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CHAPTER 3

Variations in Secular Patterns ·

IN at least one respect the utilities group is far from cohesive. It includes industries in widely diverse stages of development—from the venerability of the steam railroads to the robust middle age of electric light and power and the swiftly growing adolescence of pipe lines and air transportation. Stage of development is of course not a mere matter of chronology, for there is great variety in life spans, and maturity arrives much more quickly for some than for others. This will be apparent when we apply to their growth trends, the model pattern of secular development introduced in Chapter 2, and note the progress made by each of the components.

As indicated earlier, the individual regulated industries we have selected for special study were chosen—at least in part—with an eye to the proper representation of this heterogeneity. The components so selected are listed in Table 7, where the relative importance of each with respect to the stock of reproducible capital and capital formation is also given.

The preponderant share of steam railroads in the total during the first decade of our time span is clearly evident in this table.¹ By the early 1900's, however, this situation had been substantially altered. The proportion of the total physical stock of capital held by the railroads declined from nearly 85 to less than 70 per cent; their share of gross capital formation declined from about 82 to less than 45 per cent, and their share in net capital formation from more than 80 to less than 40 per cent.

The industries which had made the most significant relative gains from the 1870's to the 1900's were street and electric railways and electric light and power. The growth of both, of course, reflected the quick spread of the commercial application of electricity. The former in the first decade of the twentieth century accounted for 12 per cent of the constant dollar value of plant and equipment, and for about 20 per cent of the total capital formation of all regulated industries. Electric light and power—a much younger industry—accounted for less than 5 per cent of the stock of reproducible capital, but for more than 15 per cent of the total capital flow. Telephones had also made substantial gains. The all other group—roughly—maintained its relative position.

¹ Note that the term steam railroads is used loosely here and throughout this volume; it covers roads which in the modern era have used diesel or electric power as well as steam. We use the term because of its historical importance, and also to assist in avoiding confusion with the electric street railways prominent in urban transportation.

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TABLE 7

Percentage of Total for All Regulated Industries Accounted for by Each Component in Stock of Reproducible Capital and Capital Formation, Selected Decades

(based on values in 1929 dollars)

Industry	1870-1879	1900-1909	1940-1949
VALUE OF PLANT AND EQUIPMENT			
Steam railroads	84.8	67.4	52.7
Electric light and power ^a	0	4.6	17.4
Telephones	0	3.1	7.0
Street and electric railways ^a	1.5	12.2	2.7
Local bus lines ^a	0	0	0.8
All other transportation, communications, and utilities	13.7	12.7	19.5
Total	100.0	100.0	100.0
NET CAPITAL FORMATION			
Steam railroads	80.7	39.1	3.8
Electric light and power ^a	0	17.8	30.0
Telephones	0.3	8.1	41.6
Street and electric railways ^a	3.6	20.9	-9.3
Local bus lines ^a	0	0	2.4
All other transportation, communications, and utilities	15.4	14.0	31.6
Total	100.0	100.0	100.0
GROSS CAPITAL FORMATION			
Steam railroads	81.7	44.1	23.8
Electric light and power ^a	0	15.1	22.0
Telephones	0.2	9.4	20.3
Street and electric railways ^a	3.6	18.1	1.1
Local bus lines ^a	0	0	2.5
All other transportation, communications, and utilities	14.6	13.3	30.3
Total	100.0	100.0	100.0

^a Excludes publicly owned facilities.

Source: Appendix Tables B-1, C-1, D-1, E-1, F-1, G-1, and H-1. Detail may not add to 100 because of rounding.

By the 1940's further significant revisions had occurred in the relative importance of the principal regulated industries. Telephones exceeded all other components in net capital formation, accounting for about 40 per cent. Electric light and power and the all other group—reflecting the growth of pipe lines, gas utilities, trucking, air transportation, and other new industries—were not far behind with about 30 per cent each of the total net capital formation. The railroads' share in the net flow of capital had been reduced to less than 4 per cent. It is important to note, however, that the railroads still—in the 1940's—owned more than half the reproducible capital of all regulated industries and, because of the large replacement

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demand stemming from this ownership, accounted for a significant proportion of the total gross capital formation. Of course street and electric railways were actually contracting in this period. Local bus lines were growing, but accounted for only a modest share of the total investment flow.

The relative importance of each of the components in terms of output (as measured by the constant dollar value of their services) is shown in Table 8. The share of the railroads in this total declined

TABLE 8
Percentage of Total for All Regulated Industries Accounted for by
Each Component in Output
(based on nine-year averages of values in 1929 dollars)

<i>Central Year in Nine-Year Average</i>	<i>All Regulated Industries</i>	<i>Railroads</i>	<i>Electric Light and Power</i>	<i>Telephones</i>	<i>Street and Electric Railways</i>	<i>Local Bus Lines</i>	<i>All Other</i>
1886	100	80	0	...
1890	100	80	0	...
1896	100	77	1	2	9	0	11
1900	100	74	2	3	9	0	12
1906	100	68	2	6	10	0	13
1910	100	66	3	7	10	0	14
1916	100	64	5	7	9	0	15
1920	100	60	7	7	9	0	16
1926	100	52	11	9	8	1	19
1930	100	45	15	9	6	1	23
1936	100	37	19	9	5	2	28
1940	100	41	19	8	3	2	27
1946	100	38	20	8	2	2	30

Detail may not add to 100 because of rounding.

Source: Appendix Table K-9.

sharply from 1896 to 1946, though at the latter date they still accounted for nearly 40 per cent of the production of all regulated industries. Street and electric railways, which had once accounted for 10 per cent, had dropped to 2 in the 1940's. Aside from the all other group, the second most important in the 1940's, in terms of production, was electric light and power with 20 per cent. Telephones had also achieved a relative standing of significance, with 8 per cent of total output. The all other group, with its many new and widely publicized segments, accounted for 30 per cent.

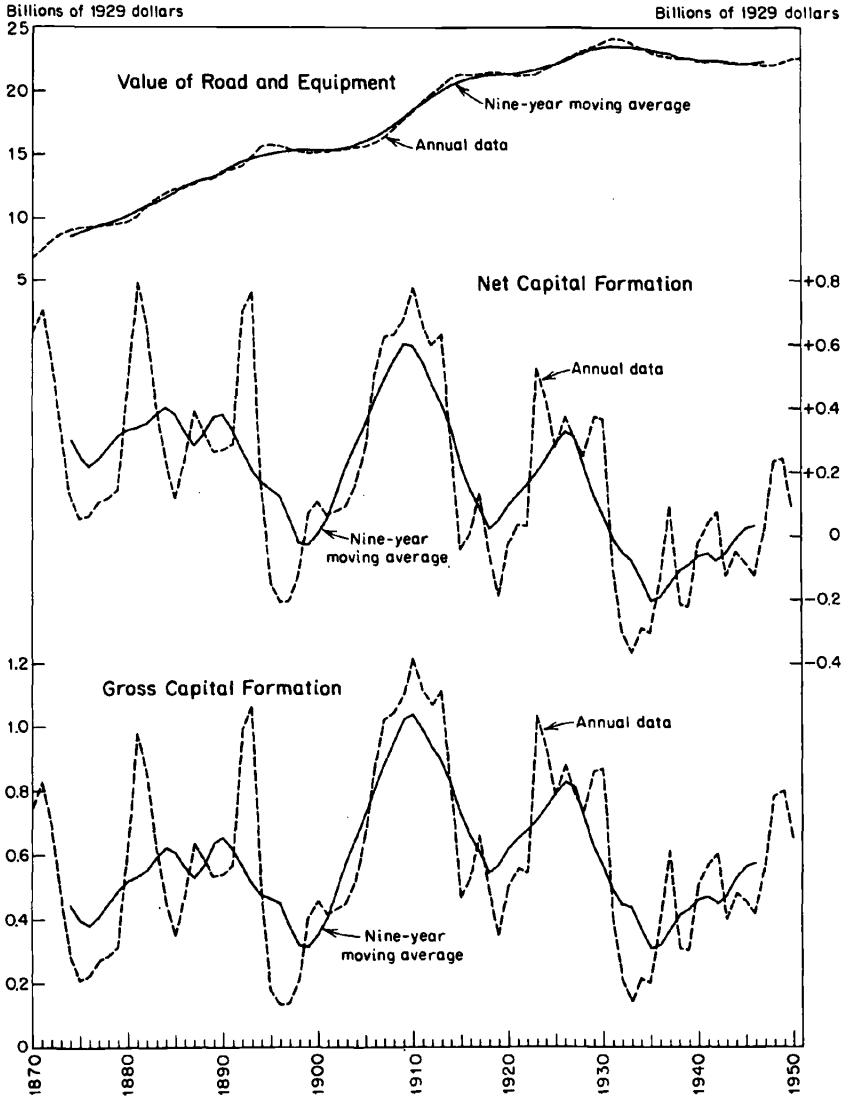
Capital Flows

The rate of growth of the various components is shown in the center panels of Charts 4 through 9. The diversity of behavior is

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CHART 4

Value of Road and Equipment and Capital Formation, Steam Railroads,
1929 Dollars, 1870-1951

