hardware outlets:				
Markup (%)[a]	33.7	33.7	31.1	28.5
Weight[b]	45	40	35	31
Weighted mean markup (%)	29.3	28.6	26.9	25.9
Distribution Cost ($ mill.)				
Wholesalers:				
Construction materials handled[c]	232	236	411	452
Cost of wholesaling[d]	45	44	73	76
Retailers:				
Construction materials handled[e]	289	300	540	608
Cost of retailing[f]	85	86	145	157
Total distribution cost	130	130	218	233
Transportation Cost to First Distributor ($ mill.)[g]	29	16	39	49
Total transportation and distribution cost ($ mill.)	159	146	257	282

[a] Based on Harold Barger, *Distribution's Place in the American Economy since 1869*, Princeton University Press for NBER, 1955, pp. 84 (wholesale) and 81 (retail). Barger's margins (percentages of the sales value of goods) were recalculated as percentages of the purchase value of goods. Barger's margins are intended to measure the entire cost of moving goods from the first distributor to the ultimate purchaser (*ibid.*, p. 55).

[b] The share of total construction materials entering distribution which flow through each outlet (*ibid.*, p. 139).

[c] Input of construction materials into the distributive system, including the costs of transportation to the first distributor (*ibid.*, p. 131) times the share of input flowing through wholesaling (p. 139).

[d] Weighted mean markup for wholesaling times construction materials handled by wholesalers.

[e] Input of construction materials into the distributive system, including the costs of transportation to the first distributor (*ibid.*, p. 131), plus the cost of wholesaling.

[f] Weighted mean markup for retailing times construction materials handled by retailers.

[g] *ibid.*, p. 130.

TABLE A–10

Value Added by Construction and the Value of Total Construction, Variants A and B, Quinquennial, 1839–1859 and 1869–1899
(dollar figures in millions)

Series	*1839*	*1844*	*1849*	*1854*	*1859*	*1869*	*1874*	*1879*	*1884*	*1889*	*1894*	*1899*
						VARIANT A: CURRENT PRICES (dollars)						
1. Materials entering construction —producers' values	48	53	73	154	156	377		444		839	1,004	1,006
2. Distribution cost	27	28	37	75	72	159		146		257	294	282
3. Value added by construction	75	81	110	229	228	536	646	590	1,008	1,096	1,298	1,288
4. Value of total construction	150	162	220	458	456	1,072	1,292	1,180	2,016	2,192	2,596	2,576
						VARIANT A: 1879 PRICES (dollars)						
Total construction:												
5. Price index (1879 = 100)	76	70	72	83	79	133	123	100	112	113	103	115
6. Value (dollars)	197	231	306	553	579	808	1,049	1,180	1,803	1,948	2,533	2,244
Construction materials:												
7. Price index (1879 = 100)	87	77	77	90	82	132	123	100	107	107	92	105
8. Value (dollars)	87	105	143	255	277	405	526	590	946	1,029	1,417	1,224
9. Value added (dollars)	110	126	163	298	302	403	523	590	857	919	1,116	1,020
						VARIANT B: 1879 PRICES (dollars)						
10. Value added by construction	87	105	143	255	277	405	526	590	946	1,029	1,417	1,224
11. Value of total construction	174	210	286	510	554	810	1,052	1,180	1,892	2,058	2,834	2,448
						VARIANT B: CURRENT PRICES (dollars)						
12. Value of total construction	132	147	206	423	436	1,075	1,296	1,180	2,115	2,315	2,905	2,813
13. Value added by construction	57	66	96	194	208	539	650	590	1,107	1,219	1,607	1,525

(Notes to Table A–10 on next page)

especially for the prewar period. It was important, then, that the estimates be tested. Table A–11 presents estimates (some very crude) of several important components of total construction for 1839, together with the estimates from the flow-of-materials data. The flow estimates are $40 million (variant B) and $60 million (variant A) larger than the sum of the independent estimates. But the independent estimates do not include the value of business building, including nonresidential agricultural building. It seems likely that this component was about as large as the housing component in 1839. The housing component is roughly the size of the gap between the flow estimates and the sum of the independent estimates. The test is crude but the results are encouraging.

