

Employment
in Manufacturing, 1899—1939

*An Analysis of Its Relation to the
Volume of Production*

by Solomon Fabricant

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Employment in Manufacturing, 1899–1939

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*(Resolution adopted October 25, 1926 and revised
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Director's Note

THIS report is one of several dealing with the trends of production and productivity in American industry since the opening of the twentieth century. Other volumes already published are *The Output of Manufacturing Industries, 1899-1937*, by Solomon Fabricant (1940); and *American Agriculture, 1899-1939: A Study of Output, Employment and Productivity*, by Harold Barger and Hans H. Landsberg (1942).

The study upon which this volume is based was made possible by funds granted by The Maurice and Laura Falk Foundation of Pittsburgh. The Falk Foundation is not, however, the author, publisher, or proprietor of this publication, and is not to be understood as approving or disapproving by virtue of its grant any of the statements made or views expressed herein.

William J. Carson
Executive Director

National Bureau of Economic Research, Inc.
December, 1942

Preface

THIS study of trends in employment, and their relation to corresponding changes in production and unit labor requirements, deals only in bare outline with certain aspects of the development of the manufacturing sector of industry in the United States since 1899. The reader will not find here a description of the conditions of human labor inside factory walls, or an account of the rise of factory trade unions. Nor will he read here of the enterprise, skill and toil that have swelled the stream of fabricated products. Yet it is hoped that the statistical analysis presented in this report will illuminate all these developments for those patient enough to study the tables, charts, and textual discussion.

American manufacturing has a complex history. We can learn to understand its development only by moving carefully through a quagmire of statistical, economic, technological, legal, sociological and biographical facts. One step in this journey was taken in a previous National Bureau report, *The Output of Manufacturing Industries, 1899-1937* (published in 1940), in which the changes in the volume and composition of factory production were described in detail. In the present volume we trace the corresponding course of factory employment and labor per unit, and study their relation to the growth of output. The study is carried up through 1939, the most recent year in which a Census of Manufactures has been taken; it begins with 1899, when adequate statistics first began to be available at reasonably frequent intervals. (For a few individual manufacturing industries, however, we have been able to push the indexes as far back as 1869.)

A summary survey of the report's findings is presented in

the final chapter, together with a brief discussion of the relation between trends in manufacturing and our general economic development. The leisurely reader will turn first to Chapter 1 in which changes in total factory employment and output, and in the ratio between these quantities, are described. Trends characterizing the major groups of industries are discussed in Chapter 2. The longer account of changes in individual manufacturing industries is divided into three sections: Chapter 3, which surveys the trends in labor per unit; Chapter 4, in which attention is focused on employment and output and the bearing upon these magnitudes of changes in unit labor requirements, capital investment, prices and costs; and Chapter 5, which deals with the course of employment during the various stages of industrial growth.

The basic indexes, given in summary in the text, are presented in full in the appendices. There, also, appear notes on the definition of employment and output; and descriptions of the original data on which the indexes and other statistics cited in the text are based, except for information already published in *The Output of Manufacturing Industries, 1899-1937*.

Solomon Fabricant

Author's Acknowledgments

THIS report owes much to the guidance of a National Bureau staff committee consisting of Moses Abramovitz, F. C. Mills and Leo Wolman. Helpful advice was given also by my colleagues Harold Barger, Jacob M. Gould, Hans H. Landsberg and Sam H. Schurr. Julius Shiskin contributed in various ways to the work involved in the early stages of the study. To Céleste N. Medlicott and Corolynn L. Lee I am deeply obligated for valiant assistance cheerfully rendered throughout the undertaking; and to Richard Leighton and Harold Rubinstein for help in the final stages. The charts are the product of H. Irving Forman's skilful craftsmanship. Bettina Sinclair contributed her editorial talents to the difficult task of organizing the report and rendering it intelligible to the reader.

To all these friends I give my sincere thanks.

S. F.

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Employment in Manufacturing, 1899–1939:
An Analysis of Its Relation
to the Volume of Production

Chapter 1

Aggregate Factory Employment and Output

THE rise of "the factory system" was a major economic development of the nineteenth century. Increase in scale of operations, detailed division of labor, intensified geographical concentration of industry, and mechanization of production are just a few of the many processes which the historian, of whatever school, cannot fail to record. Yet the nineteenth century witnessed only the infancy and youth of the factory. Manufacturing continued to grow, and its techniques to develop, well into the twentieth century, reaching a stage which some observers have called "maturity." It is upon this recent part of its history, beginning with 1899, that the present report on America's factories is concentrated.

Two of the more significant indexes of manufacturing growth are output or physical product, and employment or number of workers actually occupied in turning out the product. A third measure, the ratio of employment to output, that is, the amount of labor required to produce a unit of goods, is an especially vivid indicator—when observed at various points in time—of the transformation of the manufacturing process. Since we cannot describe the tightly woven pattern of manufacturing development in all its aspects we choose to trace the course, from the turn of the present century, of these major strands.

GROWTH AND STAGNATION IN EMPLOYMENT

In 1899, a prosperous year, five million persons earned a livelihood in American factories. Of these, about nine tenths

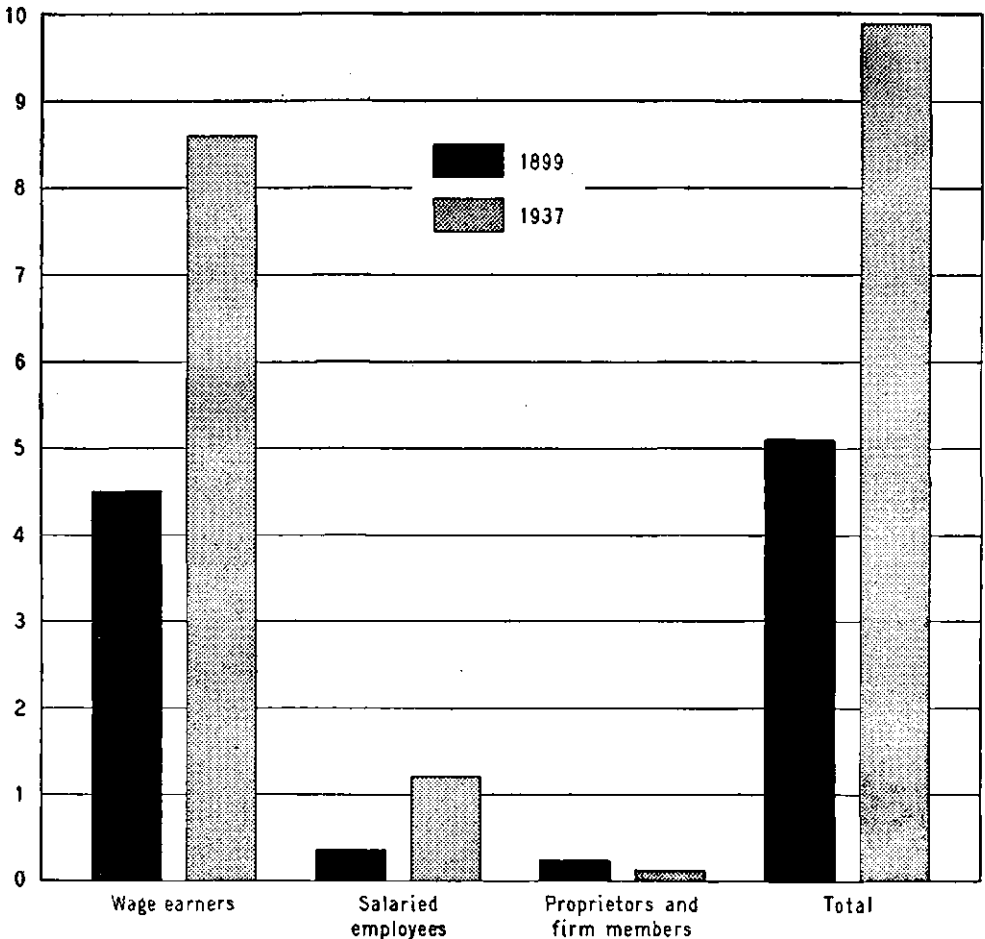
were wage earners, and the remainder were white-collar workers (including corporate officers), and entrepreneurs (Chart 1). By 1937, the latest year of peak business preceding the current war boom, the number of persons engaged in

