

This PDF is a selection from an out-of-print volume from the National Bureau of Economic Research

Volume Title: Productivity Trends in the United States

Volume Author/Editor: John W. Kendrick, assisted by Maude R. Pech

Volume Publisher: Princeton University Press

Volume ISBN: 0-87014-070-1

Volume URL: <http://www.nber.org/books/kend61-1>

Publication Date: 1961

Chapter Title: Appendix H: Communications and Public Utilities

Chapter Author: John W. Kendrick

Chapter URL: <http://www.nber.org/chapters/c2253>

Chapter pages in book: (p. 557 - 598)

APPENDIX H

Communications and Public Utilities

THIS segment, as defined by the National Income Division of the Commerce Department, consists of Telephone, telegraph, and communication services not elsewhere classified (SIC Major Group 48); Radio broadcasting and television (Major Group 77); Electric and gas utilities (Groups 491-493); and Local utilities and public services not elsewhere classified (Groups 494-97).

Indexes of output and of total factor inputs have been prepared for the major components: the two communications groups, the two gas utility groups, and the electric utilities. Indexes of output, input, and productivity were computed for the aggregate of the five covered groups and are presented in Table H-II. Indexes of the same variables are shown for the segment as a whole in Table H-I; output and capital estimates for the segments were obtained by means of coverage adjustments.

The magnitude of the uncovered groups is indicated in Table H-1 in terms of the national income estimates used for coverage adjustments after

TABLE H-1
Communications and Public Utilities:
Relative Importance of Covered and Uncovered Groups, 1929 and 1953

	<i>National Income</i>			
	1929		1953	
	millions of dollars	per cent	millions of dollars	per cent
Covered groups	2,756	96.2	9,357	93.5
Telephone, telegraph, and related services	1,125	39.3	4,116	41.1
Gas and electric utilities	1,631	56.9	5,241	52.4
Uncovered groups	108	3.8	650	6.5
Radio broadcasting and television	28	1.0	491	4.9
Local utilities and public services, n.e.c.	80	2.8	159	1.6
Total	2,864	100.0	10,007	100.0

n.e.c. = not elsewhere classified.

APPENDIX H

1929. Coverage adjustments prior to 1929 were based on employment estimates which were prepared for all components throughout. Whereas radio broadcasting was nonexistent before the 1920's, local utilities and public services were of increasing importance going back in time.

The Telephone Industry

The basic data used to obtain output, input, and productivity estimates (Table H-IV) are from the decennial censuses of 1880 and 1890, the quinquennial *Census of Telephones and Telegraph* (in the *Census of Electrical Industries*) 1902-37, and the Federal Communications Commission's *Statistics of the Communications Industry in the United States*, which has been issued annually since 1939 and contains series back to 1926. The data cover only public systems and lines in the continental United States; they do not include lines maintained by companies for their private use or systems operated by federal, state, or municipal governments. The coverage has varied slightly over the years. The decennial censuses of 1880 and 1890 and the *Census of Telephones, 1902* attempted to include data for all systems and lines; those of 1907, 1912, and 1917 covered only systems with an annual income of \$5,000 or more; those of 1922 and 1927, systems with \$10,000 or more annual income; and those of 1932 and 1937, all systems. The statistics of the Federal Communications Commission are less inclusive than the Census data. Detailed information is compiled for Class A and Class B carriers.¹ The Commission estimates that on the basis of revenues and assets reporting carriers account for more than 95 per cent of the entire industry.² Fortunately, all data used, both from Census and FCC sources, could be adjusted to provide continuity since overlapping data are available for years in which coverage changed.

OUTPUT

An output index was obtained by weighting the two categories, local message units and toll and long-distance message units, by average unit revenues in each in the following pairs of years: 1899-1917, 1917-29, 1929-37, 1937-48, 1948-53. Noncensus years during 1899-1926 were interpolated by means of an output index computed by Solomon Fabricant.³ Fabricant's annual index, 1880-1939, was based on data supplied by the American Telephone & Telegraph Company. The noncensus years during 1880-1902 were obtained by multiplying Fabricant's output

¹ Class A carriers are those with annual operating revenues exceeding \$100,000; Class B, those with revenues between \$50,000 and \$100,000.

² See *Seventeenth Annual Report for Fiscal Year, 1951*, Federal Communications Commission, p. v.

³ *Labor Savings in American Industry, 1899-1939*, Occasional Paper 23, New York (NBER), 1945, p. 49.

COMMUNICATIONS AND PUBLIC UTILITIES

index for those years by a series obtained as the ratio of our employment index (based on Census) to Fabricant's employment index in census years, interpolated linearly.

There are a number of supplementary elements of production which should be weighted into an over-all telephone industry output index, were it possible to develop adequate physical-unit measures and appropriate weights.

Examples are various types of miscellaneous telephone services such as private-line services, radio and television program transmission, teletypewriter services, and directory service. Even more difficult to evaluate and weight into a telephone output index would be the factor of "readiness to serve." The security and protective features of having communication facilities at hand in case of sudden illness, fire, and other emergencies is another element of telephone service.⁴

MANHOURS WORKED

The employment index is based on the number of employees in the industry as reported in the various censuses and, more recently, by the Federal Communications Commission. The latter series is compiled jointly with the Bureau of Labor Statistics. Coverage adjustments were made to obtain comparability. Noncensus years were interpolated by means of Fabricant's employment index.⁵

Average hours worked per week in the telephone industry for 1937-53 are the estimates of the Bureau of Labor Statistics. This series was extrapolated back to 1914 by average hours worked in the electric utility industry.⁶ Extrapolation back from 1914 to 1880 was by means of average hours in the manufactured gas industry, the Aldrich Report series of average daily hours in the gas industry⁷ being used to extrapolate from 1890 to 1880.

We were able to test the reasonableness of the figure for average hours worked per week in 1915 as obtained by the above procedure against the findings of an independent study, made by the United States Commission on Industrial Relations,⁸ of wages and hours in nine cities throughout the country, and data obtained by communication with the American Telephone & Telegraph Company. Our estimate for 1915 is 45.3 hours

⁴ Based on communication with John C. Swartley, chief statistician, American Telephone & Telegraph Co.

⁵ *Op. cit.*, p. 49.

⁶ Jacob M. Gould, *Output and Productivity in the Electric and Gas Utilities, 1889-1942*, New York (NBER), 1946, p. 70, for 1917-37. For 1914-17, see section on electric utilities in this appendix.

⁷ *Wholesale Prices, Wages, and Transportation*, Committee on Finance, Senate Report No. 1394, 52d Cong., 2d sess., 1893, Part I, pp. 178-79.

⁸ Nelle B. Curry, *Investigation of the Wages and Conditions of Telephone Operating*, 1915.

APPENDIX H

per week, the Commission's study gives an average of 45 hours, and A.T. & T. data indicate an average 44-hour week.

CAPITAL

The index of constant-dollar capital stock is based on Ulmer's⁹ estimates of the value of plant and equipment in 1929 dollars for 1880–1950. A two-year moving average was required in order to center the data, which are as of the end of each year. Ulmer first derived a series on gross capital expenditures in current dollars. Estimates of expenditures for the entire industry for 1913–50 were obtained from the American Telephone & Telegraph Company. For 1880–1912, Census data and data shown in the Federal Communications Commission's *Telephone Investigation*, Exhibits 1360-A and 1366-A, were used. Adjustments were made for write-ups and write-downs and to exclude land. Retirements for 1880–1912 were estimated on the basis of depreciation rates and the average ratio between depreciation and retirements for 1913–17. For 1880 a depreciation rate of 10 per cent was assumed (based on A.T. & T. estimates). The rate for 1950 was obtained as an average of the rates prescribed for ten companies by the Federal Communications Commission. Rates for intervening years were interpolated linearly. Annual capital expenditures for 1880–1912 were obtained as sums of the annual changes in the value of plant and equipment and estimated retirements.

Ulmer obtained a series on gross capital expenditures in constant 1929 dollars by deflating the current-dollar series by an index of construction costs. This index for 1915–50 is a weighted average of indexes for four components: telephone apparatus, wages in the building trades, commercial buildings, and telephone poles in place. For years prior to 1915, the index is based on three series: electrical equipment, construction materials, and wages in the building trades.

Beginning with the assumption of zero physical assets at the end of 1877, Ulmer arrived at his series on the value of physical assets by subtracting from his cumulative gross capital expenditures, cumulative retirements and depreciation, all in constant dollars. We extended Ulmer's series using his methods, and data on the value of plant and annual additions to plant published by the Federal Communications Commission.¹⁰

TOTAL INPUT

The method used in combining labor and capital inputs to obtain total input is the same as that described in Appendix A. The subperiods used for this group are 1880–90, 1890–1902, 1902–12, 1912–22, 1922–29,

⁹ Melville J. Ulmer, *Capital in Transportation, Communications, and Public Utilities: Its Formation and Financing*, Princeton University Press (for NBER), 1960.

¹⁰ *Statistics of the Communications Industry in the United States*, annual issues.

COMMUNICATIONS AND PUBLIC UTILITIES

1929-37, 1937-48, 1948-53. Estimates of the compensation of labor and capital are from Census data for 1922 and prior years, except that labor compensation for 1880 and 1890 had to be estimated from Census employment figures for those years and wage rates obtained from the Aldrich Report¹¹ for 1880 and from Douglas¹² for 1890. For subsequent years, labor and capital compensation estimates are based on reports of the Federal Communications Commission, adjusted to the 1929 Commerce Department levels.¹³ The relative weights are shown in Table H-2.

TABLE H-2
Telephone Industry:
Relative Weights of Labor and Capital Inputs
Subperiods, 1880-1953
(per cent)

	Labor	Capital
1880-90	55	45
1890-1902	58	42
1902-12	61	39
1912-22	60	40
1922-29	63	37
1929-37	73	27
1937-48	85	15
1948-53	86	14

The Telegraph Industry

The same basic sources (Census and FCC) were used to obtain estimates in both the telegraph and telephone industries. The first telegraph census was taken in 1880 (but included data for 1870), and the second, in 1902, after which they were taken quinquennially to 1937. The statistics relate to commercial systems operated in the continental United States; they exclude government systems, traffic of press associations or newspapers over private or leased wires, and telegraph systems owned and operated by railroads (although supplemental tables are available on the excluded systems). Relevant series for the private industry so defined are presented in Table H-V.

OUTPUT

The measure of output was computed from data on the numbers of message units for the three basic types of transmission—domestic, ocean-cable, and radiotelegraph. Average unit revenues in the terminal years of the follow-

¹¹ *Op. cit.*, p. 173.

¹² Paul H. Douglas, *Real Wages in the United States, 1890-1926*, Boston, Houghton Mifflin, 1930, p. 334.

¹³ *National Income Supplement, 1954, Survey of Current Business, Dept. of Commerce*, p. 176.