The variant A series was deflated and the variant B series inflated by use of a cost-of-production index (see Table A–10). Grebler, Blank, and Winnick indicate that the long-term movements of a construction cost index from 1890 through 1934 are "remarkably similar" to those of a true price index.[55] However, the present index has at least two minor weaknesses. The only materials represented are building materials and the materials prices are entirely wholesale prices. Building materials prices probably rose more rapidly (or fell more slowly) during the period than the prices of nonbuilding construction materials (e.g. railroad rails). On the other hand, wholesale prices probably rose more slowly (or fell more rapidly) than retail prices (see Table A–8). The effects of the two weaknesses of the index may offset.

[55] Leo Grebler, David M. Blank, and Louis Winnick, *Capital Formation in Residential Real Estate: Trends and Prospects*, Princeton University Press for NBER, 1956, p. 352.

Line 1: *1839–59*—Table A–8; *1869–99*—Shaw, pp. 64–65.

Line 2: Table A–9, interpolated and extrapolated on the value of materials entering construction (see text).

Line 3: Value added is taken to be equal to the value of materials, at cost to the user (lines 1 plus 2). Estimates for 1874 and 1884 are interpolations on Kuznets' new estimates (see text).

Line 4: Line 1 plus line 2 plus line 3 (or 2 times line 3).

Line 5: Made up from an index of building materials (weight—2) and an index of wages in the building trades (weight—1). The former is the Warren and Pearson index, converted to the base 1879, without re-weighting (pp. 100–101). The latter was made up from data in the Aldrich Report, Part I, p. 173, carried from 1889 to 1899 on the Douglas index, *Historical Statistics*, p. 67. The weighting is based on census evidence on the relative importance of wages and materials costs (in current prices).

Line 6: Line 4 divided by line 5.

Line 7: See note to line 5.

Line 8: Line 1 plus line 2 (or line 3) divided by line 7.

Line 9: Line 6 minus line 8.

Line 10: Value added is taken to be equal to the value of materials, in prices of 1879 (line 8). See text.

Line 11: Line 10 plus line 8 (or 2 times line 10).

Line 12: Line 11 times line 5.

Line 13: Line 12 minus the sum of line 1 and line 2.

TABLE A–11

Estimates of the Value of Construction, 1839[a]
(millions of dollars)

1. Housing	51
2. Public construction (other than canals and railroads)	12
3. New York, Pennsylvania, and Ohio canals	10
4. All other canals	3
5. Railroads	17
6. Lines 1 through 5	93
7. Construction omitted from lines 1 through 5: business building (including agricultural nonresidential building), private expenditures on bridges, turnpikes, river and harbor improvements	
8. Estimates of the value of total construction made from the flow of construction materials:	
Variant A	150.0
Variant B	132.0

[a] All items include expenditures on new construction and repairs.

SOURCES:

Line 1: Seaman, p. 456.

Line 2: Seaman, p. 284, "Increase in other public property, such as roads, bridges, churches, national, state and county buildings, forts, harbors, etc." (but excluding canals and railroads) plus an allowance ($2 million) for repairs.

Line 3: Harvey Hirst Segal, "Canal Cycles, 1834–1861, Public Construction Experience in New York, Pennsylvania and Ohio," Ph.D. thesis, Columbia University, 1956, pp. 117, 118, and 210.

Line 4: Rough estimate based on data in *1880 Census*, Vol. IV, *Report on the Agencies of Transportation*, T. C. Purdy, *Report on the Canals*, pp. 22–25 and 31–32.

Line 5: Estimated from data of the *1850 Census*, *Compendium*, p. 189.

Value of Manufactured Producers' Durables

The 1869–99 current price data are Shaw's (pages 61, 62). In the main, the prewar estimates are extrapolations of Shaw's detailed estimates for 1869 (pages 124–133) on census data (Table A–12).

