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CHAPTER II

Long-Term Growth of Capital in Manufacturing and Mining

Manufacturing, 1880-1953

The development of manufacturing industries is a familiar story in terms of output and employment,¹ and the broad outlines of the story are not altered when it is told in terms of the stock of capital. For this reason, we show only two measures of the development of manufacturing industries since 1880. One is a measure of the annual rate of change between benchmark years of book value of total capital in 1929 prices, in all manufacturing industries and in the fifteen major groupings (Table 5 and Chart 2).

TABLE 5
Total Capital and Gross National Product per Worker, All Manufacturing,
Dates of Peaks and Troughs in Secular Swings, 1873-1953
(based on values in 1929 prices)

<i>Level</i>	<i>Dates of Level</i>		<i>Rate of Change Per Year (percentage) (3)</i>
	<i>GNP Per Worker (1)</i>	<i>Total Manu- facturing Capital (2)</i>	
Trough	1873		
Peak	1884	1880-1890	+8.8
Trough	1892	1890-1900	+5.3
Peak	1903	1900-1904	+6.5
Trough	1912	1909-1914	+3.0
Peak	1926	1914-1919	+4.6
Trough	1932	1929-1937	-1.6
Peak	1945	1937-1948	+3.2
		1948-1953	+4.8

GNP=Gross National Product.

Source: Column 1: Simon Kuznets, "Swings in the Rate of Secular Growth," Work Memorandum No. 37, p. 19, Table 6 (mimeographed, National Bureau of Economic Research, March 1952); Columns 2 and 3: Table 6, below.

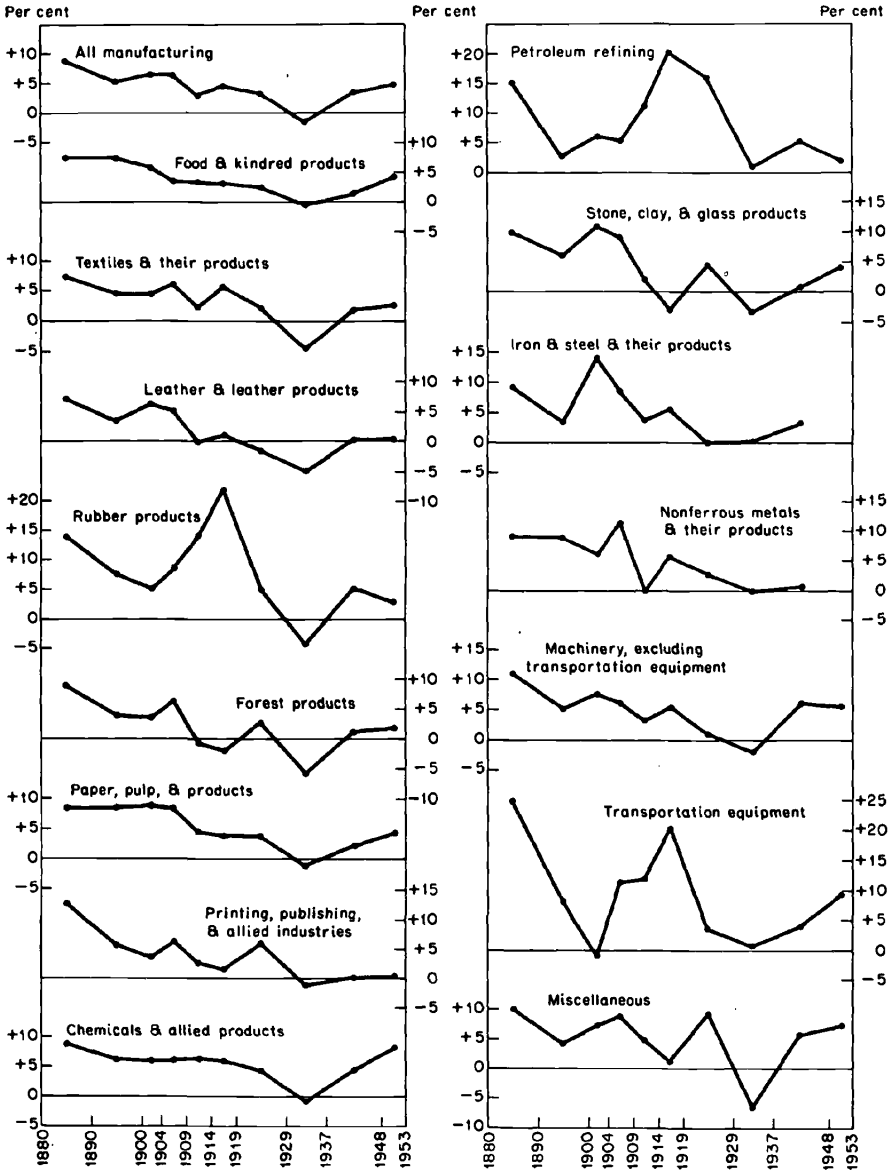
The highest annual rate of growth of the stock of manufacturing capital occurred during 1880-1890, the first decade covered by the statistics, when modern manufacturing in general was emerging from

¹ See, for example, two monographs by Solomon Fabricant, *The Output of Manufacturing Industries, 1899-1937*, and *Employment in Manufacturing, 1899-1939*, National Bureau of Economic Research, 1940 and 1942, respectively.