APPENDIX H

ing subperiods were used as weights: 1902-12, 1912-22, 1922-29, 1929-37, 1937-48, 1948-53. The 1902 relative weights were used for the earlier periods. Total messages for 1880 were estimated by assuming that the relationship existing between Western Union revenues and total revenues also applied to message units (in 1880 Western Union accounted for 76.6 per cent of the total revenues in the industry). Western Union data were used for interpolations between census years until annual data became available from the FCC reports beginning in 1926.

MANHOURS WORKED

The index of manhours was obtained as the product of the indexes of employment and of average hours worked per employee. Employment estimates before 1927 were based on the censuses; figures for noncensus years prior to 1927 were interpolated by a series on the number of telegraph offices. Estimates of total offices for the industry had to be obtained by interpolating ratios of Western Union offices to the total in census years and applying the ratios to the relevant Western Union data for intercensal years. Employment estimates since 1927 have been published by the Federal Communications Commission.¹⁴

Average hours worked per week for the period since 1943 are the estimates of the Bureau of Labor Statistics; extrapolation to earlier years was based on hours worked in the telephone industry.

CAPITAL

The index of the stock of capital was constructed in several stages. We started with a series on the gross book value of plant and equipment. For 1880-1922 these data were available for census years. Noncensus years were interpolated by means of data on the value of Western Union plant and equipment. Federal Communications Commission estimates were used for 1927 and subsequent years.

The second step was to estimate accumulated depreciation and thus, by subtraction from gross book values, to obtain net book values. Accumulated depreciation was available for 1927-53 from the Federal Communications Commission's annual publications. For 1880-1922 net book value estimates were extrapolated by gross book value.

The third step was to deflate the net book value of plant and equipment to arrive at a constant (1929)-dollar series. To construct such a deflator, it was necessary to obtain annual estimates of the prices of plant and equipment and to estimate the distribution of each year's net stock by year of acquisition in order to be able to weight the price indexes appropriately. This involved estimates of gross capital outlays and of the average length of life of the fixed assets involved.

¹⁴ *Statistics of the Communications Industry in the United States*, annual issues.

COMMUNICATIONS AND PUBLIC UTILITIES

In view of the similarities between the two industries, Ulmer's price index for telephone plant and equipment was used, extrapolated prior to 1879 by construction costs in manufactured gas (see below). *Bulletin "F"* of the Internal Revenue Service¹⁵ gives the average composite useful life for telegraph land-lines as thirty-three years, and that for ocean-cable systems, as sixty-seven years. A weighted average useful life was computed for 1929, 1932, 1937, 1948, and 1953, using as weights the gross book value of plant and equipment for land-lines and for ocean-cable systems. On the basis of such calculations a forty-year composite life was considered reasonable.

Estimates of capital outlays in the telegraph industry, 1915-53, are available from the Department of Commerce.¹⁶ Estimates for 1840-1914 were made by extrapolating back by a series on expenditures in the manufactured gas industry. This is not as farfetched a procedure as it may seem, since the outlay estimates are used merely as a basis for weighting price deflators for the book value of capital in the telegraph industry.

By depreciating each year's capital outlays over a forty-year period and summing in each year the depreciated capital outlays remaining from all preceding years, a percentage distribution of the current stock (at original cost) by year of acquisition is obtained. When these percentages are applied to the price index numbers for the current and preceding forty years, the appropriate book value deflator emerges.

TOTAL INPUT

The same methods were used to combine labor and capital inputs as explained in the notes to the electric utility industry (see below). The subperiods are the same as those used in obtaining the weighted output index. The relative returns to labor and capital are from the Commerce Department for 1929-53¹⁷; from Census data, for 1880-1922. The latter were adjusted to the Commerce level in order to provide a consistent series throughout. The relative weights are shown in Table H-3.

The Communications Group

In order to have a picture of productivity in communications as a whole, the output and input indexes for the telephone and the telegraph industries were combined. Based on the previously described methods and on the sources noted for each component, the relative weights for the various subperiods are shown in Table H-4. The productivity summary for the communications group is presented in Table H-III.

¹⁵ *Bulletin "F": Income Tax Depreciation and Obsolescence, Estimated Useful Lives and Depreciation Rates*, Rev. Ed. (July 1942), 1942, p. 66.

¹⁶ *Construction Volume and Costs, 1915-53*, May 1954, Statistical Supplement, *Construction and Building Materials*, p. 9.

¹⁷ *National Income Supplement, 1954*, p. 176.

APPENDIX H

TABLE H-3
 Telegraph Industry:
 Relative Weights of Labor and Capital Inputs,
 Subperiods, 1880-1953
 (per cent)

	Labor	Capital
1880-90	57	43
1890-1902	64	36
1902-12	74	26
1912-22	78	22
1922-29	77	23
1929-37	84	16
1937-48	96	4
1948-53	91	9

TABLE H-4
 Communications: Relative Weights of Industry Output and Inputs,
 Subperiods, 1880-1953
 (per cent)

	1880- 1902	1902- 1912	1912- 1922	1922- 1929	1929- 1937	1937- 1948	1948- 1953
Output							
Telephone	90	85	85	85	86	85	85
Telegraph	10	15	15	15	14	15	15
Total Input							
Telephone	85	83	85	85	86	85	83
Telegraph	15	17	15	15	14	15	17
Labor Input							
Telephone	85	80	82	82	84	83	82
Telegraph	15	20	18	18	16	17	18
Capital Input							
Telephone	86	88	91	90	91	95	89
Telegraph	14	12	9	10	9	5	11

OUTPUT

An index of output for the combined telephone and telegraph industries was obtained by weighting the output index for each by national income originating per unit of output, using Marshall-Edgeworth weights for the subperiods given in Table H-4. The national income originating in each industry was obtained simply by adding the returns to labor and to capital for any given year (see notes for the individual industries).

COMMUNICATIONS AND PUBLIC UTILITIES

INPUT

The combined indexes of manhours and of capital stock were computed by weighting the individual manhour and capital indexes by compensation per unit of labor and capital input respectively, using the Marshall-Edgeworth formula for the same subperiods as detailed in Table H-4.

The combined index of total input was obtained by weighting the two indexes of total factor input by the average national income originating in each industry per unit of total factor input for the successive pairs of key years.

The Electric Utility Industry

The definition of the electric utility industry employed by the Bureau of the Census in its quinquennial *Census of Electrical Industries* (1902-37) includes privately owned utilities, municipally owned utilities, cooperatives and power districts, federal and state projects, and "other."¹⁸ Although our concern is with the private segment of the industry, this was well over 90 per cent of the total until the early 1930's. Beginning with 1932, we have linked to a series from which public power production was excluded. Indexes of output, inputs, and productivity ratios are presented in Table H-VI.

OUTPUT

For 1904-32, the output estimates are those prepared by Gould and based on the censuses. His output indexes were constructed in two stages. For 1902-17 he first computed an unweighted index for the census years based on the number of kilowatt-hours generated. A true weighted output index could not be obtained for years prior to 1917 since prices charged to the various types of consumer units were not available. Alternative assumptions were then made: (1) that the relative prices for the three basic consuming units (light, power, and rail) were the same in 1902 as in 1917; (2) that the prices in 1902 were the same for all types of consumers. On these assumptions, two separate indexes of kilowatt-hours sold were constructed for 1917 on a 1902 base, using Marshall-Edgeworth price weights. An arithmetic average of the two indexes was used as the weighted output index. For the intervening census years, 1907 and 1912, the weighted index numbers were obtained by multiplying the unweighted output index by the arithmetically interpolated differences between the 1902 and 1917 ratios of weighted to unweighted indexes.¹⁹

Output indexes for census years 1917, 1922, and 1927 were obtained by weighting (Marshall-Edgeworth formula) kilowatt-hour sales by unit

¹⁸ For a detailed definition, see *Census of Electrical Industries, 1937*, Vol. I, *Electric Light and Power Industry*, pp. 2 and 16.

¹⁹ Gould, *op. cit.*, pp. 20, 26, 145, and 146.

APPENDIX H

prices for the categories of light, power, and rail. For 1927, 1932, 1937, and 1942 more detailed categories were available for weighting—farm, domestic, small commercial, large commercial, municipal street lighting, street and interurban railroad, street and electrified railroad, and “other.”²⁰

The weighted output index obtained by linking the chains described above was interpolated as follows to yield an annual series: for 1912–19, an annual series on the output of all public and private agencies in *Electrical World*, September 9, 1922, was used; for 1920–27, Federal Power Commission data were used;²¹ for 1926–42, a Marshall-Edgeworth-weighted output index (using the eight categories mentioned above) based on Edison Electric Institute data was used.²²

Gould’s output indexes for 1899–1903 and 1933–42 were not used because a series recently computed by Ulmer was better suited to our needs.²³ Ulmer’s series covers 1887–1950. His output index for 1887, 1892, 1897, and 1902 is based on total energy generated less losses as published in *Electrical World*, September 9, 1922. Intervening years were derived by geometric interpolation. Ulmer linked his index to Gould’s in 1902, after adjusting the latter’s 1902 index from a census-year (June 30, 1902) to a calendar-year basis.

Ulmer’s index for 1932–50 is here described. Applying the Marshall-Edgeworth formula with 1932 as a base, he computed an index number for 1937, using sales data from the *Census of Electrical Industries* and a classification of sales into residential, commercial and industrial, and other. Output by government systems was excluded, as it had begun to increase in importance relative to the total. With 1937 as a base and using the same sales categories, Ulmer computed index numbers for 1942, 1947, and 1950 from Federal Power Commission statistics of Class A and Class B utilities. Intervening years 1932–37 were interpolated by Federal Power Commission data on current generated; 1937–50, by the Commission’s series on sales to ultimate consumers by Class A and Class B utilities. We extended Ulmer’s index to 1953, using his methods and sources.

MANHOURS WORKED

Numbers of wage and salary earners employed in census years 1902–37 were taken from the quinquennial *Census of Electrical Industries*, on a basis comparable with the output measures. In both electric and gas utilities, proprietors of unincorporated enterprises were negligible. Kuznets’

²⁰ *Ibid.*, pp. 146–47.

²¹ *Electric Power Statistics, 1920–1940*, FPCS-20, 1941, Appendix, 4.

²² Gould, *op. cit.*, p. 148.

²³ *Op. cit.*

COMMUNICATIONS AND PUBLIC UTILITIES

annual series on employment in private electric utilities, 1917-32, was used to interpolate between census years.²⁴ The interpolator from 1932 to 1937 was the Bureau of Labor Statistics index of employment in private electric utilities.²⁵ For subsequent years employment was taken from the Bureau of Labor Statistics. For intercensal years, 1902-17, employment was assumed to grow logarithmically. The 1902-07 annual rate of change in employment was assumed to apply to the three earlier years back to 1899.

Average hours worked per week for 1917-31 were obtained from National Industrial Conference Board publications.²⁶ The data subsequent to 1931 are from the Bureau of Labor Statistics.²⁷ Estimates prior to 1917 were extrapolated by the estimates of average hours worked per week in the manufactured gas industry.