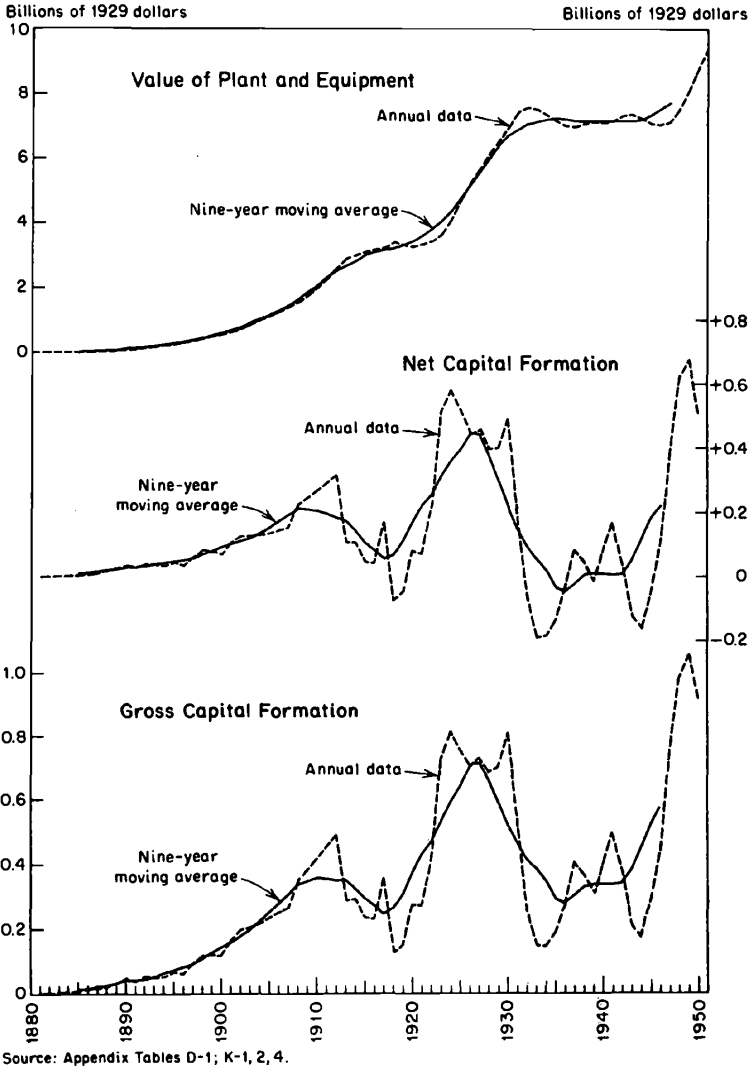


Source: Appendix Tables C-1; K-1, 2, 4.

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CHART 5

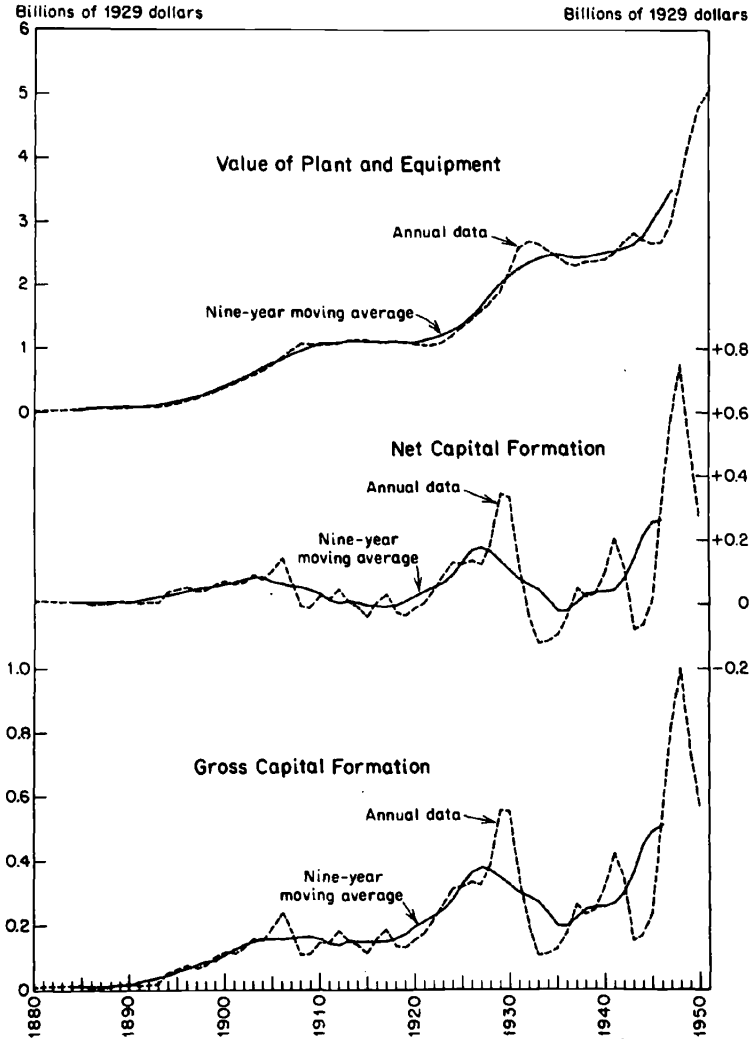
Value of Plant and Equipment and Capital Formation, Electric Light and Power, 1929 Dollars, 1881-1951



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CHART 6

Value of Plant and Equipment and Capital Formation, Telephones, 1929 Dollars, 1880-1951

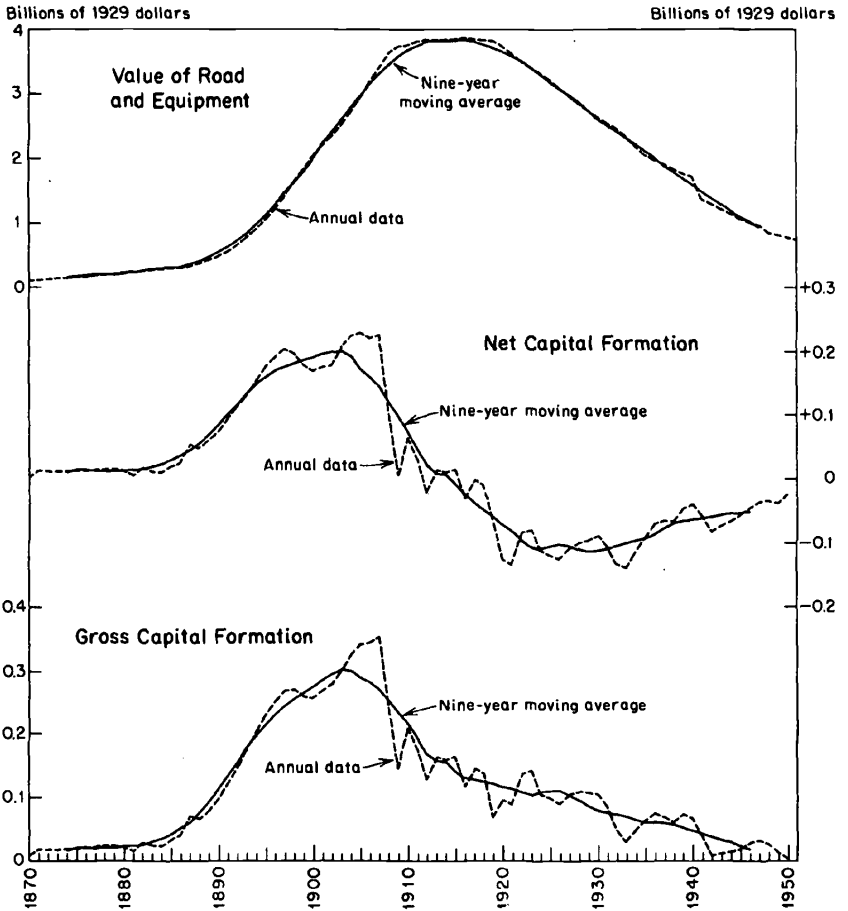


Source: Appendix Tables E-1; K-1, 2, 4.

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CHART 7

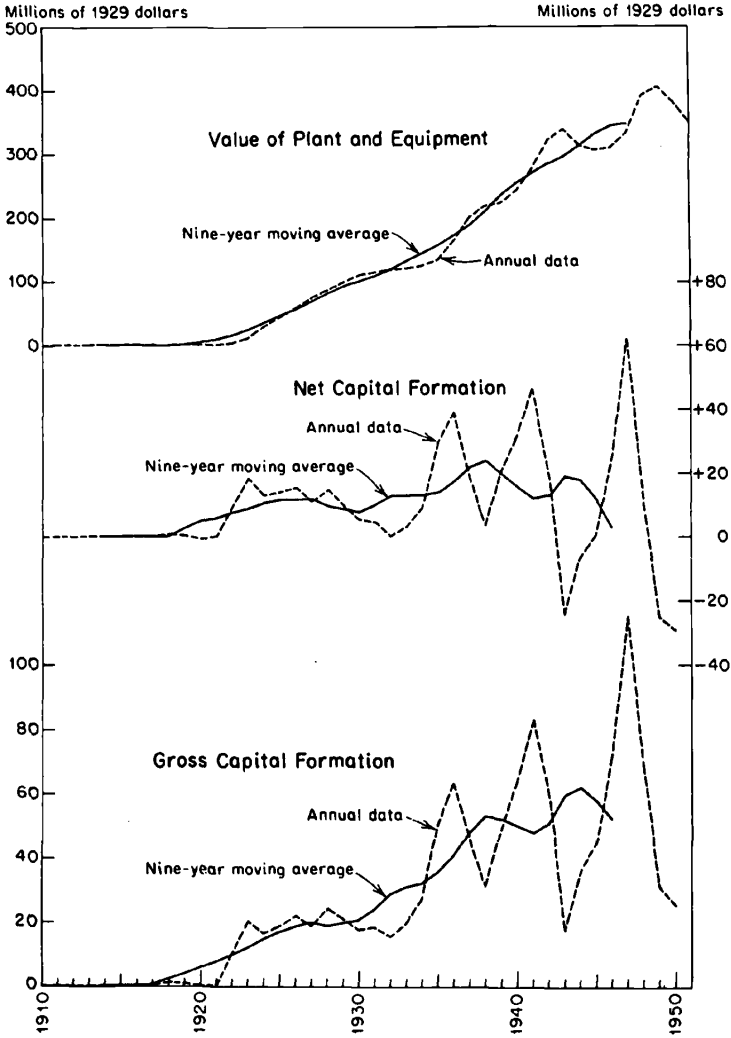
Value of Road and Equipment and Capital Formation, Street and Electric Railways, 1929 Dollars, 1870-1951