CHART 2

Total Capital, by Major Manufacturing Industries, Rate of Change per Year between Benchmark Years, 1880-1953

(values in 1929 prices)



Source: Table 6.

Note: Data for iron and steel and their products and Nonferrous metals and their products are not available separately in 1953.

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its earlier beginnings.² The annual rate of growth has tended to decrease as we approach the present period.³ However, it would be wrong to infer from this that the rate of growth decreases continuously and never reverses itself. Certainly, the stock of capital has undergone alternating periods of relatively high and low rates of increase. The long-term trend is downward because each succeeding peak rate, except for 1948–1953, and each succeeding trough rate is at a successively lower level.

The dating of these alternating periods cannot be determined precisely with our data, since we are restricted to average annual percentage changes between benchmark years. Despite this crudity, the evidence suggests that the fluctuations in the rates of change in capital stock coincide with those in countrywide output as measured by gross national product (GNP) per worker in 1929 prices (Table 5). The noncoincidence of the 1926 peak in GNP per worker and the relatively high rate of manufacturing capital in 1914–1919 are more apparent than real. If the latter figure for 1914, for example, were extrapolated by Chawner's estimates of capital expenditures for manufacturing plant and equipment in constant prices for the years 1915–1940,⁴ the long-term peak based on a nine-year moving average computed from the resulting annual estimates would appear in 1926.

How pervasive is this pattern of fluctuation? Is the pattern for total manufacturing capital a result of averaging diverse or similar chronologies? An answer is suggested by comparing the chronology of the long swings in each of the fifteen major groups with the chronology for all manufacturing industries (Tables 6 and 7). A date in parentheses indicates that the turning point for a given industry group differs from that for all manufacturing.

The chronology of only two of the fifteen major industry groups, leather and leather products and machinery, is exactly identical with the one for all manufacturing. Differences in timing occur most frequently between 1890 and 1919. Only two industry groups failed to show a peak rate of growth between 1880 and 1890, and only one failed to show a trough rate of change between 1929 and 1937. On the other hand, all industry groups developed at a relatively higher rate between 1937 and 1948 and between 1948 and 1953. Extended swings due to

² Some part of this rise must be attributed to the under-reporting of capital in 1880 (see Chapter I).

³ If, as we assume, the capital estimates are more and more net of depreciation as we move forward from 1880 to 1919, this would have a damping effect on the rate of growth; if the opposite has been true, which we doubt, the rate of growth has been exaggerated.

⁴ Lowell J. Chawner, "Capital Expenditures for Manufacturing Plant and Equipment—1915 to 1940," *Survey of Current Business*, March 1941, p. 11.

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TABLE 6
Total Capital in Manufacturing Industries: Rates of Change per Year between Benchmark Years, 1880-1953
(per cent based on values in 1929 prices)

	1880-1890	1890-1900	1900-1904	1904-1909	1909-1914	1914-1919	1919-1929	1929-1937	1937-1948	1948-1953
All manufacturing	+8.8	+5.3	+6.5	+6.4	+3.0	+4.6	+3.2	-1.6	+3.2	+4.8
Food and kindred products	+7.4	+7.4	+5.8	+3.5	+3.4	+3.1	+2.4	-0.5	+1.2	+4.1
Textiles and their products	+7.3	+4.5	+4.3	+5.9	+2.2	+5.5	+2.0	-4.6	+1.8	+2.6
Leather and leather products	+6.9	+3.4	+6.2	+5.0	-0.1	+0.9	-1.5	-5.0	+0.1	+0.1
Rubber products	+13.7	+7.5	+5.1	+8.4	+13.8	+21.6	+4.9	-4.0	+5.2	+3.0
Forest products	+8.7	+3.9	+3.7	+6.2	-0.7	-1.9	+2.6	-5.7	+1.3	+2.0
Paper, pulp, and products	+8.3	+8.6	+8.9	+8.4	+4.5	+4.1	+3.9	-1.0	+1.7	+4.4
Printing, publishing, and allied industries	+12.5	+5.6	+3.5	+6.1	+2.7	+1.5	+5.8	-1.1	+0.2	+0.3
Chemicals and allied products	+8.8	+6.2	+6.0	+6.2	+6.3	+6.0	+4.3	-0.8	+4.6	+8.3
Petroleum refining	+15.1	+2.6	+5.9	+5.2	+11.0	+20.1	+16.0	+0.8	+5.1	+2.0
Stone, clay, and glass products	+10.1	+6.1	+10.9	+9.1	+2.0	-2.9	+4.5	-3.3	+0.7	+4.0
Metals and metal products	+10.4	+5.1	+9.3	+8.0	+3.6	+7.1	+1.2	-0.4	+4.1	+6.1
Iron and steel and their products	+9.2	+3.3	+13.8	+8.3	+3.7	+5.4	-0.1	+0.1	+3.3	+4.6
Nonferrous metals and their products	+9.1	+8.9	+6.2	+11.3	-0.1	+5.8	+2.7	-0.1	+0.7	+5.8
Machinery, excluding transportation equipment	+10.9	+5.2	+7.6	+6.2	+3.3	+5.4	+1.0	-1.9	+6.3	+9.2
Transportation equipment	+24.8	+8.0	-1.0	+11.2	+11.8	+20.1	+3.4	+0.7	+4.0	+9.2
Miscellaneous	+10.0	+4.1	+7.2	+8.8	+4.7	+1.1	+9.1	-6.6	+5.8	+7.3

Source: Based on data in Appendix Tables A-8 and A-15.