TABLE A–12

Value of Manufactured Producers' Durables, Decennial, 1839–1899
(dollar figures in millions)

Year	*Current Prices*	*Price Index* (1879 = 100)	*1879 Prices*
1839	$26–29	117	$22–25
1849	64	117	55
1859	119	106	112
1869	296	154	193
1879	322	100	323
1889	562	80	700
1899	829	80	1,034

Source: See text.

Two questions arise:

1. Are census data sufficiently detailed to assure that extrapolating series are comparable over time?

2. If they are, was the division of a given product between use in production and other uses constant between 1839 and 1869?

Census data are given in tolerable detail for 1849 and in profuse detail for 1859. The returns for 1839, however, leave something to be desired. The content of one major item was sufficiently doubtful as to require two estimates to be made, based on different interpretations of the item.

On the second question, the assumption is probably justified for finished products that went almost exclusively to producers in 1869 (and later years), and quite clearly had no uses (or very limited uses) in the hands of others (e.g. locomotives). The principal items failing to meet these criteria are store and office furniture (extrapolated on furniture), business vehicles (extrapolated on carriages and wagons), cordage, and saddlery and harness. These items are important, contributing between $\frac{1}{5}$ and $\frac{1}{6}$ of the total value of manufactured producers' durables. For an estimating error on this account to have a marked effect on the total estimate, however, the change in the share going to producers would have to be pronounced indeed.

Current price estimates were deflated by use of a price index weighted by the components of the value of output estimates. Aldrich Report prices were used, principally. They were carried to 1899 on Shaw's data and pieced out for the earlier years by use of prices from Cole and Warren and Pearson. The Aldrich Report prices used were as follows: two hoop pails, wooden tubs (to 1840), scythes, shovels, harness leather, mortise locks, rim locks, anvils, kitchen chairs (to 1849), bedroom chairs, kitchen tables, meat cutters, circular saws, crosscut saws, hand saws, standard hand saws (to 1859), files (4″, 8″, 12″), augers, chisels (to 1869). A lumber price index, which moves more nearly with implement prices than any other series available for the earlier years, was taken from Warren and Pearson (p. 118). Also used were leather prices from Cole ("Spanish sole oak at Philadelphia," "hemlock sole at New York," and "sole, at New Orleans").

Current and constant price output of ships and boats were estimated separately for the years before 1899. Values per ton for wooden and iron ships were calculated for 1879 from census data and applied directly to census output data for 1889. A preliminary constant price series was then calculated for the earlier years by weighting Treasury data on ship construction (*Historical Statistics*, p. 211) with 1879 prices. Price index numbers were derived by dividing these estimates through the current price estimates (from census data).

The Treasury reporting system for ships was altered between 1869 and 1879. Consequently the level of the constant price estimates and the

level of the price index numbers for the earlier years had to be adjusted. The level of the index was adjusted and the final constant price series was derived by dividing the current price series by the new price index. The adjustment of the index was worked out in the following way. The Warren and Pearson lumber and metals index numbers for 1869 were shifted to the base 1879 and combined. This number was used as the final ships and boats price index for 1869 and was extrapolated to the earlier years on the preliminary series. The final price index numbers are 1839—126; 1849—110; 1859—106; 1869—131; 1879—100; and 1889—78. The decline from 1879 to 1889 is the result of a substantial decline in the price of iron ships, together with an increase in the weight given the prices of iron ships. Wooden ship prices actually rose somewhat between 1879 and 1889. The index number for 1899 was extrapolated from 1889 on Shaw's price index for ships and boats.

COMMENT

NEAL POTTER, Resources for the Future, Inc.

Gallman's tables are a major contribution to the statistical measurement and understanding of the pre-Civil War period in the American economy. He employs a multitude of sources in addition to a careful use of the censuses of industries. We all owe him a debt of gratitude for this job; but we will not be able to fully appraise it except in long and painful use and comparison with other information on the period.[1]

Gallman makes adequately clear, however, that the information available for this period leaves much to be desired. Census methods were of variable quality and dubious meaning in the early days—a problem which is intensified by the long time and great changes which have come over the industrial scene since the data were collected. The meaning of words has changed, the character and definitions of industries has changed, and a revolution in statistical methods and standards has come about since the census of 1840.