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CHART 8

Value of Plant and Equipment and Capital Formation, Local Bus Lines, 1929 Dollars, 1910-1951

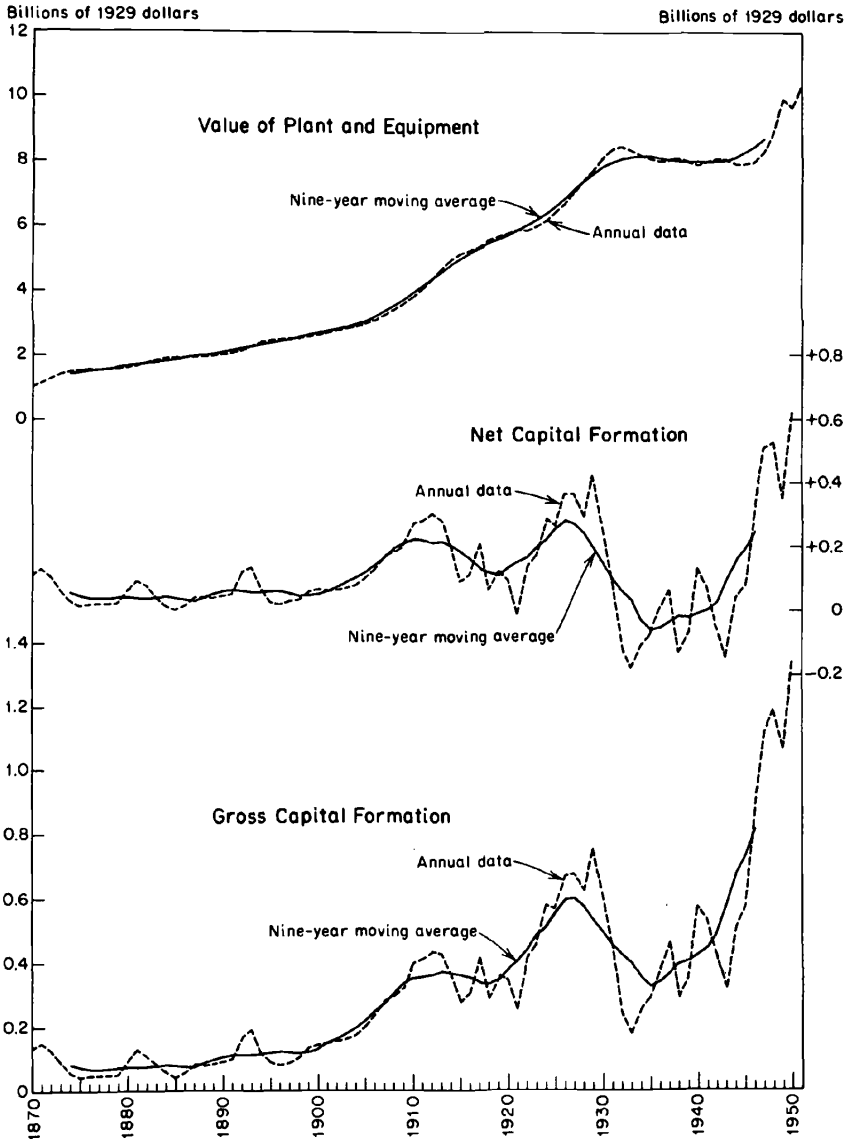


Source: Appendix Tables G-1; K-1, 2, 4.

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CHART 9

Value of Plant and Equipment and Capital Formation, All Other Utilities and Transportation, 1929 Dollars, 1870-1951



Source: Appendix Tables H-1; K-1, 2, 4.

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striking. At one extreme is the sharp upward trend for telephones, at the other the inverted U-shaped curve for street and electric railways, with its sharp downward movement over the last several decades.

Despite the inherent volatility of net capital formation series, the general long-term trend in rate of growth is reasonably clear for most components. The charts and Tables 9 and 10 tell the gist of the

TABLE 9
Net Capital Formation, All Regulated Industries and Components,
Annual Averages by Decades, 1870-1949

(millions of 1929 dollars)

<i>Decade</i>	<i>Total</i>	<i>Steam Railroads</i>	<i>Electric Light and Power^a</i>	<i>Telephones</i>	<i>Street and Electric Railways^a</i>	<i>Local Bus Lines^a</i>	<i>All Other</i>
1870-1879	352	284	0	0	13	0	54
1880-1889	474	388	9	7	27	0	43
1890-1899	447	157	48	31	152	0	60
1900-1909	826	323	147	67	173	0	116
1910-1919	600	281	122	2	-1	0	196
1920-1929	880	256	367	116	-109	11	240
1930-1939	-226	-148	16	14	-92	13	-29
1940-1949	576	22	173	240	-54	14	182

Based on Appendix Tables B-1, C-1, D-1, E-1, F-1, G-1, and H-1. Detail may not add to totals because of rounding.

^a Excludes publicly owned facilities.

story. The trend for telephones was sharply upward throughout the 1870-1950 span, with the annual net capital flow amounting to 240 million 1929 dollars in the final decade. The trend of net capital formation in electric light and power and in the all other group was also upward throughout the period of study, and was especially vigorous during the earlier years in the former. In both cases, however, the rate of advance was distinctly retarded after World War I, and even more so after the 1920's. The net flow of physical capital to the railroads expanded until the first decade of the twentieth century, moved down slightly in the next two decades, and then in the final twenty years, on balance, turned moderately negative. For street and electric railways the peak was also reached in the first decade of the twentieth century, but in this case the subsequent decline was precipitous. Capital moved out of this industry, on balance, in each of the subsequent decades. Thus, in the inverse order of relative maturity, as judged from the net capital flow, we would rank these components as follows: telephones,

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TABLE 10

Net Capital Formation, Component Regulated Industries, Nine-Year Averages,
1876-1950

<i>Central Year of Nine-Year Average</i>	<i>Millions of 1929 Dollars</i>	<i>Central Year of Nine-Year Average</i>	<i>Millions of 1929 Dollars</i>
RAILROADS			
1876	218	1880	331
1886	322	1890	379
1896	125	1900	4
1906	425	1910	598
1916	149	1920	99
1926	324	1930	66
1936	-196	1940	-61
1946	32	1950	92 ^a
ELECTRIC LIGHT AND POWER			
1886	14	1890	28
1896	54	1900	91
1906	174	1910	207
1916	82	1920	172
1926	445	1930	213
1936	-47	1940	7
1946	221	1950	513 ^a
TELEPHONES			
1886	6	1890	8
1896	41	1900	63
1906	62	1910	32
1916	-4	1920	26
1926	168	1930	107
1936	-23	1940	38
1946	262	1950	271 ^a
STREET AND ELECTRIC RAILWAYS			
1876	14	1880	13
1886	36	1890	84
1896	169	1900	191
1906	161	1910	72
1916	-26	1920	-74
1926	-102	1930	-113
1936	-86	1940	-64
1946	-51	1950	-24 ^a
LOCAL BUS LINES			
1916	b	1920	5
1926	12	1930	8
1936	17	1940	16
1946	3	1950	-29 ^a

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TABLE 10 (concluded)

<i>Central Year of Nine-Year Average</i>	<i>Millions of 1929 Dollars</i>	<i>Central Year of Nine-Year Average</i>	<i>Millions of 1929 Dollars</i>
ALL OTHER			
1876	40	1880	41
1886	36	1890	63
1896	62	1900	55
1906	145	1910	227
1916	166	1920	135
1926	285	1930	152
1936	-54	1940	-10
1946	249	1950	621 ^a

^a For 1950 only.

^b Less than 500,000.

Source: Appendix Table K-7.

electric light and power, the all other group, railroads, and street and electric railways.

Only local bus lines remain unranked. In this case, the period of operation is so short that definition of the secular trend becomes most difficult. The decade averages of Table 9 suggest a slight upward movement from 1920-50. But Chart 8 provides a different impression, and so does the more detailed tabulation of Table 10. It would appear from these that the peak rate of growth in local bus lines occurred in the 1930's, and that the subsequent decline from these very high levels has been substantial. This does not deny, of course, that the industry remains in a stage of expansion, for net capital formation in the 1940's as a whole remained positive.

Of course the impression gained from examination of the gross capital flow, shown in the bottom panels of Charts 4 through 9, is a more buoyant one. Secular declines, where they occur, are dampened or delayed, and upward trends become even steeper. Thus, the gross flow of capital to the railroads continued to rise through the 1910-19 decade, as Chart 4 and Table 11 show. Although decade averages in the latter table indicate a high for electric light and power in 1920-29, Chart 5 shows that the rate of gross investment in the years 1948-50 reached unprecedented heights. The upward trends for telephones and for the all other group are materially accelerated when attention is shifted from net to gross capital formation. Decline is virtually obliterated in the gross investment flow of local bus lines. For street and electric railways it is apparent that despite a precipitous decline, gross capital formation had not ceased entirely, for as a practical matter, as long as *any* lines remained in operation the need would persist for some replacement investment.

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TABLE 11

Gross Capital Formation, 1929 Prices, All Regulated Industries and Components, Annual Averages for the Decades 1870-1950

(millions of 1929 dollars)

<i>Decade</i>	<i>Total</i>	<i>Steam Railroads</i>	<i>Electric Light and Power^a</i>	<i>Telephones</i>	<i>Street and Electric Railways^a</i>	<i>Local Bus Lines^a</i>	<i>All Other</i>
1870-1879	530	433	0	0	19	0	77
1880-1889	753	612	10	12	40	0	79
1890-1899	908	468	70	50	204	0	115
1900-1909	1,583	698	239	149	286	0	211
1910-1919	1,742	777	304	147	147	0	366
1920-1929	2,330	760	608	304	107	15	535
1930-1939	1,387	361	342	234	66	34	350
1940-1949	2,342	557	516	475	25	59	710

Based on Appendix Tables B-1, C-1, D-1, E-1, F-1, G-1, and H-1. Detail may not add to totals because of rounding.