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TABLE 7
 Total Capital in Manufacturing Industries: Comparison with All Manufacturing of Alternating Periods of High and Low Rates of Change
 between Benchmark Years, 1880-1953
 (based on values in 1929 prices)

All Manufacturing	High	Low	High	Low	High	Low	High
	1880-1890	1890-1900	1900-1904	1909-1914	1914-1919	1929-1937	1948-1953
Food and kindred products	(1890-1900) ^a						
Textiles and their products	1880-1890	(1900-1904)	(1904-1909)	1909-1914	1914-1919	1929-1937	1948-1953
Leather and leather products	1880-1890	1890-1900	1900-1904	1909-1914	1914-1919	1929-1937	1948-1953
Rubber products	1880-1890	(1900-1904)			1914-1919	1929-1937	(1937-1948)
Forest products	1880-1890	(1900-1904)	(1904-1909)	(1914-1919)	(1919-1929)	1929-1937	1948-1953
Paper, pulp, and products			1900-1904			1929-1937	1948-1953
Printing, publishing, and allied industries	1880-1890	(1900-1904)	(1904-1919)	(1914-1919)	(1919-1929)	1929-1937	1948-1953
Chemicals and allied products	1880-1890	(1900-1904)	(1909-1914)			1929-1937	1948-1953
Petroleum refining	1880-1890	1890-1900	1900-1904	(1904-1909)	1914-1919	1929-1937	(1937-1948)
Stone, clay and glass products	1880-1890	1890-1900	1900-1904	(1914-1919)	(1919-1929)	1929-1937	1948-1953
Metals and metal products	1880-1890	1890-1900	1900-1904	1909-1914	1914-1919	1929-1937	1948-1953
Iron and steel and their products	1880-1890	1890-1900	1900-1904	1909-1914	1914-1919	(1919-1929)	1948-1953
Nonferrous metals and their products	1880-1890	(1900-1904)	(1904-1909)	1909-1914	1914-1919	1929-1937	1948-1953
Machinery, excluding transportation equipment	1880-1890	1890-1900	1900-1904	1909-1914	1914-1919	1929-1937	1948-1953
Transportation equipment	1880-1890	(1900-1904)				1929-1937	1948-1953
Miscellaneous	1880-1890	1890-1900	(1904-1909)	(1914-1919)	(1919-1929)	1929-1937	1948-1953

^a A date in parentheses indicates that the turning point for a given industry group differs from that for all manufacturing. Source: Based on data in Appendix Tables A-8 and A-15.

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prolonged expansions occurred in two industry groups related to the revolution in road transportation: transportation equipment, which includes automobiles, and rubber products. In these industries expansion was initiated in 1900–1904 and continued until 1914–1919. Other groups that reached a peak during World War I, rather than in the twenties, were petroleum refining, the metal industries, textiles, and leather products. In all these industries, substantial military orders were added to regular civilian demands. The groups closely connected with building construction—such as forest products and stone, clay, and glass products—were depressed during World War I, when these activities had a low priority, but were booming during the twenties when restrictions were removed.⁵

Thus, the development of manufacturing has not always proceeded at an even pace, and at certain periods some branches of manufacturing have lagged behind and others have forged ahead. This uneven rate of growth is shown by our second measure of relative changes in manufacturing development. For selected benchmark years, total capital in each minor industry is expressed as a percentage of total capital in all manufacturing industries (Table 8). We have selected 1880, the first year for which comparatively reliable statistics are available, the beginning of the century, and years that closely follow the termination of World Wars I and II.⁶ For these particular years it is possible to distinguish sixty-five minor industries.

Even by 1900, the industries that had been among the first to be mechanized were losing ground to newly developed products and to familiar commodities newly produced by the factory system with mechanical power and manipulation. Thus, the textile, leather, and forest products industries failed to expand as rapidly as all manufacturing industries on the average. Capital in these three major industry groups constituted 45 per cent of all manufacturing capital in 1880 and 34 per cent at the turn of the century. Within these old industries, new branches were emerging, particularly in textiles, as a result of the transfer of household activities to the factory. This was the case with women's, children's and infants' clothing, and knit goods, and these two minor industries had a better than average rate of expansion between 1880 and 1900.

The same sort of transfer explains the relative rise in food products; bakery products, canning, and slaughtering and meat packing were being rapidly shifted from the household to the market economy.