Chart 1

ALL MANUFACTURING INDUSTRIES COMBINED

Number of Persons Engaged, 1899 and 1937

Millions of persons



Based on Table B-5

manufacturing industry had grown to ten million. In a little less than four decades, therefore, the total number engaged in manufacturing—again including salaried workers, corporate officials and working proprietors as well as wage

earners—had increased by 100 percent. This rise exceeded the growth over the same period not only of the nation's population, which went up 75 percent, but also of aggregate employment in all branches of American industry (including mining, trade, farming and other nonmanufacturing activities), which rose 85 percent. Because of its more rapid rate of increase, factory employment in 1937 accounted for a somewhat larger proportion of all American workers and proprietors than it had in 1899: at the close of the nineteenth century its contribution to the total was 22 percent, as compared with 24 percent some four decades later.

Within manufacturing itself there were several noteworthy changes in the composition of employment. Wage earners, whose numbers rose by a little more than 90 percent between 1899 and 1937, lost some ground to salaried or white-collar workers, whose jobs increased by 250 percent. Entrepreneurs, on the other hand, declined both in relation to the total of manufacturing employment and absolutely: there were only half as many factory proprietors in 1937 as there had been in 1899. Since wage earners constituted the great majority of all persons engaged in factories over the entire period, the net result of these shifts was a slight decline in their share of factory employment, from about 90 percent to 85. The rapid multiplication of the number of openings for white-collar workers reflects the growing importance of supervisory, technical, and clerical functions in the manufacturing process. As for the sharp decline in the number of proprietors and firm members, it is attributable in large measure to the tendency to incorporate partnerships and single proprietorships and in part also to the growth of large-scale enterprise at the expense of the small concern.

Returning to the 100 percent rise in total factory employment, we should note two outstanding characteristics of this growth. In the first place, it was the result not of a cumulation of steady increases from year to year but of varying

annual rates of change. Even from the series based only on Census years wide fluctuations are apparent (Chart 2). The annual series for wage earners, estimated for intercensal years, tells a more complete story. According to this record there were absolute declines in employment during as many as nine intervals, only one of which, the period 1929-32, exceeded a calendar year in duration. That spectacular slump brought factory employment down to a trough that was almost 40 percent below the 1929 average and 20 percent short of the low levels of 1921 and 1914.

In the second place, the entire 100 percent increase in manufacturing employment occurred during the first two decades of the period 1899-1937. After the peak reached during the war years 1917-18 there was no net gain in factory jobs. Up to 1914 factory employment rose at a fairly substantial average annual rate. Then came the upward spurt resulting from war orders by European belligerents, followed by an imperative domestic demand for factory-made munitions of war—guns, uniforms, trucks, motor fuel, ships and airplanes. Responding to these powerful stimuli, manufacturing employment in 1917-18 touched a peak that was not surpassed in the prosperous 1920's or in the good business years 1937 and 1940. Translated into terms of human beings in the labor market, this dispassionate digest of employment data means that during most of the years in the first and second decades of the twentieth century large numbers of youths leaving school, women entering industry and immigrants crossing our borders found new jobs in American factories, as well as opportunities to fill places left by other workers. While labor turnover continued on into the 1920's and 1930's, these years brought no important net increase in factory employment; newcomers found openings in manufacturing only when existing positions became vacant.

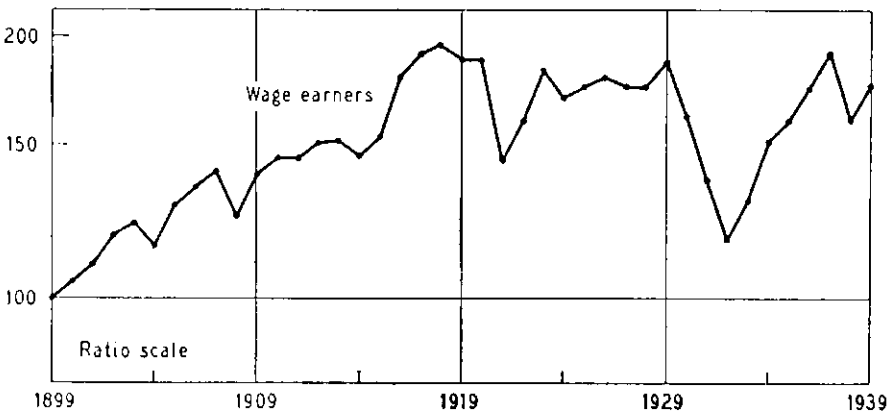
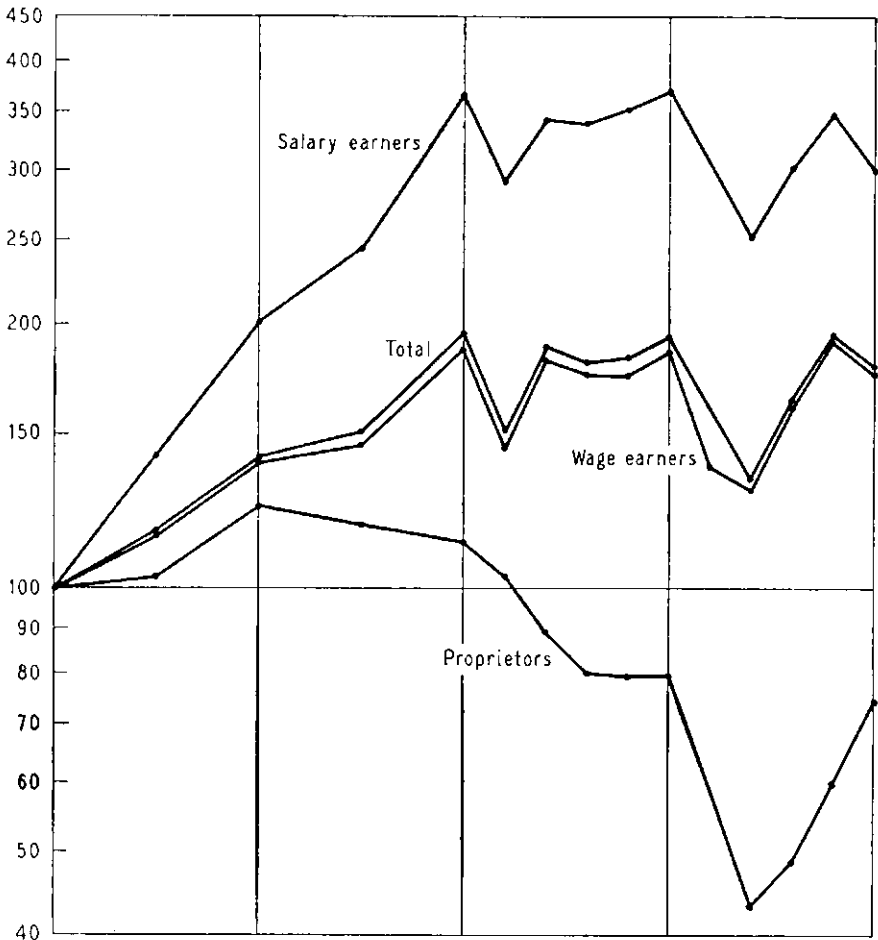
The current transformation of our industrial system into a war economy is augmenting employment at a rapid pace,