^a Excludes publicly owned facilities.

TABLE 12

Capital Consumption, 1929 Prices, All Regulated Industries and Components, Annual Averages for the Decades 1870-1950

(millions of 1929 dollars)

<i>Decade</i>	<i>Total</i>	<i>Steam Railroads</i>	<i>Electric Light and Power^a</i>	<i>Telephones</i>	<i>Street and Electric Railways^a</i>	<i>Local Bus Lines^a</i>	<i>All Other</i>
1870-1879	178	149	0	0	6	0	23
1880-1889	279	224	1	5	14	0	35
1890-1899	461	311	22	20	52	0	56
1900-1909	757	375	92	82	113	0	95
1910-1919	1,141	497	182	145	148	0	169
1920-1929	1,449	504	241	188	217	5	295
1930-1939	1,612	509	326	220	158	21	379
1940-1949	1,766	535	343	235	79	45	528

Based on Appendix Tables B-1, C-1, D-1, E-1, F-1, G-1, and H-1. Detail may not add to totals because of rounding.

^a Excludes publicly owned facilities.

The growth of capital consumption, which is the difference between gross and net capital formation, is shown in Table 12. The trend has been sharply and steadily upward in all industries except street and electric railways. The general reasons for this were cited in the previous chapter. It is significant to note that an investment of nearly two billion 1929 dollars was required annually in

the 1940's simply to keep the physical stock of capital of the regulated industries intact, and that more than one-fourth of this was accounted for by the railroads. By the 1920's capital consumption had grown to exceed net capital formation for every component except local bus lines and electric light and power, and during the next two decades capital consumption was considerably greater for these two components as well. For regulated industries in the aggregate in the 1940's, capital consumption amounted to more than three times the volume of net capital formation, and this was only in small part due to the restrictions on investment during the war years.

The Stock of Capital

In the top panels of Charts 4 through 9, the growth of the regulated industries is shown directly—at least in terms of their physical stock of capital. In this series the trend is upward for all components except two: railroads and street and electric railways. In the case of the former, the downward trend did not start until the 1930's, and it progressed only slightly after that date. For street and electric railways, the drop was sharp and started early in the twentieth century.

But even among those components for which the trend is regularly upward, there is great diversity in the pace of the movement. This was evident in our discussion of net capital formation. It is also evident, visually, in the top panels of the charts. In the earlier stages of all series, growth proceeds at an expanding rate, with the slope of the stock of capital curve gradually increasing. In the case of telephones, this condition seems to persist throughout the 1880–1950 span. For electric light and power, the all other group, and local bus lines, the rate of growth—after a time—loses some of its vigor, and in the latter, tends to flatten out. In the case of railroads and street and electric railways, this flattening out period is followed by actual cessation of growth and subsequent decline. It should be borne in mind that the latter two components were in fact fairly well developed even in 1870, and accordingly the earliest stage of growth at an increasing rate is barely evident, if at all, within the limits of the time span we cover.

Declining Relative Rates of Growth

In one respect, however, there is agreement among *all* components in the secular trends in the stock of reproducible capital. In all cases, the *relative* rate of growth progressed at a declining rate, and the stage of decline set in at very early periods in the history of each component. This is seen, in the broadest terms, in the data of

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Table 13. Here annual percentage changes in the constant dollar value of plant and equipment are given between long cycle peaks. From an annual rate of growth in their facilities of 2 per cent in the 1875-1914 period, the railroads dropped to less than 1 per cent in 1914-31, and to a slightly negative annual change in the final period of 1931-47. Electric light and power dropped from a nearly 20 per cent annual increase during the first cycle to about 5 per cent in the second and to less than 1 per cent in the third. Over the

TABLE 13
Average Annual Percentage Changes in Constant Dollar Value of Plant and Equipment during Long Cycles, All Regulated Industries and Components

Industry	PEAK DATES OF LONG CYCLES BASED ON NINE-YEAR MOVING AVERAGES ^a		
	1875-1914	1914-1931	1931-1947 ^b
All regulated industries	+3.0	+1.6	+0.04
Steam railroads	+2.2	+0.9	-0.3
Electric light and power ^c	+19.6 ^d	+5.4	+0.7
Telephones	+11.8 ^e	+4.2	+2.8
Street and electric railways ^c	+8.6	-2.3	-5.8
Local bus lines ^c	...	+39.1	+7.3
All other	+3.1	+3.1	+0.5

^a Peak dates based on data for all regulated industries.

^b Terminal date in nine-year averages.

^c Excludes publicly owned facilities.

^d 1885 (the earliest available date) to 1914.

^e 1884 (the earliest available date) to 1914.

Source: Appendix Tables B-1, C-1, D-1, E-1, F-1, G-1, and H-1.

entire time span, telephones dropped from a rate of nearly 12 per cent to one of less than 3 per cent, and street and electric railways from a 9 per cent per annum rise to an average annual decline of nearly 6 per cent. Local bus lines, during their brief history, dropped from an annual average increase of nearly 40 per cent in the 1914-31 period to one of less than 8 per cent in 1931-47. Only in the all other group was the decline anything but constantly progressive. In this case the rate of growth remained unchanged at slightly more than 3 per cent through the first two periods, and then dropped to one-half of 1 per cent in the final cycle.

When the percentage changes are examined in detail, as in Table 14, it is of course observed that the declines in relative rate of growth are by no means perfectly progressive in every case. Given the sharp cyclical fluctuations in these series, this is not surprising. Even after allowance for these fluctuations, however, it is apparent that in every component the period of declining relative rate of

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TABLE 14

Percentage Changes in Constant Dollar Value of Plant and Equipment, by Decades, 1870-1950, Component Regulated Industries

<i>Decade</i>	<i>Per Cent^a</i>	<i>Decade</i>	<i>Per Cent^b</i>
RAILROADS			
1870-1880	35	1876-1886	53
1880-1890	36	1886-1896	26
1890-1900	10	1896-1906	2
1900-1910	25	1906-1916	33
1910-1920	10	1916-1926	5
1920-1930	14	1926-1936	1
1930-1940	-8	1936-1946	-3
1940-1950	2		
ELECTRIC LIGHT AND POWER			
1890-1900	421	1886-1896	136
1900-1910	262	1896-1906	307
1910-1920	45	1906-1916	151
1920-1930	122	1916-1926	65
1930-1940	-3	1926-1936	34
1940-1950	30	1936-1946	c
TELEPHONES			
1880-1890	357	1886-1896	182
1890-1900	443	1896-1906	370
1900-1910	137	1906-1916	29
1910-1920	-1	1916-1926	32
1920-1930	142	1926-1936	60
1930-1940	-3	1936-1946	15
1940-1950	103		
STREET AND ELECTRIC RAILWAYS			
1870-1880	123	1876-1886	79
1880-1890	132	1886-1896	299
1890-1900	280	1896-1906	157
1900-1910	74	1906-1916	21
1910-1920	-5	1916-1926	-20
1920-1930	-29	1926-1936	-36
1930-1940	-47	1936-1946	-49
1940-1950	-45		
LOCAL BUS LINES			
1910-1920	2,400	1916-1926	9,717
1920-1930	4,504	1926-1936	178
1930-1940	138	1936-1946	91
1940-1950	28		

(concluded on next page)

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TABLE 14 (concluded)

<i>Decade</i>	<i>Per Cent</i> ^a		<i>Decade</i>	<i>Per Cent</i> ^b
		ALL OTHER		
1870-1880	42		1876-1886	25
1880-1890	25		1886-1896	31
1890-1900	29		1896-1906	24
1900-1910	51		1906-1916	69
1910-1920	44		1916-1926	28
1920-1930	44		1926-1936	19
1930-1940	-6		1936-1946	0
1940-1950	29			

^a Computed from end-of-year figures.

^b Computed from middle-of-year figures.

^c Rise of less than 1 per cent.

Source: Appendix Tables B-1, C-1, D-1, E-1, F-1, G-1, and H-1.

growth is preceded by at least a few years in which the relative rate of growth is rising. In electric light and power, telephones, and local bus lines, this rising period appears to have lasted little more than a decade, and possibly less. The somewhat longer period of rise in the case of street and electric railways reflects the virtual transformation of this industry in the late nineteenth century as electricity replaced cruder means of motive power. In the case of the railroads, there is no preliminary period of material rise within the time span covered by this study, but of course by 1870 this industry was nearly forty years old.

In any event, one important generalization concerning the regulated industries appears warranted from this segment of our analysis. The stock of reproducible capital grows by relative amounts which, from the secular standpoint, decline progressively from almost the very beginning of an industry's history. The lone exception among our components is the all other group; but this is a conglomerate aggregate and its sporadic relative rate of growth reflects essentially the development of new industries within the total.

This generalization is of some importance for later stages of our analysis—particularly in connection with the financing of these industries—and a further word concerning it may be in order here. The early declining relative rate of growth noted above appears to stem from characteristics typical of the regulated industries. We may consider, in contrast, the conditions attendant upon the development of a small, little-known industry, characterized by small business units. Such an industry would by its nature be expected to depart materially from the pattern described above. For its growth would depend upon the slow, gradual accumulation of capital by individual

proprietors. The high risk involved would preclude for some time access to organized capital markets, and would narrowly limit the availability of credit generally. As the industry expanded, and as the business units within it grew, these barriers might be expected to weaken. Provided that we are dealing with an industry destined for ultimate success, it is likely that its relative rate of growth would remain stable or upward for several decades as, within an ever greater radius, the nation's capital was mobilized for its use. If technological developments in this industry were such as to engender a rise in the ratio of physical capital to output, this would be an *additional* factor for an increasing—rather than a decreasing—relative rate of growth in the stock of plant and equipment, at least for some considerable period. A number of manufacturing industries would conform in whole, or in substantial part, to this pattern.