⁵ In Clarence Long's investigation there is a trough in 1917–1919 and a subsequent peak in 1924–1927. (*Building Cycles and the Theory of Investment*, Princeton University Press, 1940, p. 136, Table 11.)

⁶ At the time of writing, the basic data by minor industries for 1953 are not available.

TABLE 8
Total Capital in Manufacturing Industries: Percentage Distribution, by Minor Industry Groups, Selected Years, 1880-1948
(per cent based on values in 1929 prices)

	1880	1900	1919	1948
All manufacturing	100	100	100	100
Food and kindred products	18.5	20.6	16.4	13.8
Bakery and confectionery products	1.0	1.5	2.4	1.5
Canned products	0.3	0.8	1.0	1.5
Mill products	6.7	2.5	2.1	0.9
Packing house products	1.8	2.5	3.1	1.7
Sugar refining	1.0	2.7	1.2	0.7
Liquors and beverages	5.0	6.7	2.0	2.7
Nonalcoholic beverages	0.1	0.3	0.3	0.7
Malt liquors and malt	3.9	5.9	1.6	1.0
Wines	0.1	0.1	a	0.1
Distilled liquors	0.9	0.4	0.1	0.9
Other food products	1.2	2.5	3.0	2.8
Tobacco products	1.5	1.5	1.6	2.0
Textiles and their products	20.6	16.4	14.5	9.1
Cotton goods	8.4	6.3	5.0	b
Silk and rayon goods	0.7	1.0	1.2	b
Woolen and worsted goods	4.0	3.2	2.0	b
Carpets, floor coverings, etc.	0.8	0.6	0.4	0.4
Knit goods	0.6	1.0	1.2	0.8
Clothing	3.9	3.1	3.4	2.6
Hats, except cloth and millinery	0.3	0.3	0.3	0.1
Men's and boys' clothing, except fur and rubber	3.0	1.9	1.9	1.2
Women's clothing, children's and infants' wear except fur and rubber	0.3	0.6	1.0	1.3
Millinery	0.3	0.3	0.2	a
Textiles, n.e.c.	2.2	1.2	1.2	b
Cotton+silk and rayon+woolen and worsted goods+textiles, n.e.c.	(15.4) ^c	(11.7) ^c	(9.5) ^c	5.2
Leather and leather products	6.8	4.6	3.0	1.1
Boots and shoes	1.9	1.4	1.2	0.6
Other leather products	4.9	3.2	1.8	0.5
Leather, tanned, curried, and finished	3.2	2.4	1.3	0.3
Leather products, n.e.c.	1.8	0.8	0.5	0.2
Rubber products	0.3	0.6	2.1	1.8
Forest products	17.6	12.9	6.8	3.9
Sawmills and planing mill products	10.7	7.7	4.3	2.4
Other wood products	6.9	5.2	2.5	1.5
Wooden containers	1.2	0.9	0.5	0.2
Wood products, n.e.c.	5.7	4.3	2.0	1.3
Paper, pulp, and products	1.9	2.6	3.3	3.2
Paper, pulp, and paperboard mills	1.6	2.0	2.5	2.1
Paper bags, containers, and boxes	0.1	0.3	0.4	0.6
Other paper products	0.2	0.3	0.4	0.5
Printing, publishing, and allied industries	3.0	4.6	3.3	3.4
Book and job, including lithography	2.5	1.6	1.3	1.1
Newspapers and periodicals	d	2.6	1.7	1.8
Allied industries	0.5	0.4	0.3	0.5

(continued)

TABLE 8 (concluded)

	1880	1900	1919	1948
Chemicals and allied products	4.3	5.0	6.0	8.3
Fertilizers	0.6	0.7	0.7	0.3
Chemicals proper, acids, compounds, etc.	1.5	1.7	2.2	2.4
Allied chemical substances	2.2	2.7	3.1	5.5
Drugs, medicines, and cosmetics	0.4	0.6	0.7	1.2
Soaps, cleaning and polishing preparations	0.5	0.4	0.5	0.5
Paints and varnishes	0.5	0.6	0.6	0.8
Other chemical substances	0.8	1.0	1.3	3.0
Petroleum refining	0.8	1.1	3.0	14.2
Stone, clay, and glass products	3.2	4.0	3.6	2.8
Cement, lime, and concrete products	0.2	0.6	1.1	0.9
Clay and pottery products	1.4	1.8	1.2	0.5
Glass and glass products	0.8	0.8	0.7	0.6
Cut stone and products	0.7	0.6	0.3	0.1
Stone, clay, and glass products, n.e.c.	0.1	0.2	0.3	0.7
Metals and metal products	21.1	25.6	35.9	35.3
Iron and steel and their products	9.8	9.1	14.5	11.9
Iron and steel	7.9	6.9	11.4	8.7
Blast furnaces, steel works, and rolling mills	7.1	6.0	9.0	5.6
Ordinance and accessories	0.3	0.2	0.6	0.2
Tin cans and other tinware	^a	^a	0.6	0.5
Iron and steel, n.e.c.	0.5	0.6	1.2	2.4
Metal building materials and supplies	0.3	1.0	1.7	2.1
Hardware, tools, etc.	1.5	1.2	1.4	1.1
Nonferrous metals and their products	2.4	3.5	3.9	3.1
Clocks, watches, and parts	0.2	0.3	0.2	0.2
Jewelry, silverware, and plating	0.6	0.6	0.7	0.3
Smelting, refining, and alloying	0.7	2.0	2.4	2.2
Nonferrous metal products, n.e.c.	0.9	0.6	0.6	0.4
Machinery excluding transportation equipment	8.6	11.0	12.0	13.3
Electrical machinery and equipment; radios, complete or parts	0.1	1.0	2.5	4.4
Agricultural machinery	2.2	1.9	0.9	1.6
Office equipment	0.2	0.3	0.4	0.8
Factory, household, and miscellaneous machinery	6.1	7.8	8.2	6.5
Transportation equipment	0.4	2.0	5.3	7.0
Motor vehicles, complete or parts	^a	0.4	4.2	5.2
Locomotives and railroad equipment	0.4	1.6	1.1	0.8
Aircraft and parts	^a	^a	^a	1.0
Miscellaneous	1.8	1.9	2.0	3.1
Professional, scientific, photographic, and optical equipment	0.1	0.2	0.3	1.1
Miscellaneous, n.e.c.	1.7	1.7	1.7	2.0