We should note the sources of probable upward bias in these data: Industries omitted include not only all the services (transport, trade, finance, etc.) but also fishing, forestry, nonfarm home manufacturing, and independent hand trades (such as blacksmithing, tinsmithing, cobbling, harness-making, tailoring, and dressmaking). These activities were in considerable part displaced by manufacturing during the period 1839–99, giving Gallman's commodity output series an upward bias.

[1] One evidence of the changes in meaning which may be attached to figures, as well as changes which may be accepted in the figures themselves, when they are used and compared with other data, is the fact that the author of the tables himself has prepared a set of comments for this volume which are quite different from those prepared for the conference report, though data, trends, and many important conclusions remain unchanged.

To this bias must be added the bias caused by possible improving coverage in the censuses.

In addition we should note the considerable estimating required to fill in the deficiencies of the census data: Gallman's Table A–7 shows that his estimates of manufacturing output in 1839 were only 52 per cent from census data on value of products—and this 52 per cent is an estimate, derived from the 1840 census figures on value of product multiplied by the 1850 census ratios of value added to value of product. The remaining estimates are probably poorer, though still based on relevant data: 15 per cent are based on census physical output data, multiplied by estimated producers' prices, times 1850 census ratios of value added to value of product; 3 per cent comes from the opinion of a contemporary writer; and the remaining 30 per cent is extrapolated in ways not clearly specified, from the value-added figures of the 1850 census.[2]

The mining data look at first glance a little sounder; they come from censuses and the predecessor of the Bureau of Mines. But we note (in the notes to Table A–4) that in a number of cases physical output had to be multiplied by an estimated average price to get value of output; and from this, value added was estimated by extrapolating ratios from one census to another. We note further that the precious metals mining data was discarded throughout because of an error estimated at nearly 200 per cent. It may well be that the greatest errors occur in the precious metals field, with its large number of individual gold panners and other small operations; but we should remember there has also been a large amount of very small scale mining (of coal, oil, gas, stone, etc.), which makes room for considerable error in these series also.

The figures on construction are a kind of makeshift, since the desired value-added figure is merely estimated as equal to the value of materials used. Gallman offers some evidence that this one-to-one ratio may be correct, but it is clear that the result is a guess employed to cover a large and poorly defined industry.

There remains agriculture, which at the beginning of the period produced 70 per cent of the value added in commodity production, and at the end of the period about one-third. Checking the source notes in Table A–2, we can see that only about one-half of the total value added comes directly from census figures. The other data represent better or worse expedients for estimating figures that are not available. One of these estimates has farm labor producing more than six times as much improvement to the land in 1854 as in 1849, and more than four times as much as in 1859. The increase in this one item accounts for half the increase in real farm output from 1849 to 1854 and it is the principal cause of the out-of-line jump in productivity from 1849 to 1854. (This

[2] Mr. Gallman tells me, however, that full details are given in his doctoral dissertation.

figure may be correct, but I think we need more evidence.) Other figures, though less startling, may be equally subject to error.

Despite the limitations of his data, Gallman makes some initial uses of the material (as in approximating GNP) and some analyses (as in the tables of first and second differences for the growth rates, and the breakdown of growth in productivity into shifts of labor between sectors and intra-sector productivity gains). These are helpful steps toward the many uses, analyses, and comparisons which these data must undergo on their way to refinement and acceptance.

REPLY by Mr. Gallman

As Mr. Potter says, details of my 1839 estimate for manufacturing are contained in the dissertation cited at the beginning of the appendix to my paper. Mr. Potter's comments suggest to me, however, that it may not be amiss to extend here the remarks which appear in my paper concerning this estimate. I will also add something on the "improvements" estimate for 1854.

Manufacturing value of output in 1839 was divided among industrial groups (see Table A–7). Ratios of value added to value of output were derived for each industrial group from data of the 1850 census and were applied to the 1839 figures. Subsequently the ratios were checked against similar ratios drawn up from data of the censuses of 1860, 1870, and 1880 and were judged to be appropriate.