The regulated industries, however, were differently situated in every respect. In the most prominent and important cases, the individual business units involved were, out of technological necessity, large at the very outset. They were highly publicized and typically endowed with a substantial degree of monopoly. From their very beginnings, they attracted investors by what appeared to be a relatively low element of risk and a relatively large promise of profit. The accessibility of capital permitted a swift burgeoning at the start, which in relative terms, as we have seen, very soon diminished. And the decline was accelerated by technological developments, which in this segment of the economy, resulted in a pronounced and fairly steady reduction in the ratio of fixed real capital to product, as shall be described in Chapter 5. Of course these comments are not meant to deny the historical fact that the railroads, and some of the other utilities, at times experienced difficulty in obtaining all the capital they wanted. But in such instances capital was scarce primarily *in relation to* their own huge requirements. The point is that these industries were able to draw funds from *national* and sometimes *international*, money markets. This is something that smaller, less well-known, and riskier business units could not have accomplished.

Output

The diversity of behavior among the individual regulated industries is less pronounced in output than it is in investment. The general trend in production over the 1890–1950 period is upward for every component except street and electric railways, as the top panels of Charts 10 through 15 show. The data of Table 15, consisting of nine-year averages centered at the selected dates indicated,

VARIATIONS IN SECULAR PATTERNS

TABLE 15

Output per Annum, Component Regulated Industries, 1929 Dollars,
Nine-Year Averages, 1886-1950

<i>Central Year in Nine-Year Average</i>	<i>Millions of 1929 Dollars</i>	<i>Central Year in Nine-Year Average</i>	<i>Millions of 1929 Dollars</i>
RAILROADS			
1886	1,013	1890	1,329
1896	1,778	1900	2,334
1906	3,477	1910	4,179
1916	5,557	1920	6,013
1926	6,229	1930	5,251
1936	4,442	1940	7,231
1946	9,846	1950	8,451 ^a
ELECTRIC LIGHT AND POWER			
1896	22	1900	51
1906	128	1910	197
1916	431	1920	684
1926	1,345	1930	1,719
1936	2,257	1940	3,251
1946	5,100	1950	6,806 ^a
TELEPHONES			
1896	46	1900	111
1906	296	1910	423
1916	583	1920	725
1926	1,032	1930	1,094
1936	1,100	1940	1,350
1946	2,059	1950	2,591 ^a
STREET AND ELECTRIC RAILWAYS			
1896	211	1900	297
1906	507	1910	651
1916	814	1920	892
1926	894	1930	742
1936	536	1940	539
1946	548	1950	339 ^a
LOCAL BUS LINES			
1926	108	1930	145
1936	188	1940	301
1946	475	1950	411 ^a
ALL OTHER			
1896	255	1900	380
1906	671	1910	892
1916	1,321	1920	1,616
1926	2,286	1930	2,613
1936	3,312	1940	4,806
1946	7,904	1950	10,274 ^a

^a For 1950 only.

Source: Appendix Table K-9.

also make this clear. Perhaps the most spectacular rise is that of electric light and power, for which output advanced from about 22 million 1929 dollars per annum in the 1890's and not much more than 100 million in the first decade of the twentieth century to over 5 billion in the 1940's. But, with the exception noted, the advances for all other components are large too. Even railroad output rose from about 1 billion 1929 dollars per annum in the 1880's to about 6 billion in the 1920's and again to between 7 and 10 billion per annum in the 1940's. It is significant, however, that output of street and electric railways in 1950 was not much greater than it had been 60 years before, and that—at 340 million 1929 dollars—it was far below its peak of nearly 900 million annually in the 1920's.

When attention is directed to changes in output, greater differences appear among the several industries. These changes are shown in the lower panels of Charts 10 through 15. In Table 16 there are presented average changes in output computed between nine-year averages at selected dates for each of the components. Thus, the top figure in the second column under railroads shows that between the nine-year average centered on 1886 and the nine-year average centered on 1896, railroad output rose by an average of 77 million 1929 dollars per year.

Most striking are the progressive advances in the rate of output growth in electric light and power, telephones, and the all other group. In electric light and power, production rose at the rate of 284 million 1929 dollars per year between the 1930's and the 1940's, and in the decade of the 1940's by about 350 million per year. This compares with increases of from 10–15 million per year in the 1890's and early 1900's. Production of telephone service rose by about 124 million 1929 dollars per year in the 1940's, compared with 25 or 30 million in earlier years. The all other group reached the spectacular rate of increase of about 450 million per year between the 1930's and the 1940's, and nearly 550 million per year in the decade of the 1940's. For all three of these groups, output rose at an ever-increasing absolute rate over the 1870–1950 span.

The picture is less buoyant for the other segments. The great demands for local transportation, when use of private passenger cars was restricted during the war, boosted production of local bus lines greatly in these years. The output increment from the 1930's to the 1940's is therefore very substantial. But aside from this, it is apparent that the secular trend in output increments in this segment had turned downward in later years, and that the peak had been reached somewhere in the 1930's or 1940's. This does not mean, of course, that production was headed secularly downward. It *does* mean that

TABLE 16

Average Changes in Output, per Annum, All Regulated Industries and Components, 1886-1950

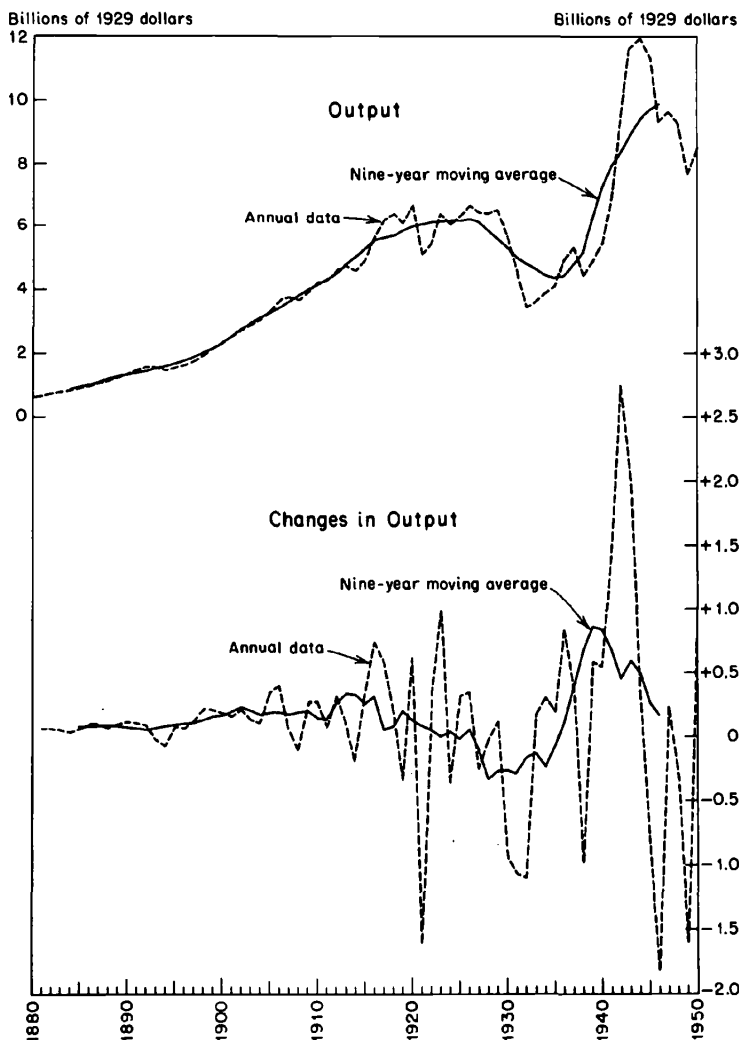
(average annual change between nine-year averages centered on the indicated years)

<i>Central Years of Nine-Year Averages</i>	<i>Millions of 1929 Dollars</i>	<i>Central Years of Nine-Year Averages</i>	<i>Millions of 1929 Dollars</i>
ALL REGULATED INDUSTRIES			
1886-1896	105	1890-1900	151
1896-1906	277	1900-1910	317
1906-1916	364	1910-1920	361
1916-1926	318	1920-1930	161
1926-1936	-6	1930-1940	591
1936-1946	1,411	1940-1950 ^a	1,139
RAILROADS			
1886-1896	77	1890-1900	101
1896-1906	170	1900-1910	185
1906-1916	208	1910-1920	183
1916-1926	67	1920-1930	-76
1926-1936	-179	1930-1940	198
1936-1946	542	1940-1950 ^a	122
ELECTRIC LIGHT AND POWER			
1896-1906	11	1900-1910	15
1906-1916	30	1910-1920	49
1916-1926	91	1920-1930	103
1926-1936	91	1930-1940	153
1936-1946	284	1940-1950 ^a	356
TELEPHONES			
1896-1906	25	1900-1910	31
1906-1916	29	1910-1920	30
1916-1926	45	1920-1930	37
1926-1936	7	1930-1940	26
1936-1946	96	1940-1950 ^a	124
STREET AND ELECTRIC RAILWAYS			
1896-1906	30	1900-1910	35
1906-1916	31	1910-1920	24
1916-1926	8	1920-1930	-15
1926-1936	-36	1930-1940	-20
1936-1946	1	1940-1950 ^a	-21
LOCAL BUS LINES			
1926-1936	8	1930-1940	16
1936-1946	29	1940-1950 ^a	11
ALL OTHER			
1896-1906	42	1900-1910	51
1906-1916	65	1910-1920	72
1916-1926	97	1920-1930	100
1926-1936	103	1930-1940	219
1936-1946	459	1940-1950 ^a	547

^a The figures used for 1950 represent production for that year only.
Source: Appendix Table K-9.