Chart 2

ALL MANUFACTURING INDUSTRIES COMBINED

Indexes of Employment

Percentage



Based on Tables B-5 and F-1

very much as it did during the war of 1914–18. The clamorous demands for workers are being met in part through absorption of those still unemployed (a reservoir less important in 1914 than it was in 1939), in part through the diversion of workers from jobs in other fields, and in part through a call upon persons not normally employed. Already there is unmistakable evidence of this new upward trend. The latest figures available at this writing indicate that in 1941 employment in American factories was 19 percent higher than in 1937, and that it has climbed still further in 1942. It is likely that opportunities for factory work will fall off again when the present war has come to an end. But whether such a decline will in fact occur, and if it does to what level and at what rate it will proceed, must depend not only on economic forces, many of which are still imperfectly understood, but on political and other noneconomic factors as well.¹

OUTPUT IN RELATION TO EMPLOYMENT

The foregoing section has sketched in brief the changes in the number and composition of factory personnel since 1899. At this point we take up a new thread in the pattern of manufacturing development, and trace the growth of the product turned out over the four decades by the army of workers that swelled from five to ten million.

Factory output rose very sharply between 1899 and 1937. Indeed, in absolute terms, the rise in output dwarfs the gain in employment. By 1937 the physical product of our factories had increased 276 percent, the number of employees only 100 percent.

Like the volume of employment, the course of output fluctuated markedly. It is true that the cyclical fluctuations in each were quite similar, as the timing of the peaks and troughs in both output and employment shows (Chart 3).

¹ For some comments on the problem of forecasting the future of factory employment, see Chapter 6.

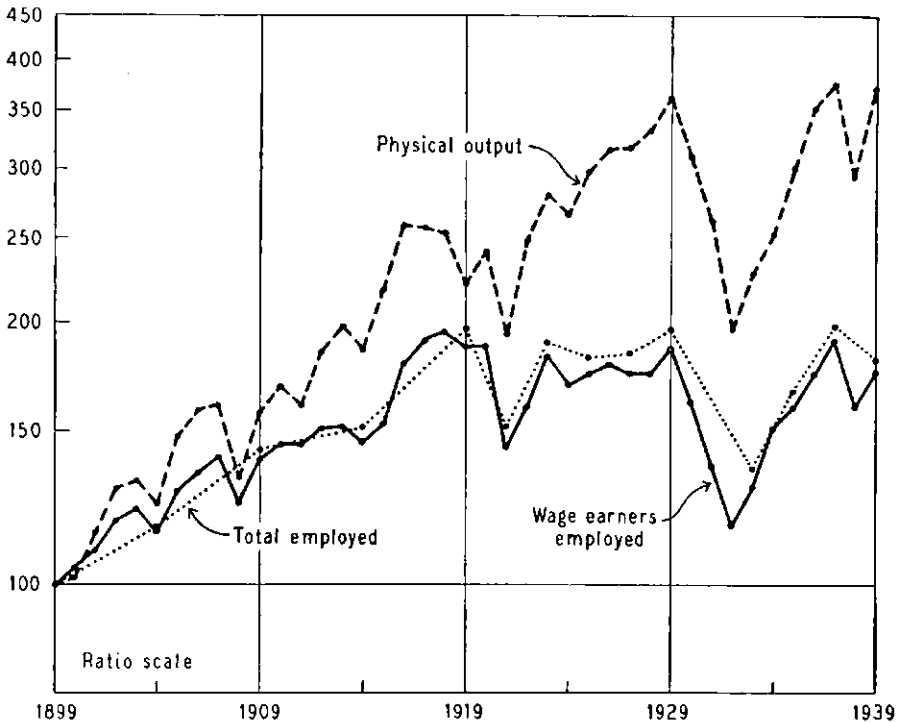
But when successive peaks are compared, output is found to have registered a series of more or less steady gains over employment. Except in three of the periods (1907–10, 1913–18 and 1929–37), the movement of output diverged progressively from that of employment. Output rose more rapidly

Chart 3

ALL MANUFACTURING INDUSTRIES COMBINED

Indexes of Output, Wage Earners Employed, and Total Employed

Percentage



Based on Table F-1

than employment in the years 1899–1903, 1903–07, 1910–13 and 1926–29. When employment declined in 1920–23 and again in 1923–26 output continued to increase. And in 1918–20, when the movements of both were downward, the drop in output was less severe than that in employment. Especially noteworthy is the continued growth of factory production during the 1920's to heights well above those of

1916–18, whereas employment, as we have seen, did not surpass the peak attained in the first World War until 1941.

The fourfold increase in output between 1899 and 1937, while employment merely doubled, means that there was a decline, during the 38 years, of 50 percent in the number of workers employed per unit of product.² The processed foods, beverages, clothing, chemicals, metals, machines, carriages and wagons, and the host of other factory products turned out in 1899, were made with the aid of 5 million workers. In 1937, four times as large a bundle of goods—greatly changed in composition, of course—was produced by only twice as many workers.

Thus far we have considered only the size of the product. If we could take statistical account of improvements in its quality, we should almost certainly find that the 50 percent decline in employment per unit is an understatement. For the commodities processed in 1937 were, on the average, superior to those made at the opening of the century.³

The measurable drop of 50 percent in the ratio of factory employment to product is equivalent to an average rate of decline of 1.8 percent per annum for the period under discussion. Yet from an examination of Chart 4 it appears that the rate of change in employment per unit of output was far

² The ratio between employment and output may be expressed either as the number of men used in the production of a unit of goods, or as the volume of product per man employed. The use of one form or the other is a matter of choice.

³ Further, in many fields of manufacture a unit of output was made from less material in 1937, thanks to the reduction of waste and the utilization of by-products. That is, the *net* output of manufacturing industries (and it is net output which is the better measure of the contribution of factories to our national product) probably rose more rapidly than their *gross* output, because of a slower rise in the input of materials. (For a discussion of the bias in indexes of physical output, when they are taken to represent net output, see Solomon Fabricant, *The Output of Manufacturing Industries, 1899–1937* [National Bureau of Economic Research, 1940], Ch. 2.) For this reason the 50 percent cut in workers per unit of product is less than the reduction that would be found in workers per unit of *net* output if we could measure it adequately.