n.e.c. = not elsewhere classified.

^a Less than one-tenth of one per cent.

^b Included in the published source in a new classification, "textile mill products," and entered here in the last category under "textiles and their products."

^c Sum of component percentages to provide figures comparable to those for 1948.

^d Not covered by the source.

Source: Based on data in Appendix Table A-8; 1948 data are adjusted to exclude investment in emergency facilities.

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Milling, on the other hand, which had been a factory process for many decades, declined sharply in relative importance during these two decades.

The largest relative expansion occurred in new industries that were still at the threshold of tremendous growth: transportation equipment; electrical machinery and equipment; metal building materials and supplies; smelting, refining, and alloying of nonferrous metals; cement, lime, and concrete products; paper bags, containers, and boxes; and rubber products. In the succeeding twenty-year period this same group of industries, together with petroleum refining and iron and steel, nearly doubled their share of manufacturing capital (from 15.5 per cent in 1900 to 29.9 in 1919). The relative decline of the old industries—textiles, leather, and forest products—continued. They accounted for a third of the total in 1900 and a quarter in 1919.

Some of the industries with a better than average rate of capital expansion up to and including 1919 had turned down by 1948. This was true of the basic metal industries, both ferrous and nonferrous, and rubber tires and tubes. Some of the metal-using industries, on the other hand (electrical machinery and equipment including radios and television sets; automobiles; airplanes; office equipment; professional, scientific, and optical instruments; and metal building materials and supplies) continued to expand at a better than average rate. However, the largest relative gains occurred in petroleum refining, followed by chemicals and allied products.⁷

The paper and printing industries accounted for about the same percentage of manufacturing capital in 1948 as in 1919. Food and kindred products as a group declined in relative importance, although the minor industries of canning and deep-freezing, and tobacco products continued their capital formation at a faster rate than that for all manufacturing industries. The older industries continued to wane, using only a seventh of all manufacturing capital in 1948 compared with a fourth in 1919. Indeed, the decline in leather and in forest products had proceeded to the point where, in absolute terms (constant prices), less capital was being utilized after World War II than after World War I. In textiles, the rise of synthetic fabrics, which cannot be shown separately, failed to offset the relative and absolute loss of capital in the primary textile industries. Throughout this period the only textile industry of growing importance in terms of capital was the manufacture of women's, children's, and infants' clothing.

In sum, the older industries, such as textiles, leather, and forest products, have declined in importance over this seventy-year period.

⁷ The percentage distribution in 1948 is based on estimates that exclude investment in emergency facilities. We find that this doesn't change the basic trend.

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The newer ones, such as the metal-producing and -using industries, chemicals, and petroleum refining, have increased in importance.⁸

Mining, 1870-1953

In mining, the depreciated net value of structures and equipment is designated "plant," and the sum of inventories, cash, and receivables, "working capital." The net value of surface land and mineral resources owned by the mining establishment, excluding leased land,⁹ is termed "land." The sum of plant and working capital is called "capital," and the sum of capital and land, "total capital."¹⁰

Chart 3 shows the growth of mining capital (book values adjusted for price changes) by major industries. Like output, capital grew rapidly in all industries to about 1909, but the rate of growth dropped sharply between 1909 and 1919 in all industries except oil. However, because of the continued rapid growth of capital in the oil industry, the rate of growth of capital in all mining was substantial until 1929. The depression of the thirties caused a shrinkage of capital in all branches, and there has been only a partial recovery since then. In none of the major mining industries did capital in 1953 exceed the 1929 level. In anthracite, the 1953 level was only one-third of the 1929 total.

These trends and, in particular, the absence of net capital formation in mining during the last two and a half decades, are brought into even sharper focus by the changes in the deflated value of capital between selected years (Table 9).