The manhour index is simply the product of the corresponding employment and average hours indexes. Because Gould adjusted output to include electricity produced and sold by electric railways, it was necessary to make a corresponding adjustment to the manhours series since the underlying employment index does not include electric railway employees engaged in producing electricity. To obtain the more inclusive manhour series, we assumed that labor productivity was the same for employees working in electricity-producing departments of electric railways as for regular utility employees. Subsequent to 1926 no adjustment was required since electric departments of electric railways were insignificant in comparison to the total.

CAPITAL

The index of the stock of capital is given by Ulmer. He derived an annual series on gross private capital expenditures back to the inception of the industry, 1880, using Census data, the *Fourteenth Annual Report of the Commissioner of Labor* (1899), Edison Electric Institute data, Federal Power Commission reports, and other supplementary studies. He adjusted the data to exclude land and to eliminate industry write-ups and write-downs of fixed assets.

The gross capital expenditures series was converted to constant 1929 dollars by use of a price index made up of two segments: (1) for 1880-1911, the composite index consisted of (a) an index of the cost of electric equip-

²⁴ Simon Kuznets, *National Income and Its Composition, 1919-38*, New York (NBER), 1941, pp. 676-710.

²⁵ Gould, *op. cit.*, p. 70.

²⁶ *The Economic Almanac for 1942-43*, p. 356; and M. A. Beney, *Wages, Hours, and Employment in the United States, 1914-36*, 1936, p. 162.

²⁷ *Handbook of Labor Statistics, 1947 Edition*, Bulletin 697, p. 126; *Hours and Earnings in the United States, 1932-40*, Bulletin 916, p. 81; *Hours and Earnings*, Annual Supplement Issue, April 1953, pp. 44-45; *Monthly Labor Review*, June 1954.

APPENDIX H

ment, from Shaw,²⁸ extrapolated back to 1880 by the Aldrich Report index for metals and implements, excluding pocket knives (weight 5), (b) an index of the cost of construction materials from Shaw (weight 3), and (c) an index of wages in the building trades, from Aldrich Report and Bureau of Labor Statistics series (weight 2); (2) for 1911-53, the Handy index of public utility construction costs was used.²⁹

Capital consumption was estimated using a seventeen-year life for equipment installed prior to 1900 and a thirty-seven-year life for equipment installed subsequent to 1919. The average life for the intervening twenty years was obtained by straight-line interpolation.

Ulmer's estimates were extended through 1953, using continuations of his series and following his methods. The series thus computed as the basis for our capital index is one which shows the movement over time of net fixed assets, expressed in constant (1929) dollars. Although inventories are not included, they are so small relative to fixed capital that total real stocks may be assumed to move closely with the latter.

TOTAL INPUT

The manhour and capital stock indexes were combined using the Marshall-Edgeworth formula for six subperiods. The weights used are the relative average unit compensations of the two factors, capital and labor, in the terminal years of each subperiod, as shown in Table H-5.

TABLE H-5
Electric Utilities:
Relative Weights of Labor and Capital Inputs,
Subperiods, 1899-1953
(per cent)

	Labor	Capital
1899-1912	54	46
1912-19	58	42
1919-29	48	52
1929-37	46	54
1937-48	55	45
1948-53	58	42

Unit labor compensation was obtained by dividing total salaries, wages, and supplements for each of the seven key years by the appropriate man-hour index. For 1902 and 1912, wage and salary data are from the *Census of Electrical Industries*; for 1919, 1929, and 1937, they are from Kuznets; for 1948 and 1953, they are from Federal Power Commission

²⁸ William H. Shaw, *Value of Commodity Output since 1869*, New York (NBER), 1947.

²⁹ *Ulmer, op. cit.*, Table D-19.

COMMUNICATIONS AND PUBLIC UTILITIES

data³⁰ for Class A and B privately owned companies, adjusted first to total coverage and then to the Commerce Department level.

The unit capital compensation estimates were obtained by dividing total capital compensation for each year by the index of the real net stock of capital. Capital compensation was taken to be the sum of net profits and interest paid, reduced by the sum of dividend and interest income received. Sources for obtaining capital compensation are the same as for labor compensation.

Manufactured Gas Utilities

The major sources of data for the productivity estimates for the manufactured gas industry (Table H-VIII) are the various censuses of manufactures (1849 was the first year for which data were given relating to manufactured gas); Gould, for 1899–1929; publications of the American Gas Association (A.G.A.), for 1929–53; and the Bureau of Labor Statistics, for series on average hours worked.

As noted by Gould, the Census attempts to include only gas plants that are predominantly manufacturing establishments. Since 1929, with the increase in sales of mixtures of manufactured and purchased natural gas, the separation of the manufactured from the natural gas industry has become difficult and the use of the Census definition impracticable. In order to provide a more continuous picture of the manufactured gas industry, the American Gas Association generally classifies a plant as manufacturing if about one-quarter or more of the mixture it sells is manufactured gas. Where possible it allocates sales of manufactured and natural gases by the same plant to the separate industries. This is possible where no mixing is involved. In such cases, the corresponding employment and capital data are also allocated.³¹

OUTPUT

In the period 1899–1929 Gould's output index was used. It was extrapolated back by *Census of Manufactures* data on value of product, deflated by Census estimates of the average value per 1000 cubic feet for 1899 and 1889, and extended back to 1869 by index numbers for the price of fuels given in the Aldrich Report.

The Gould index is based on Census data through 1929. The intercensal years, 1899–1929, were interpolated by an A.G.A. annual series on the quantity of gas sold. The index to 1919 was obtained by weighting quantities sold by unit prices for the categories of gas, by-product coke, and by-product tar, using the Marshall-Edgeworth formula, because no analysis of gas sales by type of consumer was available. For 1919–29 the

³⁰ *Statistics of Electric Utilities in the United States*, annual reports.

³¹ For a fuller discussion of industry definition, see Gould, *op. cit.*, pp. 79–80.

APPENDIX H

categories used for weighting were residential gas sales, industrial-commercial gas sales, miscellaneous gas sales, by-product coke sales, and by-product tar sales.

Although Gould's index includes the period 1929-42 we have not used it subsequent to 1932, since better basic data have become available. The A.G.A. has revised its statistics from 1932 on,³² stating sales in terms of therms (one therm being defined as a quantity of heat equivalent to 100,000 British thermal units), whereas they had previously been given in terms of cubic feet. (For further discussion of this point see section on the natural gas industry.) We computed a new index for 1932-53, using Marshall-Edgeworth weights and four sales categories (residential, commercial, industrial, and other). The series was adjusted for changing coverage, since miscellaneous by-product sales were not included. The index was linked to Gould's index in 1932.

MANHOURS WORKED

For 1899-1929, the employment estimates are from Gould,³³ who used Census data interpolated by A.G.A. series after 1919. Employment was extrapolated from 1899 to 1869 by the Census data for wage earners only. We interpolated noncensus years prior to 1919 by use of the average relationship of employment to output in census years in order to get segment totals, but productivity indexes are shown only for census years. Employment data for 1929-53 were obtained from A.G.A. *Gas Facts*, 1953 and earlier statistical bulletins.

The average hours worked per week per employee are from Gould for 1914 and 1919-42. The years between 1914 and 1919 were interpolated by hours in the electric utility industry. Average hours in 1909 were estimated from *Census of Manufactures* data, using the same ratio of actual to standard as in 1914. The years from 1909 back to 1890 were obtained by extrapolation, using the Bureau of Labor Statistics prevailing hours series. Extrapolation back to 1869 was by the series for the industry from the Aldrich Report. Hours for 1943-48 are from the annual *Economic Almanac* of the National Industrial Conference Board. The BLS series for gas utilities or combined gas and electric utilities was used for 1949-53.

CAPITAL

The same methods were used in computing the index of the stock of capital in the manufactured gas industry as were used for the telegraph industry. A.G.A. data were available for 1929-53. Census data were used for prior years.

³² See its annual publication, *Gas Facts*.

³³ *Op. cit.*, p. 120.

COMMUNICATIONS AND PUBLIC UTILITIES

The price index used for the net book value deflator was the Handy-Whitman index of construction costs,³⁴ 1911-53, for the gas industry. The Handy-Whitman index was extrapolated back to 1869 by an index obtained by combining Kuznets' construction cost index with Shaw's equipment cost index, using weights of one and three, respectively.³⁵ These weights are based on the average ratio of the value of land and buildings to machinery and equipment in 1889, 1899, and 1904 (Census data). The Shaw-Kuznets index was extrapolated to 1840 by an average of Kuznets' index and an index of metals prices,³⁶ again using weights of one and three, respectively.

The series on annual construction expenditures used in computing the deflator was from the A.G.A. for 1945-53. This series was extrapolated to 1929 by means of the Commerce Department series on construction in the gas industry. The annual expenditures for 1915-29 were computed from the same Commerce source. Since the Commerce data include outlays for both natural and manufactured gas, an allocation was made by averaging two series, one obtained by multiplying the combined expenditures by the ratios of value of product in manufactured gas to the combined value of product in manufactured and natural gas, the other obtained by multiplying the combined expenditures by the ratios of physical output in the two industries. The resulting series was raised to the A.G.A. level. Estimates of average annual expenditures prior to 1914 were made using Census data on value of plant and equipment and estimating retirements on the basis of ratios of retirements to property investment that were computed from data published by Handy.³⁷

TOTAL INPUT

The indexes of labor and capital were combined by the same methods as those used for the electric utility industry. Compensation of labor was obtained from Census data for 1899 to 1919; from Kuznets³⁸ for 1929 and 1937 (adjusted to include supplements to wages and salaries); and from the A.G.A. for 1948 and 1953 (also adjusted for supplements). Returns to capital, i.e., the sum of net profit and interest paid, were estimated from the same sources. The compensation estimates were then adjusted to Commerce levels as described in the previous section. Table H-6 gives the weights used to combine labor and capital inputs.

³⁴ Published currently in *Engineering News-Record* and in *Construction Volume and Costs* (annual) Statistical Supplement, *Construction and Building Materials*. Earlier data are in W. W. Handy, *The Yardstick of Public Utility Operations*, Baltimore, Williams & Wilkins, 1929.

³⁵ The Kuznets index is from his *National Product since 1869*, New York (NBER), 1946, and unpublished worksheets; Shaw, *op. cit.*, p. 295, col. 25a.

³⁶ *Wholesale Prices, Wages, and Transportation*, Part I, p. 92.

³⁷ *Op. cit.*, pp. 26-27.

³⁸ *National Income*, p. 362

APPENDIX H

TABLE H-6
 Manufactured Gas Utilities:
 Relative Weights of Labor and Capital Inputs,
 Subperiods, 1899-1953
 (per cent)

	Labor	Capital
1899-1909	60	40
1909-19	71	29
1919-29	74	26
1929-37	64	36
1937-48	77	23
1948-53	78	22

Natural Gas Utilities

For purposes of this study, we define the natural gas industry to include companies engaged in the transmission and distribution of natural gas and to exclude companies whose primary function is the production of such gas. The latter activity is classed as a mining operation. According to the SIC Manual, natural gas utilities include industries 4922-24. The productivity summary for this group is shown in Table H-IX.