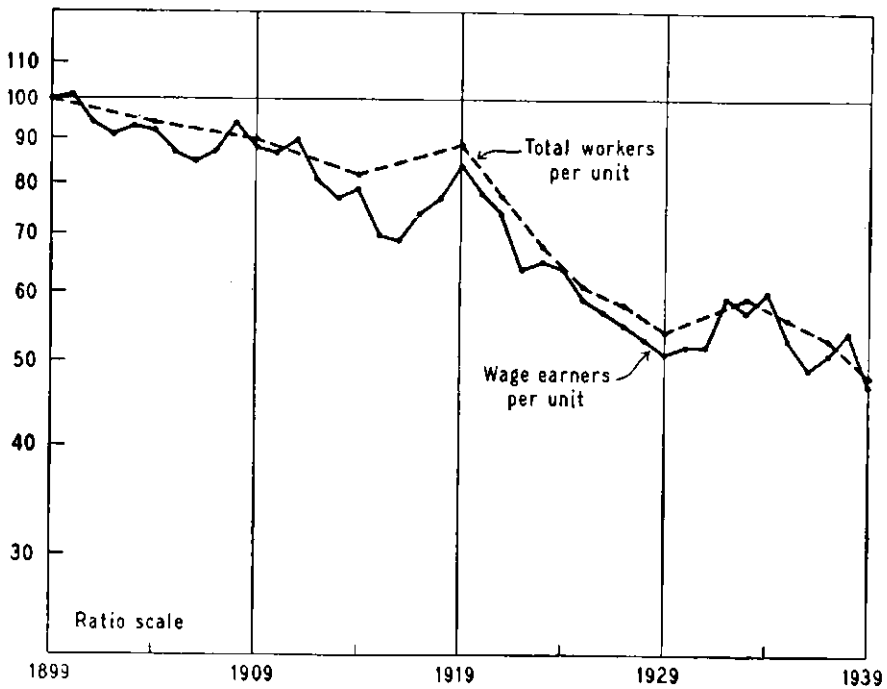
from uniform. There were short cycles as well as more persistent differences from period to period. The year-to-year movements are indicated only approximately because the figures for intercensal years are rather rough estimates. Yet it is safe to conclude that there were 10 separate occasions during the last four decades when the number of workers em-

Chart 4

ALL MANUFACTURING INDUSTRIES COMBINED

Indexes of Wage Earners and Total Workers per Unit of Product

Percentage



Based on Table F-1

ployed to turn out a unit of product increased, thus running counter to the general trend. Over several rather long periods, 1903-11, 1916-21 and 1929-36, this ratio tended either to move horizontally or to rise. In the years 1911-16 and 1923-29, on the other hand, there were specially notable declines in employment per unit.

One explanation of the fluctuations in the ratio of number employed to goods produced is to be found, of course, in the

modifications in weekly hours of labor over the four decades we are studying. In the following section the principal changes in the working week are noted, and an attempt is made to describe the rather complex effects of reduced hours upon the output of factory workers.

REDUCTIONS IN THE WORK WEEK AND THEIR RELATION TO EMPLOYMENT PER UNIT OF PRODUCT

The changing ratio of workers to product may be regarded as a function of the length of the work week and of the amount of labor, measured in manhours, employed per unit of product. If the number of manhours required to produce a unit of output remains unchanged, a decline in hours worked per man will raise the ratio of workers employed to output; conversely, if the length of the working week is unaltered, but the number of hours of labor needed per unit of product is reduced, employment will decline in relation to output. But the two variables are not mutually independent, and it is common knowledge that change in one tends to induce change in the other. For this reason a movement upward or downward in the ratio of employment to output usually reflects both a change in weekly hours of work and a modification of unit hourly labor requirements.

Reductions in the work week have occurred under varying circumstances. Often a rise in the volume of goods turned out per manhour has implemented the efforts of organized labor to share in the benefits of the accompanying reductions in costs by working less hours per week. Sometimes labor's campaign to reduce hours of work has antedated a decline in real costs and spurred the employer on to institute labor-saving improvements; in such cases a cut in hours of work has been a stimulus to the entrepreneur as well as a reward to the worker. That a reduction in hours tends to lead to improvements in methods of management, in machinery and in other

factors, has been noted, for example, in a study of cotton manufacturing by the National Industrial Conference Board.⁴ As N. I. Stone has observed, "the threatening diminution of profits acts as a powerful stimulus to the owner or manager of a plant who is anxious to make possible savings where he was satisfied before to plod along in the established rut."⁵ Occasionally the entrepreneurial reaction to reductions in hours has been so prompt and far-reaching as to surprise the trade union which initiated the demand for it.⁶

Again, a widely prevalent reason for reduction in the hours of labor—at least during the earlier part of the century when the work week was very long—has been the experience, or at least the presumption, that the average worker can actually produce about as much in ten hours as in a twelve-hour day, even with all other conditions of production unchanged. Classic examples often cited are the experiences of the Engis chemical factory near Liège in 1892, the Salford iron works in Manchester in 1893, and the Zeiss optical plant in Jena in 1900. In all of these plants moderate reductions in hours per day were accompanied by increases in output per manhour, and in two by increases in output per worker.⁷

In recent years reduction of hours has been strongly supported not as a means of sharing prosperity or effecting re-

⁴ *Research Report No. 4* (March, 1918).

⁵ "Is the Minimum Wage a Menace to Industry?" *Survey*, Feb. 6, 1915.

⁶ "The shorter work-week, as established by the thirty-five hour week, was promptly met by employers with new labor-saving devices, a more intense speed-up system of production and the establishment of the section system of production in factories where it never existed before, thus tending to destroy the immediate gains which were obtained by the thirty-five hour week. . . ." (Resolution adopted at the International Ladies' Garment Workers' convention in May 1937, cited by Harry Ober, *Trade-Union Policy and Technological Change* [National Research Project, Philadelphia, 1940], p. 82.)

⁷ These and other cases are summarized in Josephine C. Goldmark's *Fatigue and Efficiency* (Russell Sage Foundation, 1912). For more recent citations covering American industry see Harry Ober, *op. cit.*, Ch. IV, and the 1940 *Annual Report of the Wage and Hour Division of the U. S. Department of Labor*, Ch. I. It is very difficult to determine from the cases described in these and other sources the extent to which changes in factors other than hours of labor affected labor productivity.

ductions in costs, but in order to spread available employment among a larger number of workers and thus to help absorb the unemployed.

Finally, throughout our country's industrial history much effort has been devoted to putting a ceiling on hours of labor in general, and in particular to restricting the number of hours worked by women and children, and by men engaged in hazardous occupations. Behind such regulation of hours has been the consideration that despite the possibility of immediate curtailment of production per employee, the advancement of the health and happiness of the people at large would counterbalance the loss in output, and perhaps even lead ultimately to a stepping up of labor efficiency.

Whatever the grounds for reductions in the average length of the work week, the statistical evidence, assembled from rather fragmentary data and diverse sources,⁸ shows a definite downward movement in number of hours worked during the period since 1899. In that year the average full-time week for all manufacturing was about 60 hours, whereas in the years 1937-40, just prior to the acceleration of preparations for war, the average work week was about 40 hours. The decline in hours was slow during the first decade and a half, and very slight during the 1920's. The largest cuts came during and immediately following the war of 1914-18, a period in which the full-time week fell from 55 to 50 or 51 hours, and again during the recent great depression, with full-time hours declining from an average of 50 in 1929 to 40 in 1937-39.

The foregoing summary refers to the nominal work week. Data on the number of hours actually worked, including overtime and excluding undertime, are unfortunately less reliable. Such as they are, however, they do indicate that the trend in actual hours worked roughly paralleled the changes in the normal or full-time week.

⁸ Appendix C.

Despite the general decrease in labor time per wage earner, the number of workers used per unit of product declined over the period as a whole. The employment-output ratio fell by one half, while weekly hours of work declined by one third. These are the end results, reflecting net changes over four decades. If we follow the year-to-year fluctuations in the employment-output ratio, we find that the number of workers employed per unit increased during business recessions, when hours were reduced temporarily to lessen the number of lay-offs. Similar rises in employment per unit occurred also during the first World War and in the 1930's when the work week was cut drastically. Ultimately, however, we have seen that these temporary upswings in employment per unit were more than counterbalanced, resulting in long-term reductions in workers per unit.