VARIATIONS IN SECULAR PATTERNS

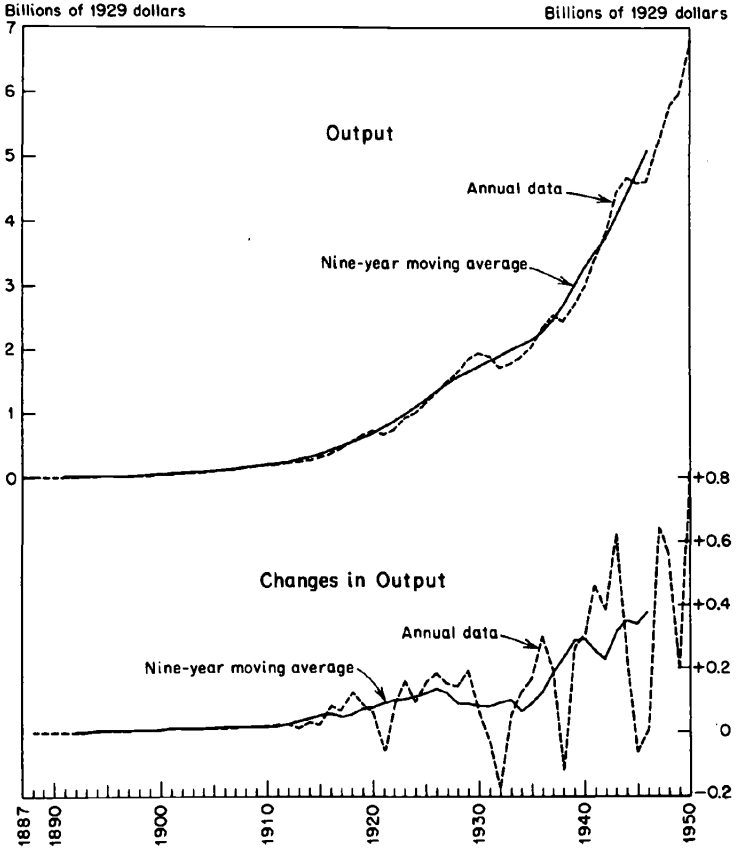
CHART 10
Output and Changes in Output, 1929 Dollars, Steam Railroads,
1880-1950



Source: Appendix Tables I-13, 30; K-9, 11.

VARIATIONS IN SECULAR PATTERNS

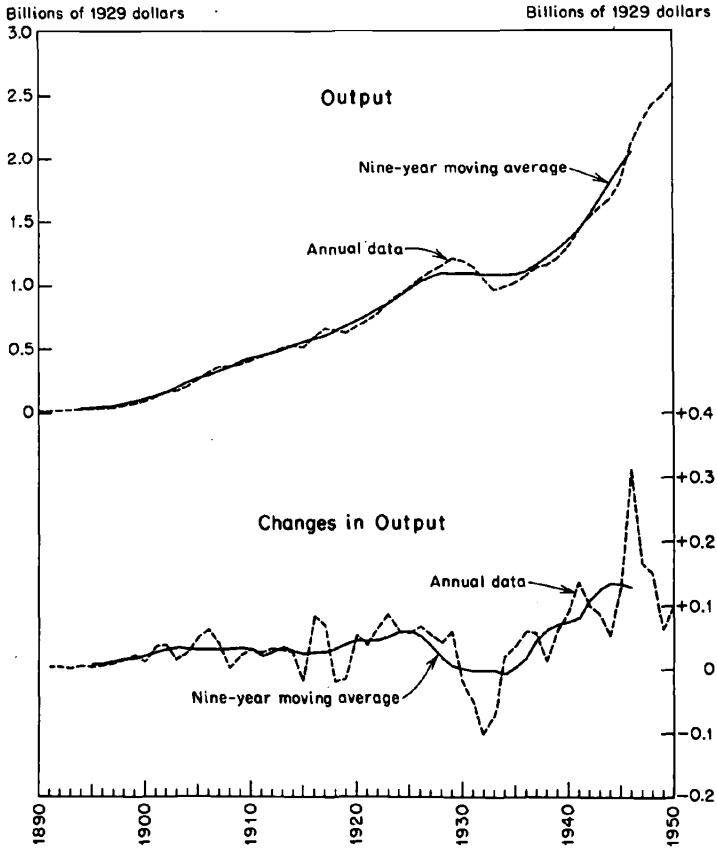
CHART 11
Output and Changes in Output, 1929 Dollars, Electric Light and Power, 1887-1950



VARIATIONS IN SECULAR PATTERNS

CHART 12

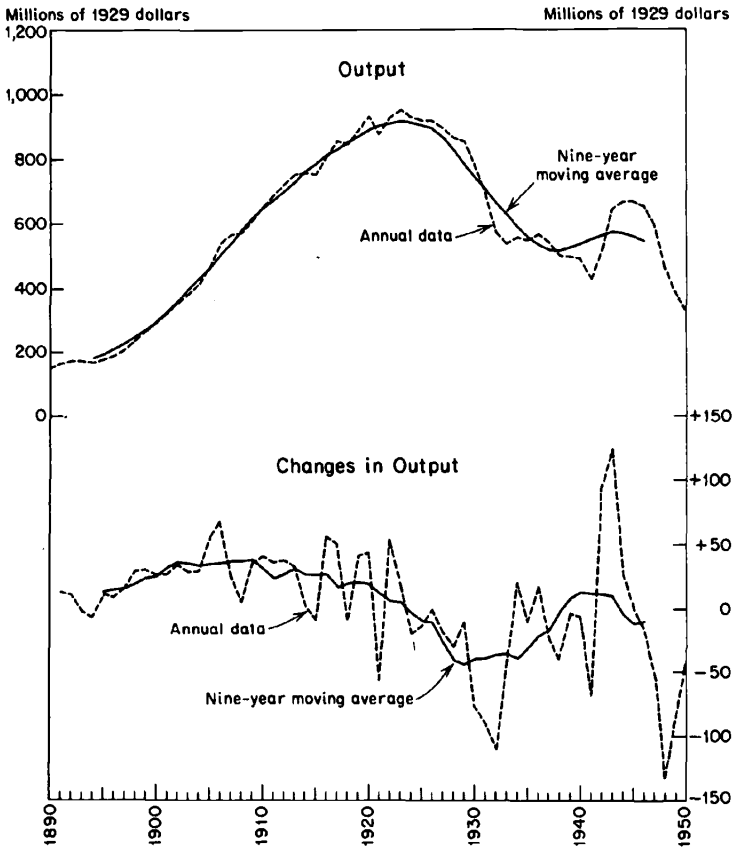
Output and Changes in Output, 1929 Dollars, Telephones, 1890-1950



Source: Appendix Tables I-20, 30; K-9, 11.

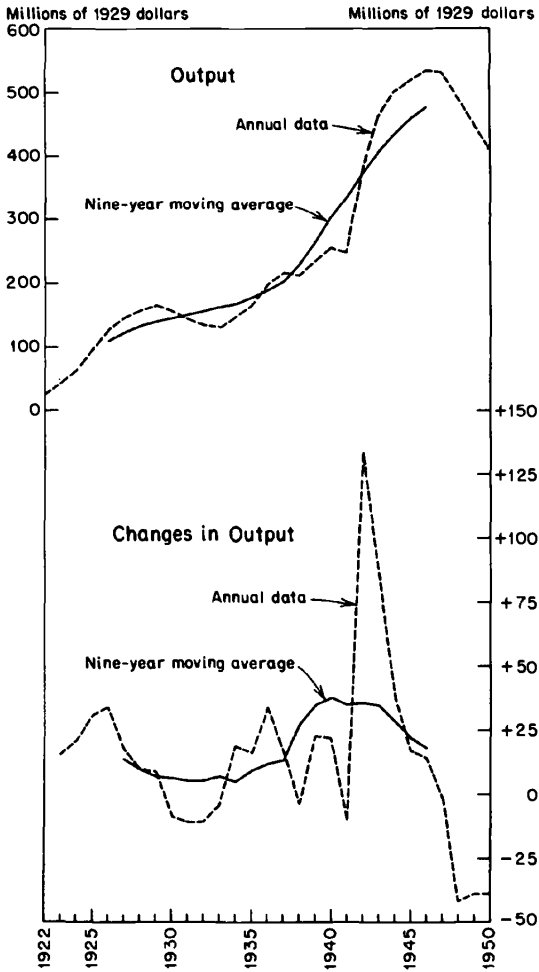
VARIATIONS IN SECULAR PATTERNS

CHART 13
Output and Changes in Output, 1929 Dollars, Street and Electric
Railways, 1890-1950



VARIATIONS IN SECULAR PATTERNS

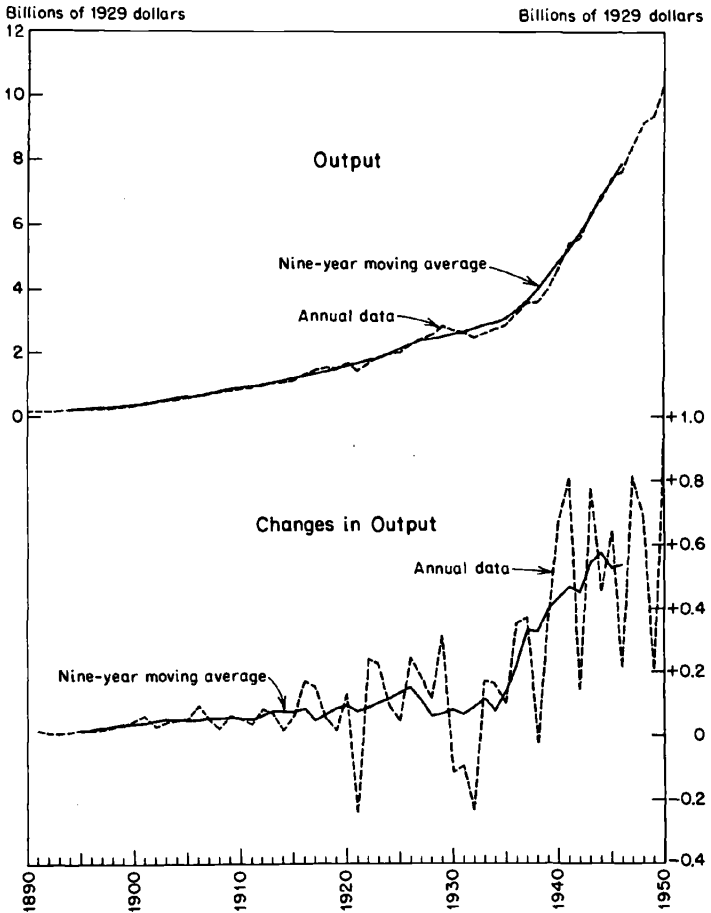
CHART 14
 Output and Changes in Output, 1929 Dollars, Local Bus Lines,
 1922-1950



Source: Appendix Tables I-27, 30; K-9, 11.