OUTPUT

Our weighted output index for 1899-1932 is from Gould,³⁹ his source being successive issues of the *Minerals Yearbook* and *Mineral Resources* of the Bureau of Mines. For 1906-19 only two categories are available for weighting, domestic-commercial and industrial (including gas for field use and carbon black manufacture). For 1919-29 the classifications are domestic-commercial and industrial (excluding field use and carbon black manufacture). For 1929-31, the data are from the American Gas Association;⁴⁰ the classifications are domestic, commercial, and industrial. In going back of 1906, the weighted index was extrapolated by unweighted total consumption, including sales for field use and carbon black manufacture. This series was available back to 1882 from Arthur F. Burns.⁴¹ From 1906 forward, the Marshall-Edgeworth formula was used in weighting the different groups.

Although Gould's output series runs to 1942, we recomputed the index for years subsequent to 1931 using the revised data of the American Gas

³⁹ *Op. cit.*, p. 103.

⁴⁰ *Statistical Bulletin 13*, "Comparative Statistics of the Natural Gas Industry, 1929-33," p. 1.

⁴¹ *Production Trends in the United States since 1870*, New York (NBER), 1934, Appendix A, Table 44, col. 45.

COMMUNICATIONS AND PUBLIC UTILITIES

Association.⁴² An important change was in the unit of measurement of gas quantities. Quantity sold had previously been measured in cubic feet; since the revision it has been measured in therms. The superiority of the therm is that a given volume of gas, so measured, always has the same heat value—in other words, it provides a measure of output of standard quality. The cubic-foot measure, on the other hand, assigns the same output importance to any given volume of gas even though the heat value of two gases of equivalent volume may be considerably different. The difference in movement as a result of the recomputation is shown in Table H-7.

TABLE H-7
 Natural Gas Utilities:
 Comparison of Weighted Output Indexes, Using Cubic Feet
 and Therms, 1932-42
 (1929 = 100)

	Therms	Cubic Feet
1932	94.9	94.9
1933	90.8	92.1
1934	96.5	100.0
1935	105.9	107.9
1936	121.6	124.8
1937	131.9	132.1
1938	127.6	126.0
1939	139.3	135.8
1940	153.4	150.0
1941	163.6	159.9
1942	185.5	178.4

The weighted output index, then, for 1932-53 was obtained by combining the thermal values of sales to the four categories of consuming units (residential, commercial, industrial, and other) using Marshall-Edgeworth price weights and adjusting the annual chain index to the 1932-53 change in an index based on end-year weights.

MANHOURS WORKED

The employment figures for 1929-33 are from Gould; for 1934-53, directly from the A.G.A.⁴³ The employment statistics prior to 1929 are crude. Gould's basic estimate for 1899 is based on several tenuous assumptions; and for 1902, 1907, 1912, 1917, 1919, and 1925, we obtained natural gas employment as the difference between Gould's totals for manufactured and natural gas and his series on manufactured gas alone.⁴⁴ We obtained

⁴² *Gas Facts, 1953.*

⁴³ *Gas Facts, 1953; Gould, op. cit., p. 123.*

⁴⁴ *Ibid., pp. 120, 125, and 136.*

APPENDIX H

an annual series by using the relationship of employment to output for the years in which employment estimates are available. The estimating equation is $y = 5.6828 + 0.6795x$, where y represents computed employment and x , the weighted output index for natural gas.

For 1929–53, average hours worked per employee per year were obtained by dividing total manhours worked by the average number of employees during the year.⁴⁵ For years prior to 1929, hours of work were assumed to move in the same manner as in the manufactured gas industry.

CAPITAL

Although there is evidence that natural gas was used commercially as early as 1825 and industrially as early as 1840, investment in plant and equipment was negligible prior to 1880. Estimates of investment in the industry are available for 1880, 1907, and 1914.⁴⁶ By assuming geometric rates of growth for 1880–1907 and 1907–14, we computed an annual series on gross expenditures, 1880–1914. A series on construction expenditures in the natural and the manufactured gas industries combined, 1915–29, is contained in *Construction and Building Materials*. The total for the two industries was allocated between them as explained in the notes on the manufactured gas industry. The resulting series for natural gas was raised to the American Gas Association level.

Annual expenditures for 1945–53 are available from the A.G.A. *Gas Facts*. An average was computed of the annual ratios between the A.G.A. series and the Commerce series for 1945–53, and this average was applied to the Commerce series for 1929–44 to raise it to the A.G.A. level. Depreciation was estimated by assuming a fifty-year average composite useful life, the same as that used for manufactured gas.⁴⁷ The gross expenditures series thus obtained was converted to constant (1929) dollars using the Handy-Whitman price index (see manufactured gas section for a description). By cumulating gross capital expenditures from the inception of the industry and deducting cumulated depreciation, all in constant (1929) dollars, we arrived at estimates of the annual real net stock of plant and equipment, 1880–1941.

Since firm data on net fixed assets for 1941–53 were available from the A.G.A., these data were used for this period, after being deflated in accordance with the method described in the telegraph industry section. The two series were linked at 1941, thus giving us the continuous series,

⁴⁵ Data are from the American Gas Association, *Employee Accident Experience of the Gas Industry, 1954*, and from direct correspondence with the Association.

⁴⁶ Federal Trade Commission, TNEC Monograph No. 36, Senate Committee Print, 76th Cong., 3d sess., 1940; *Natural Gas Journal*, June 1915, p. 290; Natural Gas Association, *Proceedings*, 1907, No. 2.

⁴⁷ Cf. *Bulletin "F"*, which gives forty-seven years as an average useful life.

COMMUNICATIONS AND PUBLIC UTILITIES

1880-1953, from which the capital index was computed and which is shown in Table H-IX beginning with 1899.

TOTAL INPUT

Labor and capital input were combined by the same method as that employed in the manufactured gas industry. Labor compensation, 1929-53, was estimated from A.G.A. data and adjusted to the Commerce level. For the key years 1899, 1909, and 1919, labor compensation was estimated by extrapolating the 1929 compensation by an index obtained as the product of the manhour index and an index of average hourly earnings, the latter assumed to be the same as for manufactured gas.

Capital compensation for 1937, 1948, and 1953 are from the A.G.A., adjusted to the Commerce level. The compensation for prior key years was obtained by using estimates of the capital stock in current prices and the 1937 rate of return on capital. Table H-8 gives the weights used in combining the indexes of labor and capital.

TABLE H-8
Natural Gas Utilities:
Relative Weights of Labor and Capital Inputs,
Subperiods, 1899-1953
(per cent)

	Labor	Capital
1899-1909	53	47
1909-19	51	49
1919-29	54	46
1929-37	58	42
1937-48	55	45
1948-53	55	45

Combined Gas Utilities

The separate industry indexes of output, manhours, capital, and total input were combined by the same methods as those used in the combination of the telephone and telegraph industries. Table H-9 gives the weights used; and Table H-VII gives the basic series for the gas industry as a whole.

Other Communications and Public Utilities

The concluding section of this appendix describes the methods used to estimate employment and manhours in radio broadcasting and television and in local utilities and public services not elsewhere classified. As indicated at the outset, these industries are a small part of the segment, and it was not feasible to estimate their output.

APPENDIX H

TABLE H-9
 Gas Utilities: Relative Weights of Industry Output and Inputs,
 Subperiods, 1899-1953
 (per cent)

	1899- 1909	1909- 1919	1919- 1929	1929- 1937	1937- 1948	1948- 1953
Output						
Manufactured Gas	70	58	49	53	52	46
Natural Gas	30	42	51	47	48	54
Total Input						
Manufactured Gas	50	45	46	51	49	51
Natural Gas	50	55	54	49	51	49
Labor Input						
Manufactured Gas	53	53	53	53	58	60
Natural Gas	47	47	47	47	42	40
Capital Input						
Manufactured Gas	46	32	33	47	33	34
Natural Gas	54	68	67	53	67	66

RADIO BROADCASTING AND TELEVISION

The employment estimates from 1929 forward are those of the Commerce Department. Employment was approximately 4,000 in 1929 and, assuming the same rate of growth before 1929 as after, employment must have been negligible prior to 1926 (i.e., less than 1,000, although the industry was born around 1920). In order to obtain manhours, average hours worked by employees in the telephone and telegraph industry were used.

LOCAL UTILITIES AND PUBLIC SERVICES, NOT ELSEWHERE CLASSIFIED

As defined for national income purposes, this group consists of private water supply systems, sanitary services, steam supply systems, and irrigation systems (SIC Groups 494-97). We have used the Commerce Department estimates of employment from 1929 forward. Little direct information on employment in these groups exists for earlier years. We have broken down the estimated numbers of persons engaged in 1929 (30,000) into major categories, and extrapolated as follows in an effort to approximate, at least roughly, the employment trend in the group.

The category of private water companies, the main component in 1929 (but less important thereafter), was extrapolated by the deflated value of plant and equipment of waterworks as given for selected years from 1880

COMMUNICATIONS AND PUBLIC UTILITIES

to 1922 by Kuznets.⁴⁸ The figures were extrapolated back to 1869 on the basis of the 1880-1900 trend and forward from 1922 to 1929 on the basis of estimates of the National Industrial Conference Board.⁴⁹ Employment on irrigation systems was extrapolated in the same manner. Employment in the remaining category, consisting principally of sanitary systems, was extrapolated on the basis of urban population.

In view of the small size of the group, and the uncertainties attaching to the estimates, annual interpolations were on a straight line. It was assumed that average hours worked per week were the same as in electric and gas utilities.

Segment Totals

Two productivity summaries were made for the segment. One is based on weighted averages of the output and input indexes for the five groups covered by direct estimates of output and capital input (Table H-II). The other purports to cover the segment as a whole (Table H-I); for key years, coverage adjustments were applied to the output indexes. Direct estimates of factor inputs were available for the entire segment.

THE COVERED PORTION OF THE SEGMENT

The output and input indexes for electric utilities, the communications group, and the gas utilities group were combined in order to obtain the productivity summary for the covered part of the segment. The factor compensation estimates, used for weights in successive pairs of key years beginning with 1899, have already been described, with one exception.

Since the censuses of the electric utilities and communications industries were taken quinquennially between 1902 and 1927, it was necessary to interpolate and extrapolate in order to obtain factor compensation estimates for the key years 1899, 1909, and 1919. This was done by computing the ratios of factor compensation estimated from the censuses to compensation estimates prepared by Martin.⁵⁰ The ratios were then interpolated linearly and applied to Martin's estimates for the key years. The 1902 ratio was applied to Martin's 1899 compensation estimates. As noted in the preceding sections, the levels of the compensation estimates were adjusted for continuity and consistency with the Commerce figures. The relative weights used to combine the group indexes in the subperiods are shown in Table H-10. The 1899-1909 weights were used for earlier years.

⁴⁸ *National Product since 1869*, Table IV-12, p. 231.

⁴⁹ *Historical Statistics of the United States, 1789-1945*, Dept. of Commerce, 1949, Series A 90, deflated.