To the 50 percent decline in workers per unit the one-third cut in hours must itself have contributed by enhancing labor's efficiency and stimulating managerial initiative. One should not infer, however, that stated reductions in hours of work have augmented workers' productivity at a constant rate throughout the four decades that have elapsed since 1899. It is more than likely that a given cut in the working day or week has had a progressively slighter effect upon labor efficiency with the passage of time. For the reaction to a reduction in hours depends, first of all, upon the absolute length of the working week that is cut. A 10-hour reduction from an average of 60 hours per week (the prevalent working period in 1899) will, as a rule, result in a greater increase in labor efficiency than an equally large cut from a 50-hour week (the average during the 1920's). Because of the downward trend in hours, then, the influence on labor efficiency of given reductions, and thus on labor requirements per unit of product, must have diminished. The rate of diminution would be all the greater if, as was the case, there were many industries in 1899 with hours well above the average of 60

whereas in 1937 industries clustered closely about the 40-hour level.⁹

The level of hours is not the only factor, among those affecting labor efficiency and unit labor requirements, that changed during the past four decades. There was also an increase in the kind of mechanization that lessens the relative importance of labor intensity in the productive process: for example, the widespread introduction of instrumental controls, and a marked trend toward automaticity of machine operation. With these changed characteristics of the factory job itself, a given reduction in hours from a specified level would have less effect on output than an identical reduction from the same level under the old conditions of work. This consideration lends added weight to the thesis that in the earlier part of the century cuts in hours must have enhanced labor efficiency and reduced unit labor requirements more drastically than shortening of hours in the latter part of the four-decade period. Unfortunately, no statistics are available to measure the precise effect on labor requirements of changes in these factors.

AGGREGATE MANHOURS AND MANHOURS PER UNIT

Because of the reductions in hours of work, the course of aggregate manhours of labor diverges from that of average number of workers, as Chart 5 shows.¹⁰ The peak in man-

⁹ See Chapter 3, Table 2.

¹⁰ The data on hours of labor relate to hours per week. It is not apparent at first sight that multiplying the index of average number of workers employed by the index of weekly hours will yield an index of aggregate manhours worked during the year, for a question arises concerning changes in the number of weeks worked per person per year. As we indicate in Appendix A, however, in the computation of the average number of persons employed account is implicitly taken of change in number of weeks per worker, and the average number of workers so calculated is, in effect, the number of persons that would be employed if all persons worked a full year; i.e., two persons working half a year each are counted as one full-time worker.

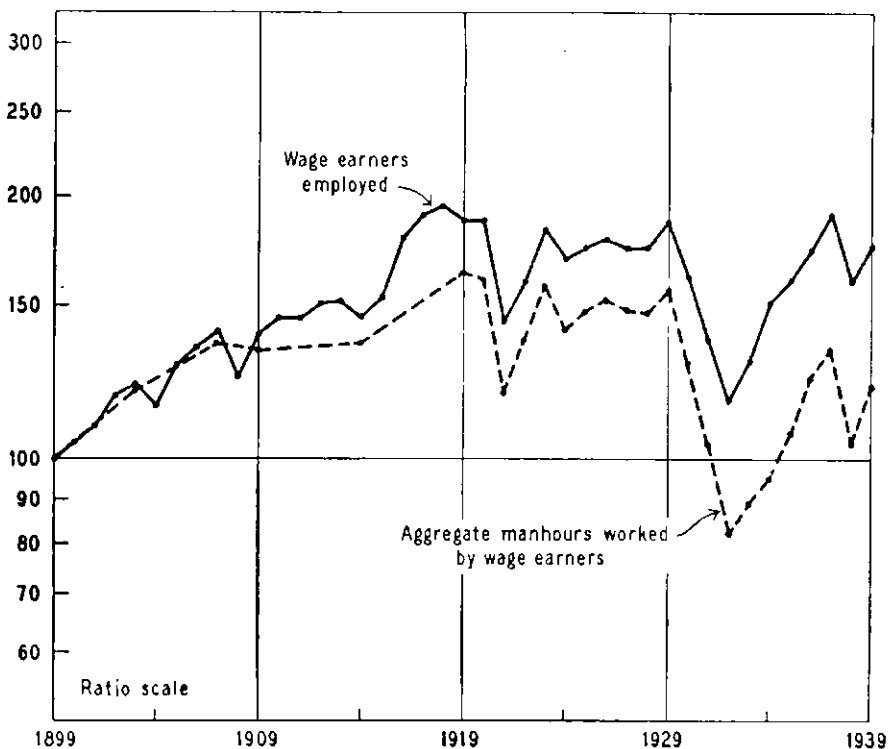
hours before the present war boom came during the war of 1917-18,¹¹ as did the high point in number of workers; but whereas the latter series was only a little higher in 1917-18 than in 1929 or 1937, the earlier war level of manhours stands out well above the heights reached in the subsequent years

Chart 5

ALL MANUFACTURING INDUSTRIES COMBINED

Indexes of Employment and Manhours

Percentage



Based on Table F-1

shown in the chart. Again, the number of workers in 1937 was slightly higher than it had been in 1929; manhours, in contrast, stood much lower in 1937 than in 1929. In short, after 1918 wage-earner employment fluctuated about

¹¹ The chart shows no 1917 or 1918 figure for manhours, owing to lack of precise information on hours actually worked in those years. But it is safe to say that the number of manhours was greater in 1917 and 1918 than in 1919, the highest figure plotted in the chart.

a horizontal trend; in manhours the trend was definitely downward. As a consequence, the number of manhours worked in factories in 1937 was no greater than it had been thirty years earlier in the prosperous year 1907, although the number of workers employed was substantially larger.

The preceding conclusion leads us to what is perhaps the most striking figure in this report, namely the estimate of the drop in manhour requirements per unit of fabricated product during the 38 years following 1899. For a halving of the number of workers employed per unit of product and a one-third reduction of the working week amounts to a decline of two thirds in the number of manhours employed per unit of goods produced. And if improvements in quality of products and savings of materials could somehow be worked into the calculations we should find an even greater cut in manhours per unit.