Little or no evidence exists that the long-term rate of growth of capital in mining has undergone cyclical fluctuations in the manner of capital growth in manufacturing. The evidence indicates rather that the rate of growth began to retard early in this period and, typically, was not arrested until the decade of World War II or even later.

⁸ The relation between differential rates of growth and differential movements in capital-output ratios is discussed in Chapter V.

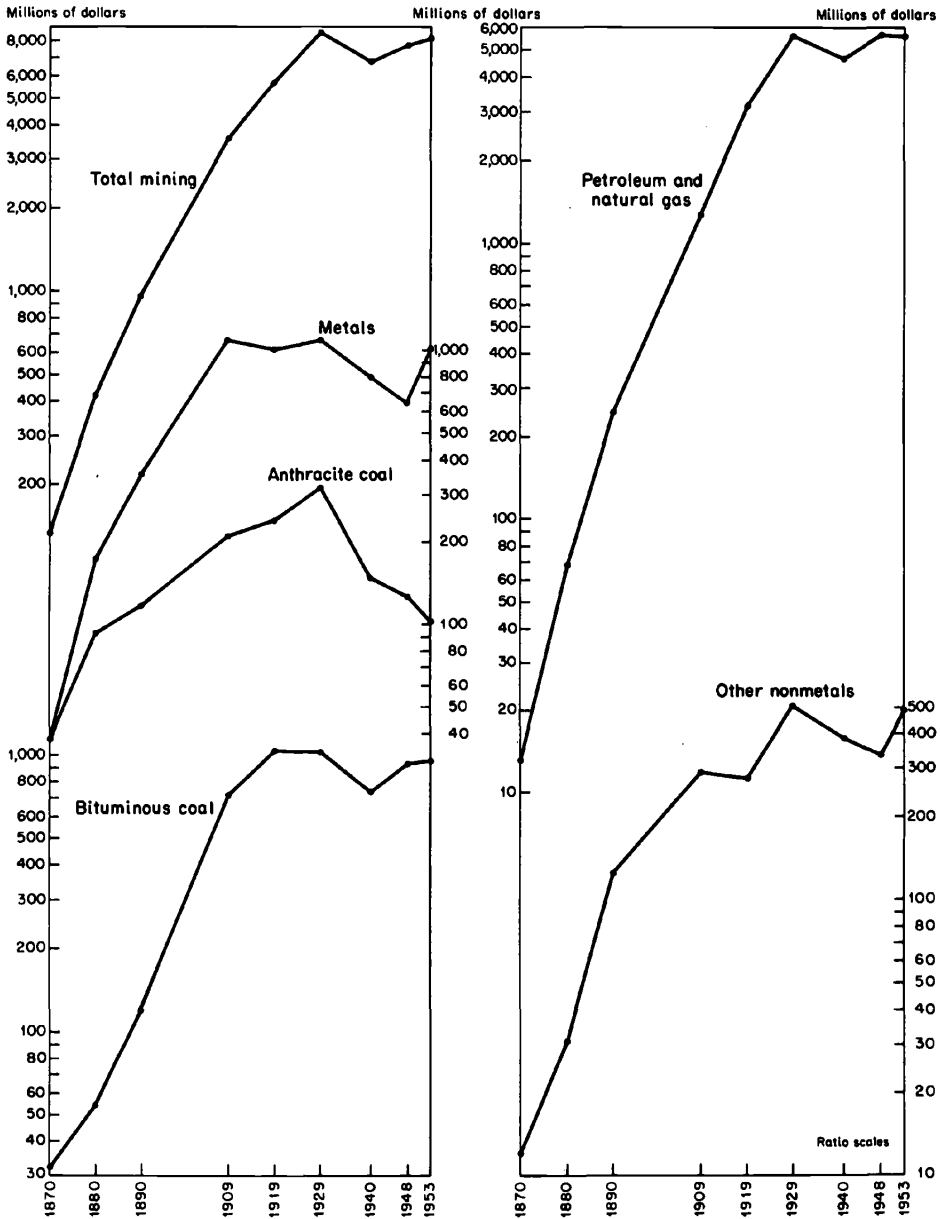
⁹ The value of leased land is excluded because of difficulties in estimating it for the period after 1919. For the narrower purpose of this study the omission is not significant. Primarily, our concern with the book value of land stems from its importance in determining the capital dimension of a mining enterprise, for example, its asset structure as compared with its liability structure. No such importance can be ascribed to the value of leases. Moreover, the only way to approximate the value of leases is to capitalize royalties. Royalties are strictly dependent upon the value of output in a given year. Hence, the value of leases is directly related to the value of output and is of limited interest for our purpose. For a more extended discussion, see Appendix B, section E.

¹⁰ The basic estimates of total capital in book values and of capital in 1929 prices, and a short description of the methods used to derive them, are given in Appendix Tables B-9 and B-11.

CHART 3

Value of Capital Excluding Land, by Major Mining Industries, Selected Years, 1870-1953

(values in 1929 prices)



Source: Based on Appendix Table B-11.