⁵⁰ Robert F. Martin, *National Income in the United States, 1799-1938*, New York, National Industrial Conference Board, 1939.

APPENDIX H

TABLE H-10

Communications and Public Utilities, Covered Segment:
Relative Weights of Industry Output and Inputs, Subperiods, 1899-1953
(per cent)

	1899- 1909	1909- 1919	1919- 1929	1929- 1937	1937- 1948	1948- 1953
Output						
Electric	60	49	43	43	33	25
Telephone and telegraph	29	37	43	42	50	59
Gas	11	14	14	15	17	16
Total Input						
Electric	44	41	43	45	42	40
Telephone and telegraph	41	43	42	41	40	40
Gas	15	16	15	14	18	20
Labor Input						
Electric	33	36	36	34	33	33
Telephone and telegraph	51	48	49	51	50	48
Gas	16	16	15	15	17	19
Capital Input						
Electric	48	44	54	60	62	59
Telephone and telegraph	37	40	34	26	18	18
Gas	15	16	12	14	20	23

THE TOTAL SEGMENT

As indicated by Table H-1, five major groups accounted for the great bulk of the national income originating in the segment in 1929, but the proportion has not been stable. In order to adjust our index numbers for the aggregate of the five groups to full coverage in key years after 1929, we have multiplied by index numbers (1929 = 100) of ratios of national income in the segment as a whole to national income originating in the five covered groups. This procedure implies that national income per unit of output has shown the same movements in the uncovered as in the covered parts of the segment.

For key years prior to 1929, the coverage adjustment index was based on the ratios of total persons engaged in the segment to persons engaged in the covered part of the segment. Here the assumption is that output per person engaged moved in parallel fashion in both the covered and uncovered portions of the segment. The coverage adjustment is shown in Table H-11.

The method of estimating employment and manhours in the uncovered part of the segment has already been described. Estimates of real capital

COMMUNICATIONS AND PUBLIC UTILITIES

TABLE H-11

Communications and Public Utilities: Adjustment Applied to Output and Capital Input Indexes of Covered-Industry Aggregate to Obtain Full-Segment Coverage, Key Years, 1869-1953 (1929 = 100)

Adjustment Index numbers	
1869	147.2
1879	134.3
1889	116.1
1899	109.1
1909	103.5
1919	100.9
1929	100.0
1937	101.1
1948	102.6
1953	102.9

NOTE: Adjustment index based on ratios of total employment in the segment to employment in the covered portion for 1929 and prior years, and on the corresponding national income ratios in 1929 and subsequent years.

stocks in the segment as a whole for 1929 and prior years are contained in Ulmer's study, where they are combined with capital stocks of the transportation segment. Totals for the two segments were segregated as described in Appendix G. After 1929, total capital input in the five groups was adjusted to full coverage by the ratios of total employment to employment in the groups covered by the capital estimates. This ratio showed only a slightly smaller rise between 1929 and 1953 than the index of the national income ratio.

TABLE H-I
 Communications and Public Utilities:^a Output, Inputs and Productivity Ratios, Key Years, 1869-1953
 (1929 = 100)

	Output	Persons Engaged	Output per Person	Manhours	Output per Manhour	Labor Input	Output per Unit of Labor Input	Capital Input	Output per Unit of Capital Input	Total Factor Input	Total Factor Productivity
1869	0.9	3.4	26.1	4.7	18.8	4.2	21.0	3.0	29.3	3.6	24.4
1879	1.7	4.8	35.0	6.8	24.7	6.0	28.2	6.4	26.6	6.2	27.3
1889	3.2	9.3	34.9	12.8	25.4	11.4	28.4	10.3	31.5	10.8	30.0
1899	6.7	16.2	41.2	20.0	33.3	17.8	37.4	20.8	32.0	19.3	34.5
1909	22.6	35.6	63.4	42.0	53.8	40.5	55.8	42.8	52.8	41.6	54.3
1919	45.8	60.8	75.3	59.8	76.6	58.3	78.6	59.5	77.0	58.9	77.8
1929	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1937	115.5	87.1	132.6	74.9	154.2	75.1	153.8	106.6	108.3	89.0	129.8
1948	249.5	124.0	201.2	107.6	231.9	108.9	229.1	130.5	191.2	121.4	205.5
1953	336.0	135.5	248.0	115.5	290.9	117.3	286.4	189.9	176.9	143.3	234.5

^a Indexes for the sum of five groups (see Table H-II) adjusted and television, and local utilities and public services not elsewhere for complete coverage of the segment, including radio broadcasting classified.

COMMUNICATIONS AND PUBLIC UTILITIES

TABLE H-II
 Communications and Public Utilities: Output, Inputs, and Productivity Ratios, Aggregate of Five Groups, 1869-1953
 (1929 = 100)

	Output	Persons Engaged	Output per Person	Manhours	Output per Manhour	Labor Input	Output per Unit of Labor Input	Capital Input	Output per Unit of Capital Input	Total Factor Input	Total Factor Productivity
1869	0.6	2.3	26.1	3.2	18.8	2.9	20.7	1.2	48.3	2.1	28.2
1879	1.3	3.6	35.0	5.1	24.7	4.6	27.3	2.9	43.6	3.8	33.4
1889	2.8	8.0	34.9	11.0	25.4	10.1	27.6	5.4	51.5	7.9	35.5
1899	6.1	14.8	41.2	18.3	33.3	16.3	37.4	15.8	38.6	15.7	38.9
1909	21.8	34.4	63.4	40.5	53.8	39.3	55.5	40.0	54.5	39.4	55.3
1919	45.4	60.3	75.3	59.3	76.6	57.7	78.7	53.2	85.3	56.4	80.5
1929	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1930	99.9	99.8	100.1	100.4	99.5	96.1	104.0	108.6	92.0	100.8	99.1
1931	96.8	89.7	107.9	89.8	107.8	88.0	110.0	114.5	84.5	98.2	98.6
1932	87.4	79.7	109.7	74.3	117.6	73.2	119.4	115.4	75.7	89.6	97.5
1933	85.5	75.5	113.2	67.6	126.5	66.6	128.4	113.3	75.5	84.7	100.9
1934	90.0	76.6	117.5	63.7	141.3	63.7	141.3	110.0	81.8	81.7	110.2
1935	96.3	76.9	125.2	64.4	149.5	64.8	148.6	107.1	89.9	81.1	118.7
1936	107.5	81.2	132.4	69.4	154.9	70.4	152.7	105.4	102.0	84.0	128.0
1937	114.2	86.0	132.8	73.9	154.5	74.3	153.7	105.2	108.6	86.3	132.3
1938	111.4	82.4	135.2	70.4	158.2	71.1	156.7	106.0	105.1	84.2	132.3
1939	119.7	82.6	144.9	70.3	170.3	70.7	169.3	106.2	112.7	84.0	142.5
1940	130.3	85.4	152.6	73.2	178.0	74.1	175.8	106.9	121.9	86.7	150.3
1941	145.3	90.5	160.6	78.0	186.3	79.4	183.0	109.3	132.9	91.4	159.0
1942	158.7	89.8	176.7	78.1	203.2	78.0	203.5	110.2	144.0	90.8	174.8

(continued)

APPENDIX H

TABLE H-II (concluded)

	Output	Persons Engaged	Output per Person	Manhours	Output per Manhour	Labor Input	Output per Unit of Labor Input	Capital Input	Output per Unit of Capital Input	Total Factor Input	Total Factor Productivity
1943	176.2	86.5	203.7	78.1	225.6	78.3	225.0	111.2	158.5	91.3	193.0
1944	183.7	84.1	218.4	77.4	237.3	78.1	235.2	108.6	169.2	90.4	203.2
1945	189.3	86.1	219.9	78.9	239.9	81.6	232.0	108.1	175.1	92.9	203.8
1946	201.7	104.5	193.0	90.3	223.4	95.0	212.3	109.1	184.9	103.2	195.4
1947	224.7	111.6	201.3	94.4	238.0	99.7	225.4	115.7	194.2	108.4	207.3
1948	243.0	120.1	202.3	104.0	233.7	107.1	226.9	126.5	192.1	117.2	207.3
1949	249.6	121.0	206.3	103.2	241.9	104.3	239.3	138.3	180.5	117.7	212.1
1950	272.2	119.6	227.6	102.8	264.8	106.1	256.6	148.9	182.8	121.9	223.3
1951	293.4	123.0	238.5	106.1	276.5	108.9	269.4	160.3	183.0	127.3	230.5
1952	307.8	126.6	243.1	107.6	286.1	111.5	276.1	171.2	179.8	132.2	232.8
1953	326.5	130.2	250.8	110.8	294.7	113.9	286.7	182.6	178.8	137.0	238.3

COMMUNICATIONS AND PUBLIC UTILITIES

TABLE H-III
Telephone and Telegraph Industries: Output, Inputs, and Productivity Ratios, 1879-1953
(1929 = 100)

	Output	Persons Engaged	Output per Person	Manhours	Output per Manhour	Labor Input	Output per Unit of Labor Input	Capital Input	Output per Unit of Capital Input	Total Factor Input	Total Factor Productivity
1879	1.3	3.4	39.8	4.9	27.5	3.8	35.3	4.6	29.1	4.0	33.5
1889	3.3	6.5	49.7	9.2	35.4	7.3	44.5	9.3	34.9	7.7	42.2
1899	8.0	12.3	65.4	15.2	52.9	14.1	56.7	22.2	36.0	16.7	47.9
1909	30.8	32.7	94.2	37.9	81.3	37.8	81.5	53.7	57.4	43.2	71.3
1919	48.0	61.7	77.8	60.0	80.0	59.6	80.5	55.7	86.2	58.8	81.6
1929	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1930	95.8	91.2	105.0	92.1	104.0	91.6	104.6	115.7	82.8	97.0	98.8
1931	90.9	81.9	111.0	82.7	109.9	82.5	110.2	125.8	72.3	92.4	98.4
1932	80.4	73.1	110.0	69.0	116.5	69.1	116.4	127.2	63.2	82.3	97.7
1933	74.4	68.9	108.0	62.0	120.0	62.1	119.8	123.7	60.1	76.1	97.8
1934	76.7	70.0	109.6	58.4	131.3	58.1	132.0	118.3	64.8	71.9	106.7
1935	80.7	69.1	116.8	58.1	138.9	58.1	138.9	113.7	71.0	70.7	114.1
1936	87.8	73.2	119.9	63.0	139.4	62.9	139.6	110.7	79.3	73.8	119.0
1937	92.0	76.8	119.8	66.4	138.6	66.3	138.8	110.0	83.6	76.2	120.7
1938	91.9	72.9	126.1	63.0	145.9	63.2	145.4	111.6	82.3	73.5	125.0
1939	96.2	72.6	132.5	63.1	152.5	63.4	151.7	112.7	85.4	73.8	130.4
1940	102.2	76.6	133.4	67.3	151.9	67.6	151.2	115.4	88.6	78.2	130.7
1941	112.6	86.4	130.3	76.9	146.4	77.5	145.3	122.1	92.2	88.3	127.5
1942	119.7	89.4	133.9	80.3	149.1	81.0	147.8	129.4	92.5	92.7	129.1
1943	127.0	91.5	138.8	85.1	149.2	85.8	148.0	129.6	98.0	97.2	130.7