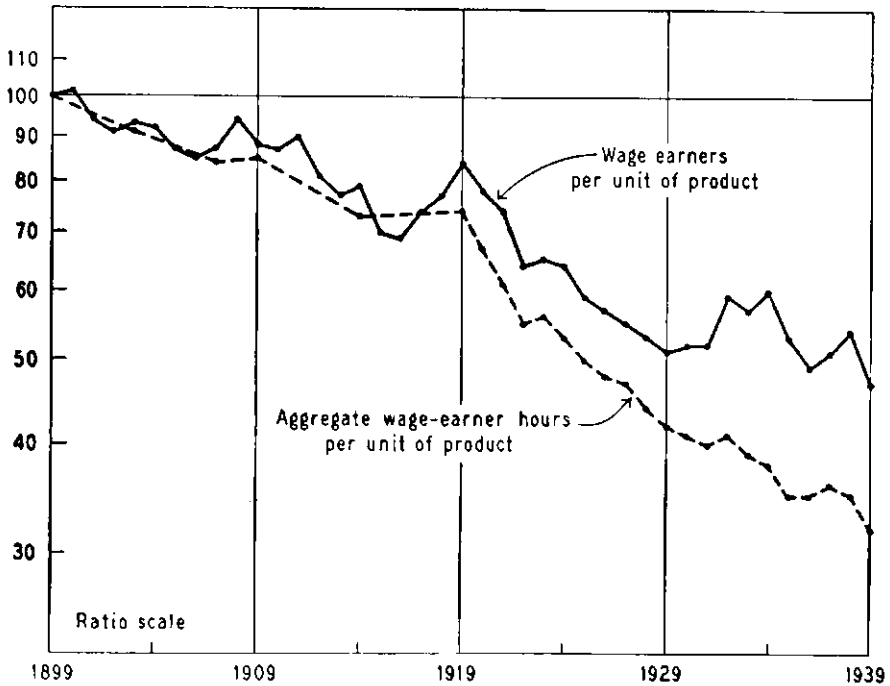
The two-thirds reduction in the ratio of manhours employed to quantity of product manufactured is the net result of almost four decades of change. Like the employment-output ratio, the ratio of manhours to output did not decline smoothly, but shifted in tempo from one brief period to another (Chart 6). Yet in comparison to the movement of workers employed per unit, the fluctuations in manhours per unit are relatively mild. The scarcity of data on actual hours for each year since 1899, and the lack of precision in such hours data as are available, make it difficult, of course, to place complete trust in such summary statements. It is possible that an abundance of reliable data would show more fluctuations than does the series charted, although there can be little question that the manhour-output ratios are much more stable from year to year than the corresponding employment-output ratios.

Despite this relative stability in the manhour-output ratio several interesting changes occurred in its average rate of decline. Here too the lack of complete and accurate data on

actual hours makes it hard to define the shifts. Nevertheless one can conclude, first, that the five-year period terminating with the end of the first World War witnessed practically no net decline in the manhour-output ratio.¹² Second, during most of the 1920's there was an exceptionally rapid drop in

Chart 6

ALL MANUFACTURING INDUSTRIES COMBINED
Indexes of Wage Earners and Aggregate Wage-Earner Hours
per Unit of Product
Percentage



Based on Table F-1

manhours per unit. The manhour-output ratio fell during the decade 1919-29 at a rate of more than 5 percent per annum. If this rapid rate of decline had prevailed during the entire period after 1899, unit labor requirements in 1939

¹² It seems likely, though not certain, that manhours per unit fell considerably from 1914 to 1915, dropped slightly from 1915 to 1916, rose sharply from 1916 to 1917, and went up slightly from 1917 to 1918. That is, the slow rate of decline during the first World War period was due entirely to the failure of manhours per unit of output to fall during 1917 and 1918.

would have been less than one half of what they actually were in that year. Finally, the decline in labor per unit after 1930, while much slower in pace than that which characterized the 1920's, was not very much behind the average for the entire four decades.¹³

Chart 6 depicts also a fairly high degree of persistence in the declining trend of manhours per unit. While we know all too little about actual hours worked per week during the years since 1899, it seems reasonable to conclude that the years when there was no reduction in the manhour-output ratio are relatively few. These years, interestingly enough, were sometimes periods of growing business, in which output and investment rose rapidly, and sometimes poor business years, when output and investment fell off. Capital investment, widely considered one of the significant sources of decline in unit labor requirements, has in fact fluctuated rather violently,¹⁴ apparently without any noteworthy or even con-

¹³ Reference should be made again to a factor generally affecting our measures of output, namely, change in the quality of goods produced by factories. On net balance there has been improvement: if we were to compare the products of American factories turned out in 1937 with corresponding goods produced in 1899 the greater number of them would be found to be more durable, more efficient, less noisy in operation, or otherwise better. But such comparisons might not lead to similar results if shorter intervals were considered. To the extent that there have been fluctuations in the rate of improvement in the quality of fabricated commodities, some of the variation in the rate of decline in manhours per unit of product may be accounted for, though it is unlikely that the quality factors can explain a very large amount of this variation. In particular, it is possible that improvements in quality were least noteworthy, if not actually negative on the average, in the period following 1929. One reason for measuring only the net change between 1929 and 1937 and ignoring the years between is to eliminate as far as possible the effects of cyclical changes in quality and other factors. But there is some ground for the belief that the long recession following 1929 resulted in a deterioration of the average quality of some goods, not entirely counterbalanced in the revival that followed. Thus there seems to have been a tendency, especially in consumers' semidurable goods like shoes and clothing, for factories to shift their emphasis to the cheaper grades. Since these require much less labor in fabrication than do the more expensive qualities or styles, the change in the character of output would be accompanied by a decline in the measure of manhours per unit even in the absence of other factors affecting this ratio.

¹⁴ Appendix E.

sistent effects on short-term changes in the manhour-output ratio. The ratio dropped from 1920 to 1921 and again from 1929 to 1931, yet capital investment fell in both periods, in the latter to a level actually below current depreciation charges. But during 1923–29, another period when man-hours per unit were declining rapidly, capital investment was at a high level. It is surprising, also, that the period 1935–37 is to be counted among those in which there was no decline in unit manhour requirements, for in these three years capital investment rose to heights comparable even with the level of the boom period 1923–29.

One explanation lies in the difference between the current *flow* of capital and changes in the existing *stock* of capital goods. Even violent fluctuations in new investment cause relatively mild changes in plant and equipment; and capital goods do not actually decline until new investment falls below the rate of wear and tear. Yet it is alone through changes in the quantity and character of existing capital goods that changes in new investment can exert a direct influence upon the ratio of labor to product.¹⁵ And if a period of adaptation (for reorganization or breaking-in) is necessary, the labor-output ratio fails to react immediately even to fluctuations in the volume of capital goods.

The relatively minor fluctuations in unit labor requirements—despite severe fluctuations in capital investment—may be explained in part too by the customary removal from service of less efficient equipment as output (and with it new investment) declines, and its return when output (and new investment) rises. Equipment set aside and then brought back into use presumably requires more manhours of labor for the production of a unit of output than equipment kept continuously in operation. An outstanding example is provided

¹⁵ Changes in investment have indirect effects on the ratio through their influence on the national output. This chain of relationships is too complex to trace here.

by the intermittent resort to beehive ovens in coke production. These ovens yield half the product per worker that is derived from byproduct ovens. As a consequence they have been declining in importance ever since the introduction of the byproduct oven during the 1890's and now contribute less than 5 percent of total coke production. Yet during peaks in coke output, the inefficient beehive ovens are restored to use, only to be set idle again when output falls. The alternation of use and disuse of less efficient equipment thus helps to offset the influence of fluctuations in new investment upon the labor-output ratio.

Still another explanation of the comparatively steady course followed by the manhour-output ratio is to be found in the frequent utilization of factory labor to maintain old machines and plant and sometimes even to construct new plant and equipment. When investment in purchased capital goods is declining, investment in capital goods produced by the entrepreneur for his own use and for the maintenance of old fixed assets is commonly decreased. At such times manhours expended in the latter types of investment activity are cut down, presumably more drastically than total manhours of work. The consequence, in the absence of other influences, is a drop in total manhours per unit of output during recession and a rise during recovery.¹⁶

¹⁶ The reverse seems to apply, however, in a few industries. Here it appears that the need for maintaining plant and equipment even during depression results in a smaller decline in maintenance labor than in total labor. This situation, coupled with the inefficiencies of operation at low utilization of capacity, accounts in part for increases in manhours per unit during recession and for decreases during revival. Modern steel mills, for example, are designed for high-speed volume production, and when they are not operating close to capacity they require excessive amounts of labor per ton of output: the unit labor requirement per gross ton of finished steel products at a rate of operation equal to 20 to 25 percent of capacity is 46 manhours as compared with 34 manhours when 55 to 60 percent of capacity is utilized. (B. H. Topkis, and H. O. Rogers, "Man Hours of Labor per Unit of Output in Steel Manufacture," *Monthly Labor Review*, May 1935. For similar data on cement see B. H. Topkis, "Labor Requirements in Cement Production," *Monthly Labor Review*, Mar. 1936.)