Value of output of the clothing and leather (other than tanning) industries was estimated from figures for Massachusetts, derived from state censuses (1837, 1845). The leather estimates were made because the 1840 census returns of the value of leather output were deficient. The 1840 returns apparently lump together several important industries, including the clothing industry, in an "all other" category. I preferred to make individual estimates for these industries, since there was good reason to suppose that the "all other" category was under-returned. Estimates were made for industries appearing in the 1850 census, in existence in 1839, but not explicitly reported in the 1840 census (that is, presumably included in "all other"). With some exceptions (for example, clothing, as noted above), the value of output of these industries was extrapolated from 1849 to 1839. The extrapolator, in most cases, was the value of output of the industrial group of the industry for which value of output in 1839 was sought (see Table A–7). For example, the value of output of wooden containers was extrapolated from 1849 to 1839 on the value of output of lumber and wood products returned at both the 1840 and 1850 censuses. Had I used the "all other" category instead of following the procedure described above, the 1839 estimate of value added by manufacturing would have been about 25 per cent smaller than it is. I believe that these estimates, however crude, improve

the record available for manufacturing. In any case, very large errors, indeed, would be required here to change the findings described and discussed in the paper materially.

The "improvements" series accounts for between 2 and 6 per cent of value added by agriculture, in census years, and as much as 16 per cent, in one intercensal year. It is the weakest of the agricultural series that are quantitatively significant. Mr. Potter regards it with suspicion, noting that it "has farm labor producing more than six times as much improvement to the land in 1854 as in 1849, and more than four times as much as in 1859." Some further account of the way in which the estimates were constructed for the fifties may help the reader to evaluate the series.

First, the series covers improvements made by farm labor using farm materials. All other improvements are included in the construction series. It was assumed that farm labor and materials were used exclusively in the improvement of land previously unimproved (breaking virgin land, fencing, etc.) and that nonfarm materials and labor were used to make repairs, replace sod huts with frame buildings, and so on, on improved land. These assumptions leave room for both omissions and duplications. Repairs made with farm materials enter neither the agricultural nor the construction series, while the fencing of virgin land with nonfarm materials enters both. Nonetheless, the violence done reality by these assumptions is probably not great.

The "improvements" series, then, is based on the number of acres of newly improved land. Now the question is whether a very much greater volume of new land was improved in 1854 than in 1849 or 1859. The principal source of virgin land during the fifties was the federal government. The number of acres of land improved between 1850 and 1860 was about 50 million, according to the census. The number of acres sold to individuals by the federal government was about 42 million (Gallman, *op. cit.*, p. 94). For purposes of the estimates, the land improved during the decade was allocated among the years on the basis of federal sales to individuals. Speculation in land would throw the series off, since land purchased for speculative purposes would not be improved immediately. According to Hibbard (*op. cit.*, p. 104), speculation was "given a body blow" by the Preemption Act of 1841. (The speculation of the 1830's had already been extinguished by the collapse of 1837.) Subsequently there was some speculation through the medium of military warrants, and this became serious after 1852, when warrants were made assignable (Hibbard, p. 121). Since land acquired through warrants is excluded from the series on sales used to make the estimates, this speculation should not be reflected in the estimates. With the Graduation Act of 1854 speculation broke out again in connection with the sale of federal land (Hibbard, pp. 300, 301),

though much of the speculation of the mid- and late fifties was still conducted through warrants (Hibbard, p. 224). The collapse of 1857 snuffed out speculation.

The "improvements" estimate for 1854 may be influenced somewhat, then, by speculative activity. How important is this influence likely to be? One cannot say with precision. But suppose that all of the purchases under the graduation principle in fiscal 1855 were speculative purchases, an extreme supposition, since the sale of land below the $1.25 minimum must have stimulated purchases for immediate improvement. Were the estimates to be remade on this assumption, however (data from Hibbard, p. 104), the estimate of "improvements" in 1854 would be three times the estimate for 1849 and twice the estimate for 1859. That is, a substantial change would be made, but "improvements" would remain very much more important in 1854 than in 1849 or 1859. It should be noted, also, that the findings described and discussed in the paper would remain virtually unchanged.