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TABLE 9

Mining Industries: Total Change in Capital between Selected Years, 1870-1953
(millions of dollars in 1929 prices)

	All Mining ^a	Metals	Coal		Petroleum and Natural Gas	Other Nonmetals
			Anthracite	Bituminous		
1870-1880	+283	+136	+55	+22	+55	+13
1880-1890	+508	+183	+24	+64	+176	+62
1890-1909	+2,558	+736	+94	+595	+1,020	+111
1909-1919	+2,120	-89	+29	+323	+1,869	-10
1919-1929	+2,846	+82	+78	-10	+2,468	+228
1929-1940	-1,833	-288	-170	-296	-964	-116
1940-1948	+1,074	-147	-19	+229	+1,059	-48
1948-1953	+354	+368	-26	+7	-146	+151

^a Because of rounding details may not add to total.
Source: Appendix Table B-11.

Table 10¹¹ shows that the highest rate of growth for total mining took place between 1870 and 1880 and that in all major branches except bituminous coal capital grew faster than output.¹² In the next decade, total mining output continued to grow rapidly, at a rate slightly lower than that during 1870-1880. Capital increased more than output in all major industries except anthracite mining.¹³ The pattern of rapid mining growth continued at an only slightly lessened rate in the third period, 1890-1909. Capital grew faster than output in all the major industries except metals.¹⁴

During 1909-1919, capital continued to increase at a faster rate than output in the three major industries enjoying relatively high rates of

¹¹ The comparison given here and in Tables 23, 24, and 33 is somewhat affected by differences between the bench marks with respect to employment levels. For a discussion of this problem, see Appendix B, section C.

¹² The rates of growth for this period are probably somewhat overstated because the coverage of the 1870 census is incomplete, particularly in the case of precious metals.

¹³ Note that during this decade the growth of capital in bituminous coal conformed strictly to the growth of output and that in copper mining the increase in output was steeper than that in capital. However, the statistical record for copper mining is unreliable in the earlier years.

The high capital figure reported for anthracite in 1880 seems to have worried the census authorities (*Report on the Mining Industries of the United States: 1880*, Bureau of the Census, p. 639). The inclusion of the value of nonproducing mines of the then largest anthracite mining company—the Philadelphia and Reading Coal and Iron Company—may have contributed to the overstatement (*ibid.*, p. 631). Chart 3 shows that the 1880 figure lies far above a smooth curve connecting the 1870 figure with the later figures. This would be the case even if we made a reasonable allowance for any possible understatement of the figures for 1870. This suggests that the 1880 census overstates the value of capital in anthracite mining.

¹⁴ The latter is affected by the shifts in industry weights (Table 10).

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TABLE 10
Mining Industries: Capital (Excluding Land) and Output, Rates of Change per Year between Selected Years, 1870-1953
(per cent based on values in 1929 prices)

	Total Mining		Metals		Anthracite		Bituminous		Petroleum and Natural Gas		Other Nonmetals	
	Capital	Output	Capital	Output	Capital	Output	Capital	Output	Capital	Output	Capital	Output
1870-1880	+12.4	+7.1	+16.5	+10.0	+9.5	+5.0	+5.5	+8.3	+18.2	+16.2	+10.5	n.c.
1880-1890	+8.4	+6.6	+7.4	+5.6	+2.3	+4.7	+8.2	+8.3	+13.6	+7.0	+14.6	+13.3
1890-1909	+6.8	+5.4	+5.8	+6.2	+3.0	+2.9	+9.4	+7.1	+8.6	+7.0	+4.4	+3.9
1909-1919	+4.9	+2.4	-0.9	+0.6	+1.3	+0.9	+3.8	+2.0	+9.5	+7.9	-0.5	+0.1
1919-1929	+4.1	+4.7	+0.8	+3.2	+2.8	-1.7	-0.1	+1.6	+6.0	+11.3	+6.3	+6.8
1929-1940	-2.2	+0.5	-2.8	+0.1	-7.2	-3.3	-3.1	-1.4	-1.7	+2.5	-2.4	-0.4
1940-1948	+1.9	+4.1	-2.7	+0.1	-1.8	+1.3	+3.5	+3.5	+2.6	+5.6	-1.7	+4.9
1948-1953	+0.9	+2.2	+9.4	+2.4	-4.6	-13.1	+0.1	-5.6	-0.5	+4.4	+7.7	+5.9
1870-1919	+7.9	+5.4	+6.8	+5.7	+3.8	+3.3	+7.2	+6.6	+11.6	+9.0	+5.6 ^a	+4.1 ^a
1919-1953	+1.1	+2.8	0.0	+1.3	-2.5	-3.1	-0.2	+10.0	+1.7	+6.0	+1.7	+3.8

B. MINOR METALS INDUSTRIES		Lead and Zinc		Precious Metals	
		Capital	Output	Capital	Output
1870-1880	+13.6	+7.7	+8.2	+10.2	+11.0
1880-1890	+9.9	+7.3	+14.6	+4.0	+3.7
1890-1909	+8.5	+6.6	+12.2	+9.0	+7.3
1909-1919	+0.4	+1.7	+5.3	+0.1	+7.0

Copper		Iron	
		Capital	Output
1870-1880	+17.3	+13.6	+7.7
1880-1890	+6.4	+9.9	+7.3
1890-1909	+12.2	+8.5	+6.6
1909-1919	+5.3	+0.4	+1.7

n.c. = not comparable.
a 1880-1919.