Although the net effect of the various influences noted in the preceding paragraphs is difficult to assess, variation in the degree to which they offset one another may help to explain the inconsistent relations between capital investment and the manhour-output ratio. But it is hardly likely that these are the only relevant factors. There are also modifications in factors other than capital investment, the efficiency of the equipment in actual use, or the number of maintenance workers. Among these are changes in the quality and character of products as prices fall and rise; in managerial efficiency with recession and recovery; and in labor's productivity as unemployment contracts or expands, as hours of labor are cut or lengthened, and as labor organization waxes and wanes. These and other changes, some peculiar to single periods, others occurring in most business cycles, must be analyzed before we can understand why the labor-output ratio for all manufacturing industries combined behaves as it does during short periods.¹⁷

SIGNIFICANCE OF THE DECLINE IN UNIT LABOR REQUIREMENTS

The reduction of over two thirds in labor per unit of product, measured in manhours, and of one half in terms of men employed, reflects a very marked transformation in

¹⁷ It is conceivable that the cyclical fluctuations in the ratios for individual manufacturing industries are much more consistent in behavior and extreme in amplitude than the ratio for all factories combined. The average hides the diverse movements characterizing individual industries; these may cancel one another more completely in some cycles than in others, depending on the shifting relative importance of each industry in the total. The evidence collected in this study (Appendix F and Chart 12, below) goes little further than to suggest that there is some industrial diversity of cyclical pattern and that in a few industries there is fairly considerable amplitude of fluctuation. Here too, however, the general impression is one of gradual decline with moderate and random fluctuations, rather than of considerable and systematic variation about a downward trend. Our statistics tell us little about the consistency of the cycles in labor per unit of output in individual industries. To study these fluctuations adequately we should need extensive monthly data.

manufacturing techniques, conditions of work, intensity of labor effort, and material means of production. The industrialist of 1899 would rub his eyes in amazement were he suddenly set down in the United States of today. He would find new materials, more and bigger machines, novel and flexible sources of power, giant factories and nation-wide industrial networks, advanced mechanical, chemical, and electrical processes, assembly lines speeding the flow of work, intensified division of labor, and revised methods of labor management. These and a host of other innovations and developments coincided with the drop in labor requirements per unit of product, and many of them no doubt contributed to that decline.

A few of the changes may be defined quantitatively, though their influence is not subject to exact appraisal. For example, the net book value of capital assets used in manufacturing between 1904 (the earliest year for which we have data) and 1937 rose from \$6 billion to almost \$25 billion, or from about \$1,000 of capital assets per worker to over \$2,000. Price increases between 1904 and 1937 must have accounted for a good part of this rise, but even after allowing for them so far as we can, we find an increase of at least 30 percent in the net value of capital instruments per worker.¹⁸

Again, the aggregate rated horsepower capacity of prime movers and of electric motors driven by purchased energy utilized in manufacturing plants increased from 10 million in 1899 to over 50 million in 1939—a rate more than twice as rapid as that at which employment in factories advanced. As for the expansion in the scale of industrial operations, with all that it implies with respect to specialization of industries, plants, and labor, the fourfold increase in output serves as a rough measure of its scope.

Unfortunately there are direct and precise measures for very few of the phenomenal developments in contemporary

¹⁸ The data are presented and discussed in Appendix E.

manufacturing.¹⁹ No information is available for years prior to about 1920 on such an important form of capital as manufacturing inventories, which amounted to over \$12 billion in 1937 (equal to 50 percent of the value of net capital assets); yet inventories are in some degree substitutes for equipment, particularly in meeting seasonal peaks in demand, and they affect manhours per unit of output directly by enhancing the regularity of the flow of work.

As for the increased efficiency of labor itself, the one-third drop in hours must have contributed to it, but this figure is hardly an adequate gauge of the influence of the reduction in the work week. The elimination, in large part, of the child labor that was employed in 1899 is also a factor in greater labor efficiency, yet its effect, too, is difficult to weigh quantitatively. In addition, of course, many of the important changes are qualitative: revisions of plant layout; improvements in equipment, notably increases in the size of machines; accelerated speed of operation; more precise control devices; and less susceptibility to breakdown. Together with air conditioning, improvements in lighting, elimination of disturbing pillars, and other refinements in factory building and design, these qualitative advances have been so revolutionary that one might well venture the statement (though it cannot be substantiated in quantitative terms) that they have contributed as much to reducing unit labor requirements as has the growth in the physical stock of productive instruments.

Confronted by this complex of influences which is beyond synthesis or direct measurement, we must return to the ratio of labor input to units of output as perhaps the simplest and most readily computed single index of all the changes, large

¹⁹ As is noted in Appendix E, statements concerning changes in capital assets must be accepted with caution. On the incommensurability of the horsepower capacity of different types of engines and motors see W. L. Thorp, "Horsepower Statistics for Manufactures," *Journal of the American Statistical Association*, Dec. 1929.

and small, that have shaped contemporary manufacturing processes. Appraised either in terms of men or of manhours, the decline in this ratio is the most telling measure of their cumulative impact.

This complex effect should not be considered identical with change in "efficiency," or with any other single aspect of manufacturing development. If the reduction in labor requirements per unit of product, whether calculated in numbers employed or in hours worked, can be held to reflect a multitude of changes in the processes and means of production, it cannot be regarded also as a measure of change in the efficiency, amount or character of any one factor of production. Those who consider the figures cited to be indexes of labor efficiency, of quantity of capital invested, or of improvement in capital equipment, are in effect ascribing to one or another factor the result of changes in all factors. For the same reason one cannot reasonably focus attention exclusively on any one motivating force behind the far-reaching changes measured by the decline in labor per unit. If we stress management as their initiator we may underestimate the other factors that must have stimulated management: for example, trade union efforts to raise wage rates, and encouragement of standardization of products and regulation of hours and conditions of labor by governmental agencies. Sometimes, of course, a specific change in unit labor requirements may be accurately ascribed to some single factor; but this is hardly true of changes in broad industrial categories over long periods. And finally, developments in manufacturing alone cannot account for the decline in its unit labor requirements, for the latter reflects also changes in other parts of the economy.²⁰ The reduction in the utilization of labor per unit of product in American factories since 1899 cannot be viewed, therefore, as the result of the operation of

²⁰ See Chapter 6 for a discussion of the relation between developments in factories and those in the economy at large.

any one factor of production, or even of all the factors resident in manufacturing. It must be interpreted rather as reflecting, in just one segment of our industry, the cooperative action of all factors, both within manufacturing and outside it.