(continued)

APPENDIX H

TABLE H-III (concluded)

	Output	Persons Engaged	Output per Person	Manhours	Output per Manhour	Labor Input	Output per Unit of Labor Input	Capital Input	Output per Unit of Capital Input	Total Factor Input	Total Factor Productivity
1944	131.0	89.9	145.7	84.0	156.0	85.0	154.1	126.2	103.8	96.0	136.5
1945	141.4	96.6	146.4	89.1	158.7	90.4	156.4	125.0	113.1	101.0	140.0
1946	161.8	122.8	131.8	107.2	150.9	109.6	147.6	132.7	121.9	120.3	134.5
1947	173.6	128.6	135.0	107.2	161.9	109.8	158.1	153.1	113.4	123.1	141.0
1948	182.7	133.5	136.9	115.7	157.9	119.1	153.4	183.4	99.6	135.8	134.5
1949	185.8	126.6	146.8	107.9	172.2	111.1	167.2	210.0	88.5	130.2	142.7
1950	192.5	127.3	151.2	109.5	175.8	112.9	170.5	225.7	85.3	133.4	144.3
1951	195.7	131.9	148.4	113.9	171.8	117.6	166.4	238.5	82.1	139.3	140.5
1952	198.9	137.7	144.4	116.7	170.4	120.7	164.8	254.5	78.2	143.8	138.3
1953	204.5	139.8	146.3	118.7	172.3	122.9	166.4	273.6	74.7	147.8	138.4

COMMUNICATIONS AND PUBLIC UTILITIES

TABLE H-IV
Telephone Industry: Output, Inputs, and Productivity Ratios, 1879-1953
(1929 = 100)

	Output	Persons Engaged	Output per Person	Manhours	Output per Manhour	Capital Input	Output per Unit of Capital Input	Total Factor Input	Total Factor Productivity
1879	0.15	0.6	25.0	0.8	18.8	0.5	31.3	0.6	23.1
1880	0.2	0.7	28.6	0.9	22.2	0.6	33.3	0.8	25.0
1881	0.3	0.8	37.5	1.1	27.3	1.1	27.3	1.1	27.3
1882	0.4	1.0	40.0	1.3	30.8	1.6	25.0	1.4	28.6
1883	0.5	1.1	45.5	1.5	33.3	2.0	25.0	1.6	31.2
1884	0.5	1.2	41.7	1.6	31.2	2.5	20.0	1.9	26.3
1885	0.6	1.2	50.0	1.6	37.5	2.9	20.7	2.0	30.0
1886	0.6	1.2	50.0	1.6	37.5	3.0	20.0	2.1	28.6
1887	0.7	1.4	50.0	1.9	36.8	2.9	24.1	2.2	31.8
1888	0.8	1.5	53.3	2.0	40.0	3.0	26.7	2.3	34.8
1889	0.9	1.6	56.2	2.1	42.9	3.4	26.5	2.5	36.0
1890	1.1	1.8	61.1	2.4	45.8	3.8	28.9	2.9	37.9
1891	1.2	2.0	60.0	2.7	44.4	4.1	29.3	3.2	37.5
1892	1.4	2.3	60.9	3.1	45.2	4.3	32.6	3.5	40.0
1893	1.3	2.5	52.0	3.3	39.4	4.6	28.3	3.8	34.2
1894	1.5	2.7	55.6	3.5	42.9	5.7	26.3	4.3	34.9
1895	1.9	3.2	59.4	4.1	46.3	7.7	24.7	5.4	35.2
1896	2.2	3.8	57.9	5.0	44.0	10.1	21.8	6.9	31.9
1897	2.7	4.8	56.2	6.1	44.3	12.4	21.8	8.4	32.1
1898	3.7	6.1	60.7	7.2	51.4	14.4	25.7	9.9	37.4
1899	5.6	8.3	67.5	10.0	56.0	17.0	32.9	12.6	44.4
1900	6.7	10.8	62.0	12.6	53.2	20.3	33.0	15.4	43.5
1901	9.1	13.5	67.4	16.6	54.8	23.5	38.7	19.2	47.4
1902	11.9	16.2	73.5	18.9	63.0	26.6	44.7	21.7	54.8

(continued)

APPENDIX H

TABLE H-IV (continued)
Telephone Industry: Output, Inputs, and Productivity Ratios, 1879-1953
(1929 = 100)

	Output	Persons Engaged	Output per Person	Manhours	Output per Manhour	Capital Input	Output per Unit of Capital Input	Total Factor Input	Total Factor Productivity
1903	13.4	17.9	74.9	21.2	63.2	30.5	43.9	24.6	54.5
1904	15.0	19.6	76.5	23.0	65.2	34.5	43.5	27.1	55.4
1905	18.7	24.0	77.9	28.1	66.5	38.8	48.2	31.9	58.6
1906	22.5	28.3	79.5	33.1	68.0	44.8	50.2	37.4	60.2
1907	26.3	30.0	87.7	35.1	74.9	50.1	52.5	40.6	64.8
1908	28.4	31.1	91.3	36.2	78.5	51.8	54.8	41.9	67.8
1909	29.9	32.1	93.1	37.2	80.4	51.3	58.3	42.3	70.7
1910	32.0	35.9	89.1	40.5	79.0	51.5	62.1	44.6	71.7
1911	33.4	39.7	84.1	43.7	76.4	52.5	63.6	47.0	71.1
1912	35.5	41.8	84.9	44.9	79.1	54.1	65.6	48.3	73.5
1913	36.9	45.5	81.1	47.4	77.8	55.4	66.6	50.4	73.2
1914	37.5	45.6	82.2	46.3	81.0	55.4	67.7	49.7	75.5
1915	41.3	45.6	90.6	46.0	89.8	54.2	76.2	49.1	84.1
1916	46.6	50.2	92.8	50.3	92.6	53.4	87.3	51.7	90.1
1917	49.8	55.8	89.2	55.4	89.9	54.3	91.7	55.4	89.9
1918	49.1	57.7	85.1	56.5	86.9	54.4	90.3	56.2	87.4
1919	48.3	59.6	81.0	57.8	83.6	52.8	91.5	56.7	85.2
1920	52.5	65.2	80.5	62.3	84.3	51.7	101.5	59.3	88.5
1921	55.1	67.2	82.0	65.7	83.9	51.4	107.2	61.5	89.6
1922	59.5	68.2	87.2	67.1	88.7	52.6	113.1	62.8	94.7
1923	66.5	73.3	90.7	71.7	92.7	55.9	119.0	67.0	99.3
1924	71.1	78.5	90.6	77.2	92.1	61.2	116.2	72.4	98.2
1925	75.9	80.9	93.8	80.0	94.9	67.4	112.6	76.2	99.6
1926	82.7	83.3	99.3	80.1	103.2	73.7	112.2	78.2	105.8

(continued)

COMMUNICATIONS AND PUBLIC UTILITIES

TABLE H-IV (concluded)

1927	86.6	84.7	102.2	83.2	104.1	80.0	108.2	82.2	105.4
1928	92.7	90.4	102.5	88.4	104.9	87.3	106.2	88.1	105.2
1929	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1930	96.5	89.5	107.8	90.3	106.9	116.3	83.0	96.5	100.0
1931	92.9	81.4	114.1	82.1	113.2	127.2	73.0	92.9	100.0
1932	83.3	73.5	113.3	69.4	120.0	129.1	64.5	83.7	99.5
1933	76.3	69.1	110.4	62.2	122.7	125.3	60.9	77.3	98.7
1934	78.5	69.2	113.4	57.6	136.3	119.5	65.7	72.5	108.3
1935	81.8	68.5	119.4	57.7	141.8	114.5	71.4	71.3	114.7
1936	88.8	72.7	122.1	62.5	142.1	111.3	79.8	74.2	119.7
1937	93.1	76.3	122.0	65.9	141.3	111.5	83.5	76.8	121.2
1938	94.0	73.9	127.2	64.0	146.9	113.2	83.0	75.3	124.8
1939	98.9	74.0	133.6	64.5	153.3	114.5	86.4	75.9	130.3
1940	106.1	78.5	135.2	69.1	153.5	117.7	90.1	80.7	131.5
1941	117.2	88.9	131.8	79.4	147.6	125.1	93.7	91.2	128.5
1942	125.3	92.7	135.2	83.6	149.9	132.9	94.3	96.3	130.1
1943	132.9	94.9	140.0	88.5	150.2	133.8	99.3	101.0	131.6
1944	137.3	94.1	145.9	88.6	155.0	130.4	105.3	100.5	136.6
1945	148.2	102.7	144.3	95.4	155.3	129.2	114.7	106.7	138.9
1946	173.5	135.4	128.1	118.9	145.9	137.4	126.3	129.7	133.8
1947	186.9	143.6	130.2	119.6	156.3	159.3	117.3	133.5	140.0
1948	199.2	151.0	131.9	131.8	151.1	191.5	104.0	149.3	133.4
1949	204.0	144.4	141.3	123.8	164.8	220.4	92.6	144.2	141.5
1950	211.5	145.7	145.2	126.2	167.6	237.6	89.0	148.2	142.7
1951	215.1	151.4	142.1	131.9	163.1	251.6	85.5	155.3	138.5
1952	220.7	158.6	139.2	135.9	162.4	268.9	82.1	160.9	137.2
1953	226.7	161.4	140.5	139.1	163.0	289.6	78.3	166.1	136.5

APPENDIX H

TABLE H-V
 Telegraph Industry: Output, Inputs, and Productivity Ratios, 1869-1953
 (1929 = 100)

	Output	Persons Engaged	Output per Person	Manhours	Output per Manhour	Capital Input	Output per Unit of Capital Input	Total Factor Input	Total Factor Productivity
1869	4.9	7.2	68.2	9.6	51.1	n.a.			
1879	10.9	14.9	73.2	19.9	54.8	32.3	33.7	22.8	47.8
1889	21.9	26.3	83.3	35.1	62.4	46.4	47.2	36.2	60.5
1899	25.0	28.5	87.7	34.2	73.1	57.8	43.3	39.5	63.3
1902	28.3	28.7	98.6	33.5	84.5	59.0	48.0	39.5	71.6
1907	39.6	29.3	135.2	34.3	115.5	74.0	53.5	44.0	90.0
1909	35.8	35.3	101.4	40.9	87.5	73.2	48.9	48.6	73.7
1912	41.3	47.5	86.9	51.0	81.0	74.5	55.4	56.3	73.4
1917	57.8	67.8	85.3	67.4	85.8	74.9	77.2	69.1	83.6
1919	46.4	69.9	66.4	67.8	68.4	80.9	57.4	70.8	65.5
1922	73.2	72.6	100.8	71.4	102.5	89.4	81.9	75.5	97.0
1927	90.2	87.5	103.1	85.9	105.0	88.8	101.6	86.6	104.2
1929	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1930	91.3	97.9	93.3	98.7	92.5	109.4	83.5	100.4	90.9
1931	78.6	84.0	93.6	84.7	92.8	111.8	70.3	89.0	88.3
1932	62.5	71.2	87.8	67.3	92.9	108.1	57.8	73.8	84.7
1933	63.0	68.2	92.4	61.3	102.8	107.2	58.8	68.6	91.8
1934	65.9	73.3	89.9	61.0	108.0	106.4	61.9	68.3	96.5
1935	73.8	71.2	103.7	60.0	123.0	105.3	70.1	67.2	109.8