Source: Based on Appendix Tables B-8 and B-11 and worksheets.

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growth—oil and gas, bituminous coal, and anthracite. The other two industry groups—metals and other nonmetals—show an absolute decline in the amount of capital invested and a very moderate increase, if any, in output. Has this decline in capital been a result of shifts in the relative importance of component industries or a result of lessened use of capital in each of the industries? In the case of other nonmetals the answer cannot be readily given. For metals, a glance at Table 10 suggests that the declining output of the precious metals mining industry, an unusually large capital user, was as much responsible as the decreasing use of capital per unit of output in iron, lead and zinc, and precious metals mining.

What appeared in 1909–1919 to be an exceptional relationship (the faster growth of output than of capital in metals and in other nonmetals) became the rule during 1919–1929. In metal mining, capital increased slightly, while output increased substantially. In bituminous coal, a moderate increase in production was accompanied by a slight decline in capital. In oil and other nonmetal mining, there was a substantial increase in output with a relatively smaller increase in capital. The only exception to the new growth relationship was in anthracite mining, where capital increased and output fell.¹⁵ By comparison, the shrinkage of capital in anthracite during the thirties appears unusually rapid.

The story of the thirties is one of capital shrinkage in all mining industries, accompanied by a less than proportional shrinkage in production, and even, in the case of oil, an increase. In the forties, the relationships are more varied. Capital declined and production increased in metals, anthracite, and other nonmetals; bituminous coal output increased in proportion to the increase in capital; and the increase in output of natural gas and petroleum was more than proportional to the increase in capital. In the five years between 1948 and 1953, a marked reversal in pattern developed. Only in the petroleum industry did capital decline while output increased. In metals and in other nonmetals, the increase in capital was substantially higher than in output. In anthracite, on the other hand, the decline in capital was less than the decline in output. In bituminous coal mining, a slight increase in capital occurred along with a considerable decline in output.

During 1870–1919, when growth was rapid, capital grew at a steeper rate than output in all mining industries. During 1919–1953, when growth was at a much lower rate, production rose at a faster rate

¹⁵ This somewhat strange increase in capital at a time of a sustained downward trend in production is also indicated by the capital figures reported by the Pennsylvania State Bureau of Statistics in its *Report on Productive Industries*.

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when capital expanded. When capital contracted, output was either stationary or declined at a less rapid rate than capital.¹⁶

Summary of Findings

1. In manufacturing industries, the highest annual rate of growth in the stock of capital, expressed in 1929 prices, occurred during 1880-1890, the first decade covered by the statistics, when modern manufacturing in general was emerging from its earlier beginnings. The evidence of subsequent retardation in the rate of growth of capital is unmistakable, but it is equally clear that the decreases in the rate of growth have not been continuous. Rather, the evidence suggests, there have been alternating periods of relatively high and low rates of increase.

2. This uneven pace of development was even more apparent in the individual branches of manufacturing; at certain periods, some branches have lagged behind and others have forged ahead. This is revealed by expressing total capital in each branch as a percentage of total capital in all manufacturing industries for each benchmark year. Even by 1900, textiles, leather, and forest products, industries that had been among the first to be mechanized, were losing ground to familiar commodities then newly produced by the factory system and to newly developed products. The largest relative growth occurred in new industries that were still at the threshold of tremendous growth: transportation equipment; electrical machinery and equipment; metal building materials and supplies; nonferrous metals; cement, lime, and concrete products; paper bags, containers, and boxes; and rubber products. The basic metal industries, and rubber tires and tubes, industries with a better than average rate of capital expansion up to 1919, had a less than average rate by 1948. Some of the metal-using industries, on the other hand, continued to expand at a better than average rate. The largest relative gains, however, occurred in petroleum refining, followed by chemicals and allied products.

3. In mining, capital (book values adjusted for price changes) grew rapidly in all branches to about 1909, but the rate of growth dropped sharply between 1909 and 1919 in all industries except oil. The depression of the thirties caused a shrinkage of capital in all branches, and there has been only a partial recovery since then. In none of the major branches did capital in 1953 exceed the 1929 level.

4. There is little or no evidence that the long-term growth of capital in the total of all mining industries has undergone alternating periods

¹⁶ For long-term trends in employment, hours, horsepower, and supplies in mining industries, see Appendix Table B-15; see also, Israel Borenstein, *Capital and Output Trends in Mining Industries, 1870-1948*, Occasional Paper No. 45, pp. 19-28.

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of high and low rates of growth similar to those in manufacturing. The evidence indicates, rather, that the rate of growth began to retard early in this period and, typically, was not arrested until the decade of World War II, or even later.

5. In the period 1870–1919, when growth was rapid, capital grew at a steeper rate than output in all mining industries. In the period 1919–1953, when growth was at a much lower rate, output grew at a faster rate when capital expanded and was either stationary or declined at a less rapid rate when capital contracted.