VARIATIONS IN SECULAR PATTERNS

CHART 15
Output and Changes in Output, 1929 Dollars, All Other Utilities,
1890-1950



Source: Appendix Tables I-29, 30; K-9, 11.

the secular *rate of growth* in the output of local bus service had begun to decline.

It seems evident, likewise, that the rate of growth in railroad output was headed downward. Here, too, the febrile activity of the World War II period obscures the secular movement, but in this case analysis may be placed on a broader historical base. Though the downward trend is sufficiently clear, the approximate date of the turning point remains indistinct. The most likely times are the immediate pre-World War I period and the early 1940's, with perhaps some favor to the latter because of the pronounced all-time peaks persisting over a significant span in this period. Street railways, on the other hand, present a case with few complexities. Output increments turned downward in the first decade of the twentieth century, and by the 1920's had become negative. They remained negative thereafter, on balance, except for a brief flurry in the World War II period.

The *relative* rate of growth in output is measured in the data of Table 17. In every component, these relative output increments display a pronounced declining secular trend. The declines commence at very early dates—though just how early is obscured by the fact that the output series do not begin for some components until the 1890's. In two cases—the railroads and local bus lines—the largest percentage increases in output actually occurred in the 1936–46 period, reflecting the wartime bulge in activity previously noted. But even in these components the secular downward trend, stemming from the earliest date, seems apparent. Indeed in all cases the declines are spectacular—for example, the drop from the 543 per cent rise in 1896–1906 to the 92 per cent rise in 1940–50 in telephones, or the drop from a 76 per cent rise in 1886–96 to a rise of 17 per cent in 1940–50 in railroads.

It is by no means inevitable for the percentage rate of growth in output to decline from the earliest days of an industry's development, as appears to be the case in each of the components we have examined. Rather, this phenomenon seems to stem from characteristics indigenous to the regulated industries, and perhaps to certain other industries which closely resemble them. The considerations bearing on this were discussed in the section above, dealing with the diminishing rates of growth in capital.

Application of the Model Pattern

In the previous chapter, we described a model pattern of secular growth, which was accordingly applied to the capital formation and output series of all regulated industries in the aggregate. We now

VARIATIONS IN SECULAR PATTERNS

TABLE 17

Percentage Changes in Output, by Decades, Component Regulated Industries, 1886-1950

(based on nine-year averages of values in 1929 dollars)

<i>Central Years of Nine-Year Averages</i>	<i>Per Cent</i>	<i>Central Years of Nine-Year Averages</i>	<i>Per Cent</i>
RAILROADS			
1886-1896	76	1890-1900	76
1896-1906	95	1900-1910	79
1906-1916	60	1910-1920	44
1916-1926	12	1920-1930	-13
1926-1936	-29	1930-1940	37
1936-1946	122	1940-1950 ^a	17
ELECTRIC LIGHT AND POWER			
1896-1906	482	1900-1910	287
1906-1916	237	1910-1920	247
1916-1926	212	1920-1930	152
1926-1936	67	1930-1940	89
1936-1946	126	1940-1950 ^a	109
TELEPHONES			
1896-1906	543	1900-1910	281
1906-1916	97	1910-1920	71
1916-1926	77	1920-1930	51
1926-1936	7	1930-1940	23
1936-1946	87	1940-1950 ^a	92
STREET AND ELECTRIC RAILWAYS			
1896-1906	140	1900-1910	119
1906-1916	61	1910-1920	37
1916-1926	10	1920-1930	-17
1926-1936	-40	1930-1940	-27
1936-1946	2	1940-1950 ^a	-37
LOCAL BUS LINES			
1926-1936	74	1930-1940	108
1936-1946	152	1940-1950 ^a	37
ALL OTHER			
1896-1906	163	1900-1910	135
1906-1916	97	1910-1920	81
1916-1926	73	1920-1930	62
1926-1936	45	1930-1940	84
1936-1946	139	1940-1950 ^a	114

^a The figures used for 1950 represent production for that year only.
Source: Appendix Table K-9.

apply this model to the several individual industry groups within that aggregate, which we have selected for special study. The several stages of development inherent in this model should be recalled at

this point. They are listed again, at least with reference to the behavior of the net capital formation series, in the first column of Table 18, and in the second and third columns they are related to the key points indicated by capital letters in Chart 3. The key dates in the secular development of each of the regulated industries, in accord with this pattern for capital formation, are given in this table.

These key dates were selected as follows. Tables 9 and 10 and the relevant charts were studied, as previously described, to determine whether the series on the stock of plant and equipment and on net capital formation had advanced throughout the period of study, secularly, or had reached some turning point in the intervening period. In the latter case, long cycles were marked off in the nine-year moving averages of the series concerned, and the cycle with the highest average level then selected. Within this cycle the highest nine-year average was determined, and the year about which this average was centered was designated as the peak. Of course the selection of a peak in the net capital formation series automatically determined the inflexion point (point A in the upper panel of Chart 3) in the stock of capital series, since these are necessarily simultaneous. An exception to the general practice described was made in the case of local bus lines, for which the investment series do not conform to the long cycle patterns of the other regulated industries. In this case the peak of net capital formation was dated in 1938, which was the all-time high in the nine-year moving averages, and both from its graph and a study of the data in Table 10 appeared to be followed by a definite secular downtrend.

The inflexion point in net capital formation (point A' in the lower panel of Chart 3) was determined from mathematical curves fitted to the data.² However, in cases where the peak of net capital

² The form of the curve fitted to the constant dollar value of plant and equipment is:

i.
$$\log y = a + bt + ct^2,$$

where y is the stock of capital and t is time measured in years.

The differential of this curve is the trend of net capital formation, drawn in the center panels of Charts 1 and 2. The form of this curve is:

ii.
$$\frac{dy}{dt} = y(b + 2ct),$$

where $\frac{dy}{dt}$ is net capital formation.

The inflexion points in net capital formation are found by taking the second differential of equation ii (equivalent to the third differential of equation i), setting this equal to zero and solving for t . This solution yields three values of t , which provide the timing of inflexion points A', C' and E' respectively in Chart 3. However, point C' is equivalent to point B—the maximum level of the stock of capital; this point, as described above, is determined by another method. Therefore, except for street railways, where point E' is required, our interest is in A' only.

TABLE 18
Key Dates in Pattern of Secular Growth of Capital, All Regulated Industries and Components

STAGE IN PATTERN AS DEFINED BY BEHAVIOR OF NET CAPITAL FORMATION	TERMINAL POINTS IN STAGES AS DESIGNATED IN CHART 3:		APPROXIMATE DATES OF STAGES IN:						
	Net Capital Formation	Stock of Physical Capital	Total Utilities and Trans- portation	Steam Railroads	Electric Light and Power	Telephones	Street and Electric Railways	Local Bus Lines	All Other
Increases by increasing amounts	A'	-	Up to 1875	1840-1857	1881-1909	1878	1850-1889	1910-1930	Up to 1919
Increases by decreasing amounts	B'	A	1875-	1857-1881	1909-		1889-1905	1930-1938	1919-
Decreases by increasing amounts but remains positive	C'	B		1881-1931			1905-1916	1938-	
Becomes negative and decreases by decreasing amounts	D'	C		1931-			1916-1933		
Increases by increasing amounts but remains negative	E'	-					1933-1949		
Increases by decreasing amounts but remains negative	F'	D					1949-		

For derivation, see accompanying text.

formation had not yet been reached, the existence of inflexion point A' was first checked by a study of the detailed data of Table 10, before resorting to curve fitting. Inflexion point E', on the negative branch of the net capital formation curve, had to be dated only for street railways. This date was fixed from the mathematical curve.

It must, of course, be realized that all the key dates listed in Table 17, no matter how great the care taken in their determination, are by their nature rough approximations. Secular movements cannot be said to change pace or direction in a particular hour, day, month, or year. Although for convenience secular stages have been marked off for each component as well as for all regulated industries by specific years, each of these dates should be interpreted as the central point in a time range or period (perhaps of five to 10 years in length) within which the secular turning point falls. And of course no purely objective method is available for determination of these central points. Moving averages of a length different from nine years may have been studied and the form of the curves employed modified in one way or another. Such alterations in approach would surely have altered some of the results obtained. But if judged as approximations within a fairly broad range as indicated, the key dates provided in Table 17 possess considerable substance; alternative approaches resulting in minor revision of conclusions can, from this point of view, be adjudged irrelevant. And the pattern of growth, thus liberally interpreted, nevertheless fulfils its intended mission of providing a broad framework for the comparative analysis of the secular development of the regulated industries.