(continued)

COMMUNICATIONS AND PUBLIC UTILITIES

TABLE H-V (concluded)

1936	81.3	75.3	108.0	64.8	125.5	104.5	77.8	71.2	114.2
1937	85.4	79.0	108.1	68.3	125.0	94.4	90.5	72.5	117.8
1938	79.0	68.7	115.0	59.5	132.8	92.4	85.5	63.6	124.2
1939	80.4	66.9	120.2	58.2	138.1	90.5	88.8	62.2	129.3
1940	79.4	68.7	115.6	60.5	131.2	83.0	95.7	64.2	123.7
1941	85.8	76.2	112.6	68.0	126.2	79.0	108.6	71.6	119.8
1942	87.4	75.9	115.2	68.5	127.6	76.9	113.7	72.0	121.4
1943	93.0	77.8	119.5	72.6	128.1	63.7	146.0	75.5	123.2
1944	94.4	72.9	129.5	67.7	139.4	61.0	154.8	70.5	133.9
1945	101.3	71.7	141.3	66.0	153.5	59.0	171.7	68.7	147.5
1946	94.2	71.8	131.2	64.3	146.5	58.2	161.9	67.1	140.4
1947	96.8	68.5	141.3	61.9	156.4	50.8	190.6	64.3	150.5
1948	87.7	62.9	139.4	56.9	154.1	50.4	174.0	59.2	148.1
1949	81.1	54.8	148.0	49.6	163.5	48.7	166.5	52.0	156.0
1950	83.4	53.2	156.8	48.1	173.4	46.9	177.8	50.5	165.1
1951	84.6	53.4	158.4	48.2	175.5	44.9	188.4	50.4	167.9
1952	73.9	53.4	138.4	46.9	157.6	44.1	167.6	49.0	150.8
1953	77.6	52.6	147.5	44.4	174.8	43.8	177.2	46.6	166.5

n.a. = not available.

TABLE H-VI
 Electric Utilities: Output, Inputs, and Productivity Ratios, 1899-1953
 (1929 = 100)

	Output	Persons Engaged	Output per Person	Manhours	Output per Manhour	Capital Input	Output per Unit of Capital Input	Total Factor Input	Total Factor Productivity
1899	2.0	8.8	22.8	10.7	18.6	7.9	25.3	9.4	21.3
1902	3.9	11.3	34.6	13.4	29.0	12.0	32.5	12.9	30.2
1907	7.5	18.0	41.7	21.5	34.9	22.1	33.9	21.9	34.2
1909	9.7	22.0	44.0	26.1	37.1	28.5	34.0	27.3	35.5
1912	13.0	29.9	43.5	32.4	40.1	41.1	31.6	36.6	35.5
1913	13.6	28.1	48.4	29.5	46.0	44.2	30.8	36.2	37.6
1914	15.2	28.9	52.6	29.4	51.8	45.8	33.2	36.8	41.3
1915	16.6	29.5	56.2	29.8	55.7	46.8	35.5	37.4	44.4
1916	21.1	35.6	59.2	35.7	59.1	47.5	44.4	41.2	51.2
1917	24.5	39.6	61.8	39.4	62.1	49.0	50.0	44.0	55.7
1918	31.4	42.8	73.3	41.9	74.9	49.7	63.2	45.8	68.6
1919	36.0	44.8	80.3	43.5	82.7	48.8	73.8	46.3	77.8
1920	39.3	49.1	80.1	47.0	83.6	49.1	80.0	48.1	81.7
1921	36.3	50.6	71.8	49.5	73.4	50.2	72.3	49.9	72.7
1922	41.2	55.4	74.4	54.5	75.6	52.3	78.8	53.4	77.2
1923	50.0	70.7	70.7	69.1	72.3	57.8	86.5	63.2	79.1
1924	54.9	74.7	73.5	73.5	74.7	65.9	83.3	69.5	79.0
1925	63.5	75.5	84.1	74.8	84.9	74.0	85.8	74.4	85.3
1926	73.5	83.8	87.7	80.7	91.1	81.1	90.6	80.9	90.9
1927	81.7	85.9	95.1	84.4	96.8	87.8	93.1	86.2	94.8
1928	89.5	91.9	97.4	90.0	99.4	94.1	95.1	92.1	97.2

(continued)

COMMUNICATIONS AND PUBLIC UTILITIES

TABLE H-VI (concluded)

1929	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1930	103.5	103.3	100.2	104.2	99.3	106.6	97.1	105.5	98.1	104.9	97.1	105.5	98.1
1931	101.9	96.1	106.0	97.2	104.8	111.5	91.4	104.9	97.1	104.9	91.4	104.9	97.1
1932	92.7	83.7	110.8	79.0	117.3	112.3	82.5	97.0	95.6	97.0	82.5	97.0	95.6
1933	95.4	78.5	121.5	70.8	134.7	110.5	86.3	92.2	103.5	92.2	86.3	92.2	103.5
1934	102.2	81.6	125.2	67.9	150.5	107.7	94.9	89.4	114.3	89.4	94.9	89.4	114.3
1935	111.2	83.7	132.9	70.6	157.5	105.3	122.4	89.3	124.5	89.3	122.4	89.3	124.5
1936	127.3	89.8	141.8	77.2	164.9	104.0	138.8	91.7	138.8	91.7	138.8	91.7	138.8
1937	137.5	96.3	142.8	83.2	165.3	104.3	145.3	94.6	145.3	94.6	145.3	94.6	145.3
1938	131.0	93.2	140.6	79.8	164.2	105.3	124.4	93.2	140.6	93.2	124.4	93.2	140.6
1939	145.0	92.7	156.4	78.8	184.0	105.5	137.4	92.7	156.4	92.7	137.4	92.7	156.4
1940	161.4	94.9	170.1	80.9	199.5	105.9	152.4	94.1	171.5	94.1	152.4	94.1	171.5
1941	186.5	96.6	193.1	82.5	226.1	107.8	173.0	95.8	194.7	95.8	173.0	95.8	194.7
1942	207.3	90.1	230.1	77.5	267.5	109.3	189.7	93.7	221.2	93.7	189.7	93.7	221.2
1943	241.1	80.2	300.6	71.5	337.2	108.7	221.8	90.0	267.9	90.0	221.8	90.0	267.9
1944	252.7	77.2	327.3	71.4	353.9	106.5	237.3	89.0	283.9	89.0	237.3	89.0	283.9
1945	249.1	77.9	319.8	72.8	342.2	104.9	237.5	89.0	279.9	89.0	237.5	89.0	279.9
1946	249.4	92.4	269.9	82.4	302.7	105.2	237.1	94.6	263.6	94.6	237.1	94.6	263.6
1947	284.4	99.6	285.5	89.5	317.8	108.9	261.2	100.2	283.8	100.2	261.2	100.2	283.8
1948	314.8	106.3	296.1	95.7	328.9	116.3	270.7	107.2	293.7	107.2	270.7	107.2	293.7
1949	325.5	110.5	294.6	98.3	331.1	125.9	258.5	112.8	288.6	112.8	258.5	112.8	288.6
1950	369.8	111.6	331.4	99.4	372.0	135.2	273.5	117.5	314.7	117.5	273.5	117.5	314.7
1951	415.8	112.4	369.9	100.7	412.9	143.0	290.8	121.7	341.7	121.7	290.8	121.7	341.7
1952	446.1	113.8	392.0	101.3	440.4	151.2	295.0	125.6	355.2	125.6	295.0	125.6	355.2
1953	491.0	116.0	423.3	103.1	476.2	160.8	305.3	130.7	375.7	130.7	305.3	130.7	375.7

APPENDIX H

TABLE H-VII
 Manufactured and Natural Gas Utilities: Output, Inputs, and Productivity Ratios, 1889-1953
 (1929 = 100)

	Output	Persons Engaged	Output per Person	Manhours	Output per Manhour	Labor Input	Output per Unit of Labor Input	Capital Input	Output per Unit of Capital Input	Total Factor Input	Total Factor Productivity
1889	11.5	26.6	43.2	34.5	33.3	34.6	33.2	8.9	128.8	23.9	48.1
1899	15.8	35.7	44.3	42.7	37.0	41.6	38.0	23.7	66.7	34.6	45.7
1904	25.4	50.0	50.8	58.3	43.6	57.2	44.4	31.3	81.2	47.1	53.9
1909	37.5	65.6	57.2	75.7	49.5	74.4	50.4	43.2	86.8	62.4	60.1
1914	50.3	80.5	62.5	81.1	62.0	79.4	63.4	59.9	84.0	72.2	69.7
1919	65.9	87.0	75.7	86.4	76.3	85.5	77.1	66.0	99.8	78.3	84.2
1924	75.0	98.1	76.5	91.8	81.7	91.1	82.3	n.a.			
1929	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1930	101.2	94.4	107.2	94.5	107.1	92.8	109.1	104.0	97.3	97.2	104.1
1931	98.6	90.3	109.2	86.4	114.1	85.6	115.2	106.4	92.7	93.7	105.2
1932	92.1	84.4	109.1	73.0	126.2	74.2	124.1	106.7	86.3	86.9	106.0
1933	88.2	84.4	104.5	72.5	121.7	72.6	121.5	105.9	83.3	85.6	103.0
1934	92.2	90.8	101.5	72.0	128.1	73.1	126.1	104.5	88.2	85.3	108.1
1935	97.5	91.7	106.3	74.1	131.6	74.3	131.2	103.0	94.7	85.5	114.0
1936	105.8	97.8	108.2	77.9	135.8	80.8	130.9	102.0	103.7	89.1	118.7
1937	109.6	98.1	111.7	78.2	140.2	81.2	135.0	100.6	108.9	88.8	123.4
1938	106.7	95.0	112.3	74.7	142.8	77.7	137.3	99.9	106.8	86.2	123.8
1939	113.9	96.0	118.6	73.9	154.1	76.9	148.1	99.4	114.6	85.6	133.1
1940	124.4	100.1	124.3	78.7	158.1	80.6	154.3	99.3	125.3	88.0	141.4
1941	130.3	100.4	129.8	79.2	164.5	79.7	163.5	99.4	131.1	87.4	149.1

(continued)

COMMUNICATIONS AND PUBLIC UTILITIES

TABLE H-VII (concluded)

1942	145.1	88.3	164.3	71.2	203.8	70.8	204.9	92.8	156.4	79.2	183.2
1943	156.8	82.3	190.5	68.5	228.9	69.8	224.6	99.6	157.4	80.8	194.1
1944	165.0	81.5	202.5	68.0	242.6	71.1	232.1	96.4	171.2	80.6	204.7
1945	173.1	83.7	206.8	70.7	244.8	73.5	235.5	100.3	172.6	83.5	207.3
1946	183.2	96.2	190.4	75.4	243.0	77.4	236.7	97.6	187.7	85.3	214.8
1947	210.5	111.8	188.3	87.8	239.7	90.6	232.3	100.8	208.8	95.2	221.1
1948	229.3	116.6	196.7	93.8	244.5	94.7	242.1	104.4	219.6	99.1	231.4
1949	238.2	119.3	199.7	94.0	253.4	95.5	249.4	110.5	215.6	101.6	234.4
1950	272.4	122.6	222.2	97.0	280.8	98.3	277.1	120.0	227.0	106.8	255.1
1951	308.8	123.7	249.6	98.8	312.6	98.8	312.6	139.3	221.7	113.6	271.8
1952	330.7	131.5	251.5	102.5	322.6	103.0	321.1	152.8	216.4	120.9	273.5
1953	347.2	135.9	255.5	105.5	329.1	106.5	326.0	162.7	213.4	126.5	274.5

n.a. = not available.

APPENDIX H

TABLE H-VIII
 Manufactured Gas Utilities: Output, Inputs, and Productivity Ratios, 1869-1953
 (1929 = 100)

	Output	Persons Engaged	Output per Person	Manhours	Output per Manhour	Capital Input	Output per Unit of Capital Input	Total Factor Input	Total Factor Productivity
1869	2.2	16.8	13.2	22.2	10.0	5.6	39.7	15.7	14.1
1879	4.4	20.6	21.2	27.0	16.1	13.0	33.5	21.5	20.3
1889	8.6	25.0	34.2	32.7	26.2	20.9	41.0	28.2	30.4
1899	15.6	43.2	36.1	51.3	30.4	52.3	29.8	52.1	29.9
1904	26.6	60.9	43.7	70.6	37.7	63.7	41.8	68.4	38.9
1909	38.0	77.3	49.2	88.4	43.0	78.9	48.2	85.3	44.5
1914	52.8	97.4	54.2	97.8	54.0	100.8	52.4	98.4	53.7
1919	71.2	96.5	73.8	95.3	74.7	104.9	67.9	97.8	72.8
1924	82.0	105.2	77.9	98.7	83.1	n.a.			
1929	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1930	100.2	99.3	100.9	97.7	102.6	101.1	99.1	98.9	101.3
1931	97.5	97.3	100.2	94.1	103.6	103.2	94.5	97.4	100.1
1932	89.7	91.7	97.8	77.6	115.6	103.6	86.6	87.0	103.1
1933	85.8	90.3	95.0	77.8	110.3	102.9	83.4	86.8	98.8
1934	88.4	93.1	95.0	75.7	116.8	101.0	87.5	84.8	104.2
1935	90.1	91.6	98.4	73.3	122.9	98.8	91.2	82.5	109.2
1936	91.9	94.0	97.8	77.2	119.0	95.1	96.6	83.6	109.9
1937	89.9	90.0	99.9	72.8	123.5	91.2	98.6	79.4	113.2
1938	88.4	86.9	101.7	69.7	126.8	89.0	99.3	76.4	115.7
1939	91.5	86.9	105.3	68.7	133.2	88.2	103.7	75.5	121.2

(continued)

COMMUNICATIONS AND PUBLIC UTILITIES

TABLE H-VIII (concluded)

1940	98.7	88.8	111.1	70.7	139.6	86.8	113.7	76.7	128.7
1941	100.7	87.6	115.0	69.6	144.7	84.8	118.8	75.4	133.6
1942	109.1	75.1	145.3	60.1	181.5	84.0	129.9	67.6	161.4
1943	116.1	68.9	168.5	58.7	197.8	79.5	146.0	65.5	177.3
1944	119.0	66.0	180.3	58.1	204.8	75.2	158.2	63.9	186.2
1945	125.4	66.0	190.0	58.9	212.9	70.8	177.1	63.5	197.5
1946	133.8	72.5	184.6	58.3	229.5	67.9	197.1	62.4	214.4
1947	150.1	76.9	195.2	62.1	241.7	67.1	223.7	65.2	230.2
1948	146.3	75.7	193.3	61.2	239.1	62.9	232.6	63.5	230.4
1949	137.6	73.4	187.5	59.0	233.2	60.6	227.1	61.2	224.8
1950	138.5	67.7	204.6	54.5	234.1	58.4	237.2	57.1	242.6
1951	137.4	59.6	230.5	48.3	284.5	52.6	261.2	50.7	271.0
1952	133.4	49.8	267.9	40.1	332.7	43.7	305.3	42.2	316.1
1953	131.9	44.4	297.1	35.6	370.5	39.2	336.5	37.5	351.7

n.a. = not available.

TABLE H-IX
 Natural Gas Utilities: Output, Inputs, and Productivity Ratios, 1899-1953
 (1929 = 100)

	Output	Persons Engaged	Output per Person	Manhours	Output per Manhour	Capital Input	Output per Unit of Capital Input	Total Factor Input	Total Factor Productivity
1899	17.0	25.8	65.9	30.6	55.6	6.5	261.9	19.3	88.1
1900	18.1	28.0	64.6	32.3	56.0	7.5	241.0	20.6	87.9
1901	20.2	31.4	64.3	38.2	52.9	8.7	233.0	24.3	83.1
1902	21.5	33.9	63.4	39.1	55.0	10.1	212.9	25.5	84.3
1903	22.8	35.4	64.4	41.6	54.8	11.6	196.6	27.5	82.9
1904	23.7	36.3	65.3	42.1	56.3	13.4	176.9	28.6	82.9
1905	26.8	39.8	67.3	46.0	58.3	15.5	172.9	31.7	84.5
1906	29.7	43.0	69.1	49.7	59.8	17.8	166.9	34.7	85.6
1907	32.5	46.2	70.3	53.4	60.9	20.5	158.5	37.9	85.8
1908	33.2	46.3	71.7	53.2	62.4	23.2	143.1	39.1	84.9
1909	38.1	51.3	74.3	58.7	64.9	26.0	146.5	43.3	88.0
1910	41.2	54.0	76.3	60.3	68.3	28.8	143.1	45.6	90.4
1911	41.9	54.1	77.4	58.8	71.3	31.6	132.6	46.2	90.7
1912	46.1	57.8	79.8	61.3	75.2	34.3	134.4	48.8	94.5
1913	46.2	57.0	81.1	58.7	78.7	37.1	124.5	48.8	94.7
1914	48.4	58.4	82.9	58.6	82.6	39.9	121.3	50.1	96.6
1915	51.6	60.5	85.3	60.9	84.7	41.9	123.2	52.4	98.5
1916	59.5	67.4	88.3	68.1	87.4	45.2	131.6	57.7	103.1
1917	63.7	70.4	90.5	71.2	89.5	46.2	137.9	59.9	106.3
1918	60.5	71.2	85.0	71.2	85.0	46.1	131.2	59.8	101.2
1919	60.8	75.3	80.7	74.4	81.7	46.9	129.6	61.8	98.4
1920	65.4	81.2	80.5	81.5	80.2	48.2	135.7	66.2	98.8
1921	52.3	67.5	77.5	69.0	75.8	49.1	106.5	59.8	87.5
1922	59.4	76.1	78.1	75.5	78.7	53.5	111.0	65.4	90.8

(continued)

COMMUNICATIONS AND PUBLIC UTILITIES

TABLE H-IX (concluded)

1923	64.7	83.1	77.9	80.1	80.8	57.4	112.7	69.7	92.8
1924	68.2	88.1	77.4	82.5	82.7	63.8	106.9	73.9	92.3
1925	69.2	90.1	76.8	82.1	84.3	69.0	100.3	76.1	90.9
1926	76.4	93.5	81.7	86.3	88.5	77.4	98.7	82.2	92.9
1927	80.2	92.4	86.8	86.0	93.3	86.4	92.8	86.2	93.0
1928	87.3	94.1	92.8	92.0	94.9	93.7	93.2	92.8	94.1
1929	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1930	102.3	88.1	116.1	87.2	117.3	106.6	96.0	95.3	107.3
1931	99.9	81.2	123.0	76.0	131.4	109.3	91.4	90.0	111.0
1932	94.9	74.8	126.9	70.3	135.0	109.5	86.7	86.8	109.3
1933	90.8	76.8	118.2	66.8	135.9	108.5	83.7	84.3	107.7
1934	96.5	87.9	109.8	70.1	137.7	107.6	89.7	85.8	112.5
1935	105.9	91.9	115.2	75.4	140.5	106.8	99.2	88.6	119.5
1936	121.6	102.9	118.2	84.9	143.2	108.2	112.4	94.7	128.4
1937	131.9	108.4	121.7	90.6	145.6	109.0	121.0	98.3	134.2
1938	127.6	105.4	121.1	86.5	147.5	109.0	117.1	96.0	132.9
1939	139.3	107.8	129.2	86.0	162.0	108.7	128.2	95.6	145.7
1940	153.4	114.8	133.6	92.1	166.6	109.2	140.5	95.6	154.6
1941	163.6	117.0	139.8	91.6	178.6	110.3	148.3	99.4	164.6
1942	185.5	105.3	176.2	83.7	221.6	100.5	184.6	90.7	204.5
1943	202.3	99.7	202.9	83.2	243.1	113.2	178.7	96.1	210.5
1944	216.3	101.6	212.9	87.1	248.3	110.4	195.9	97.0	223.0
1945	226.5	106.5	212.7	91.7	248.3	118.6	191.0	103.2	219.5
1946	238.4	126.8	188.0	101.6	234.6	115.8	205.9	107.3	222.2
1947	278.1	156.8	177.4	127.5	218.1	121.2	229.5	123.9	224.5
1948	321.3	169.4	189.7	138.6	231.8	128.7	249.7	133.3	241.0
1949	346.2	178.7	193.7	143.9	240.6	139.3	248.5	140.9	245.7
1950	411.8	193.5	212.8	157.5	261.5	155.0	265.7	155.5	264.8
1951	483.5	206.5	234.1	168.1	287.6	187.7	257.6	175.8	275.0
1952	529.6	236.9	223.6	190.7	277.7	213.2	248.4	199.6	265.3
1953	562.8	254.1	221.5	205.8	273.5	230.8	243.8	215.7	260.9

APPENDIX H

TABLE H-X

Communications and Public Utilities:
Persons Engaged and Manhours, by Group, 1929

	Persons Engaged (thousands)	Manhours (millions)
Telephone	428	998
Telegraph	107	275
Electric	311	756
Manufactured gas	87	231
Natural gas	67	172
Radio broadcasting and television	4	10
Local utilities and public services, n.e.c.	30	75
Total	1,034	2,517

n.e.c. = not elsewhere classified.