That the growth of capital in each of the regulated industries—at least roughly—followed the outline of the model pattern, was indicated in our examination, earlier in this chapter, of the detailed data dealing with the stock of capital and capital flows. For, though not overtly acknowledged, this model provided the framework for that analysis—the underlying structure around which the figures were organized. The extent to which the several components progressed along this model pattern, however, varied greatly. At one extreme was telephones. From the standpoint of its investment behavior, this industry was by far the least mature of all, for not only did its stock of capital rise by increasing amounts, but its net capital formation itself rose at an increasing absolute rate throughout the period from the industry's beginning in the late 1870's to 1950. With reference to the model in Chart 3, the development of the industry had not only failed to reach point A, but had not even

reached the earlier point A'. The position of telephones was well within the very earliest stage.

At the other extreme was street and electric railways, a prime example of an industry whose life span in nearly its entirety was covered by the period studied. In this most mature component, the change-over from an increasing to a decreasing rate of advance in net capital formation came at the end of the 1880's. The peak in net capital formation—equivalent to a change-over from an increasing to a decreasing rate of growth in the stock of capital—came in the middle of the first decade of the twentieth century. Net capital formation then turned downward in this component, diminishing at an increasing rate until it reached zero around 1916. At this point the stock of capital was at its peak. Subsequently it was subject to continuous contraction. Net capital formation turned negative, continuing to decrease—though by diminishing amounts—until the early 1930's. At this juncture, while remaining negative throughout, net capital formation began to rise. This means that the net capital formation series was moving back toward zero—i.e., that the reductions in the stock of capital were becoming smaller over time. In the late 1940's it appeared that this approach to the zero line—at which point the entire stock of the industry's plant and equipment would be dissipated—became subject to some retardation.

Among the other components, steam railroads came closest to matching the maturity of the street railways—though it still remained a substantial distance away. For steam railroads the change-over from an increasing to a decreasing rate of growth in the stock of capital—the peak in net capital formation—came in the early 1880's; the peak in the stock of capital itself seemed to fall in the early 1930's. But in the years between 1931 and 1950, the railroads did not progress very far along the stage from C' to D' in the model pattern, i.e., the reductions in the stock of capital were modest. In contrast street railways had not only completed the stage from C' to D', but had finished the following one from D' to E', and had apparently—in addition—made a start on the final stage leading to F'. Thus steam railroads were a much less mature component. Though their stock of capital had indeed headed downward since the early 1930's, the negative balance of their net capital formation was only moderate, admitting substantial spurts of net investment over protracted periods.

Electric light and power and the heterogeneous all other group ranked somewhat behind telephones in the inverse order of maturity. After World War I, in both cases, the pace of expansion evidenced some loss of vigor. Somewhere between the years just preceding and

immediately following that conflict, they appear to have passed the point at which net capital formation changes over from an increasing to a decreasing rate of advance. Local bus lines progressed one stage further in the model pattern. Just before or after World War II, this industry passed the point at which the *stock of capital* changed over from an increasing to a decreasing rate of advance. In 1950, in all three cases, the stock of capital was still heading secularly upward, but in local bus lines its rise was proceeding by diminishing amounts.

The fact that several industries are in the same stage of development, of course, casts faint light upon the relative duration of their remaining life spans. Indeed it should be emphasized that there was wide variation among components in the length of any given stage of development, and there was but little similarity in the duration of the various stages in any given component. Thus, for steam railroads, electric light and power, street and electric railways, and local bus lines, the first stage (during which net capital formation increases by increasing amounts) ranged in length from 17 to 39 years. The second stage for the same components varied in length from 15 to 24 years. The third stage ranged from 11 years for street and electric railways to 50 years for steam railroads. And it will be recalled in the case of telephones, that by 1950 the first stage of development had lasted some 70 years and still had not ended.

Such wide variations, however, befit the nature of the causal factors at work—especially the long-term growth characteristics of demand together with the ubiquitous, and capricious impact of technological change. The role of the latter, in particular, enters in quite different ways in the history of our industries. For example, it is this factor, especially, which accounts for the fact that the first stage of secular development had by 1950 lasted 70 years for telephones (and was still in progress), while during roughly the same period street and electric railways had passed through five of the six stages which carry an industry from its birth to its final demise. This is an extreme example of variation—and a dramatic illustration of the distinction between chronological age and degree of maturity.

For it is obvious that there is but slight connection between chronological age and the relative positions in the model pattern of growth occupied in 1950 by the five components studied. The first street railways were established around 1850, some ten years *after* construction of the first steam railroads. The former nonetheless was a considerably more mature industry, reflecting the greater, swifter, and more conclusive impact of competitive forms of transportation upon its business. Chronologically, telephones is a slightly

older component than electric light and power and it is much older than local bus lines, but from the standpoint of the secular growth pattern it is more youthful than either. Electric light and power was less mature than local bus lines, though it predates that component by some 40 years.

In Table 19, key dates in the model pattern of growth are presented for each of the regulated industries, based upon the behavior of output. Of course, if the technical relationship between capital and production had always remained unchanged, there would have been no need for this additional tabulation. Analysis in terms of the stock of capital and net capital formation, as provided in Table 18, would have sufficed. But this technical relationship did indeed change, in a significant manner which we analyze in detail in the following chapter. And accordingly the patterns of growth described by the production series differ materially from those already defined in investment.

Determination of these dates presented a slightly different problem from that encountered in the capital formation series. For, though quite volatile, there is no distinct or pronounced evidence of long cycles in the production series. Consequently, the methods of determination employed for capital formation were revised somewhat. Thus, principal reliance for the location of peaks in output and in changes in output was placed upon a study of the nine-year averages given in Tables 15 and 16. In fact, in connection with the discussion of these tables, the general areas of the peaks were pointed out. In the general time spans cited, the maximum points were selected, and designated as peaks, from examination of the nine-year moving average series, shown in Charts 10 through 15. For those components for which the peak in changes in output had not yet been reached, Table 16 was also used to explore the existence of inflexion point A'. When it appeared that this inflexion point had in fact been reached, its date was determined from a mathematical curve of the same form as those employed in the study of capital formation.

Though the picture of growth patterns derived from the study of production differs from that provided in our analysis of capital formation, it does so in a systematic way. Generally speaking, the industries appear less mature within this framework. The telephone industry still appears in the earliest stage of most vigorous growth, as it did in the capital formation study, but it is now accompanied in this standing by electric light and power and the all other group. In all three cases, not only did output increase at an increasing rate, but changes in output also advanced at an expanding rate through

TABLE 19

Key Dates in Pattern of Secular Growth of Output, All Regulated Industries and Components

STAGES IN PATTERN AS DEFINED BY BE- HAVIOR OF ANNUAL CHANGES IN OUTPUT	TERMINAL POINTS IN PATTERNS AS DESIGNATED IN CHART 3:		APPROXIMATE DATES OF STAGES IN:						
	Annual Changes in Output	Output	Total Utilities and Trans- portation	Steam Railroads	Electric Light and Power	Telephones	Street and Electric Railways	Local Bus Lines	All Other
Increases by increasing amounts	A'	-	^a	1840-1891	1881-	1878-	1850-1893	1910-1928	^a
Increases by decreasing amounts	B'	A	-	1891-1942			1893-1906	1928-1943	
Decreases by increasing amounts but remains positive	C'	B					1906-1923	1943-	
Becomes negative and decreases by decreasing amounts	D'	C		1942-			1923-1948		
Increases by increasing amounts but remains negative	E'	-					1948-		
Increases by decreasing amounts but remains negative	F'	D							

Chart 3 presents the secular pattern of capital formation. An analogous pattern is assumed for output. The pattern for output corresponds with that for the stock of capital (upper panel of Chart 3) and the pattern for changes

in output corresponds with that for net capital formation (lower panel of Chart 3). For derivation, see text accompanying Chart 3.

^a This stage had not been completed by 1950.

the entire period of analysis. The latter two components had been in a significantly later stage of development when appraised from the standpoint of capital formation. Indeed, they had each reached the point at which net capital formation (analogous to output increments) had not only ceased to rise by increasing amounts, but had actually begun to decrease.

Ranking on a par behind these three, in the inverse order of maturity, are steam railroads and local bus lines, when production is used as the standard of secular development. The latter—alone among the components, except for telephones—reached the same stage of growth in terms of output as it did in terms of capital formation. Output increments passed the point of change-over from an increasing to a decreasing rate of advance in the late 1920's, and appeared to reach their peak in the early 1940's. Hence, total production of local bus line service was still rising, secularly, in 1950, though by diminishing absolute amounts. Substituting the stock of capital for output, and net capital formation for output increments, we see the same pattern of growth noted previously for this component.

In the case of railroads, however, the change is substantial. It will be recalled that the stock of capital had begun to decline, with net capital formation turning negative for this component as early as the 1930's. Production provided by the railroads, on the other hand, was still pointed secularly upward in 1950. Output increments had ceased to rise by increasing amounts in the early 1890's, but they continued to advance until the early 1940's. Since then they appear to have been declining, though remaining substantially positive. Stated alternatively, production of railroad service since the early 1940's continued to advance, secularly, but by diminishing amounts.

To a lesser degree street and electric railways also have a slightly more youthful look, when judged by production, though still ranking as by far the most mature of the components studied. In terms of the model pattern of growth, this component in 1950 stood between the points D' and E' when judged by production, instead of between E' and F' as in the capital formation analysis. Nevertheless—and most important—production of street railway service like the stock of capital in this component, was headed secularly downward in 1950, and had been tending in this direction for at least twenty-five years.

Thus the relative standing of the several regulated industries, with respect to the model pattern of growth, is much the same when judged by the behavior of production as by that of capital formation.

VARIATIONS IN SECULAR PATTERNS

But in the former framework, the various components appear to be in significantly earlier stages of development, reflecting systematic changes in their respective capital coefficients, as shall be discussed more fully later. An apparent exception is telephones, but in this case no earlier stage than that reached in the capital formation framework is possible. A real exception is local bus lines, for in this case—unlike the others—the secular relationship between capital and output remained relatively unchanged.