Trends among Major Industrial Groups

THE host of factory workers which grew from 5 to 10 million persons and quadrupled the total output of American manufacturing in 40 years turned out thousands of diverse products. These men and women joined in processes as analytic as animal slaughter, as synthetic as automobile assembly, as magical as the transformation of wood pulp into cloth. Because of the number and complexity of the commodities, processes and plants encompassed by the term manufacturing, it is necessary to classify individual establishments by industries, and thus reduce the number of separate categories with which we must deal. But even this reduction leaves us with some 300 industries, according to the classification in the 1929 Census of Manufactures. Before attempting to follow the trends in employment and output in individual industries, it is well, therefore, to classify these industries into major divisions (17 such groups are considered here ¹) and to make a brief survey of the statistics for the larger groups. This grouping paves the way for the more detailed description to follow by highlighting the major shifts within the broad field of manufacturing.



CONTRIBUTIONS OF THE GROUPS TO TOTAL FACTORY EMPLOYMENT AND OUTPUT

Of the 4.5 million wage earners employed in factories in 1899 almost one quarter were engaged in processing textiles (Chart 7). This group of industries, the largest in terms of

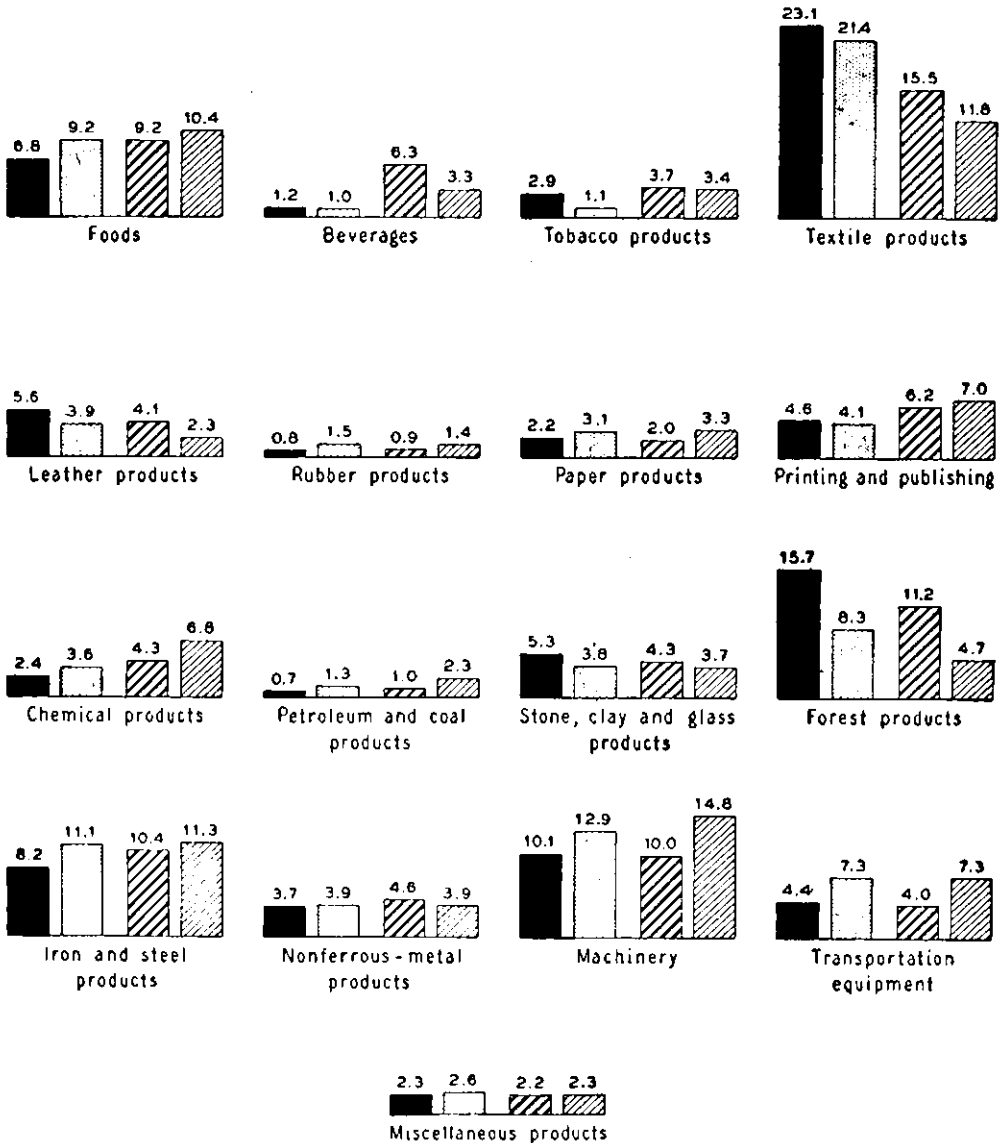
¹ The classification is similar but not quite identical with that in the Census itself; it follows the one adopted in *The Output of Manufacturing Industries, 1899-1937*.

Chart 7

MAJOR GROUPS OF MANUFACTURING INDUSTRIES
Relative Contributions to Wage-Earner Employment and
Value Added for All Manufacturing Industries Combined,
1899 and 1937

1899 1937
 Wage-earner employment
 Value added

Figures over columns indicate the percentage contribution to employment or value added



Based on Table B-1 and THE OUTPUT OF MANUFACTURING INDUSTRIES, 1899-1937, Table 9

employment, plus forest products and machinery, which ranked second and third respectively, accounted in combination for almost half of all factory wage earners.² Of least importance as employers were the groups manufacturing beverages, rubber products, and petroleum and coal products: all three had percentage contributions of one or less in 1899 (although each employed over 30 thousand wage earners in that year). By 1937, the latest peak year preceding the second World War, the industrial pattern of factory employment had changed considerably. Textiles still headed the list, but the forest products group now stood below iron and steel and machinery. The largest rise was in the relative contribution to total factory employment of transportation equipment and iron and steel products, the most severe decline in forest products.³

When measured in terms of value added by manufacture,⁴ the various groups appear in a somewhat different order. For 1899 the textile group leads in this classification as well, but its percentage share of the total is only 15.5. Forest products comes next, also with a lower relative contribution than in the case of employment, and it is followed not by machinery,

² The titles of the groups indicate with fair precision the character of the industries allocated to each. The groups are not entirely mutually exclusive because of unavoidable overlapping among establishments and industries in respect of product, material and process; but the degree of overlapping is slight in relation to the clear areas, and involves no duplication whatever. The chemical products group excludes those chemical industries which produce petroleum and coal products, since the latter are classified separately; and the machinery group excludes industries producing the class of machinery called transportation equipment. The miscellaneous group includes musical instruments, brushes, professional and scientific instruments, and so forth. The individual industries in each group are listed in full in Appendix B-1.

³ The discussion in this chapter is confined largely to wage earners since adequate data on other types of employment are difficult to obtain. In terms of total employment, that is, wage earners plus salaried personnel and proprietors, the relative standings of the various groups would be a little different from those shown in Chart 7. Information on the number of workers other than wage earners is presented in Appendices B-2 to B-5.

⁴ Value added by manufacture equals gross value of manufactured products minus cost of materials and fuel.

as in the employment breakdown, but by iron and steel products. The three largest groups together contributed less than two fifths to the total dollar product in 1899. In 1937 it is machinery which heads the list of contributors to aggregate value added by manufacture, with textiles now in second place and iron and steel again third.

The differences in the ranking of the several groups in respect of contributions to employment and to the dollar product of manufacturing suggest noteworthy variations from group to group in employment per unit of product and in the changes that occurred in this ratio between 1899 and 1937. In the following pages the shifts in the ratio are described in some detail.

TRENDS IN EMPLOYMENT PER UNIT OF PRODUCT

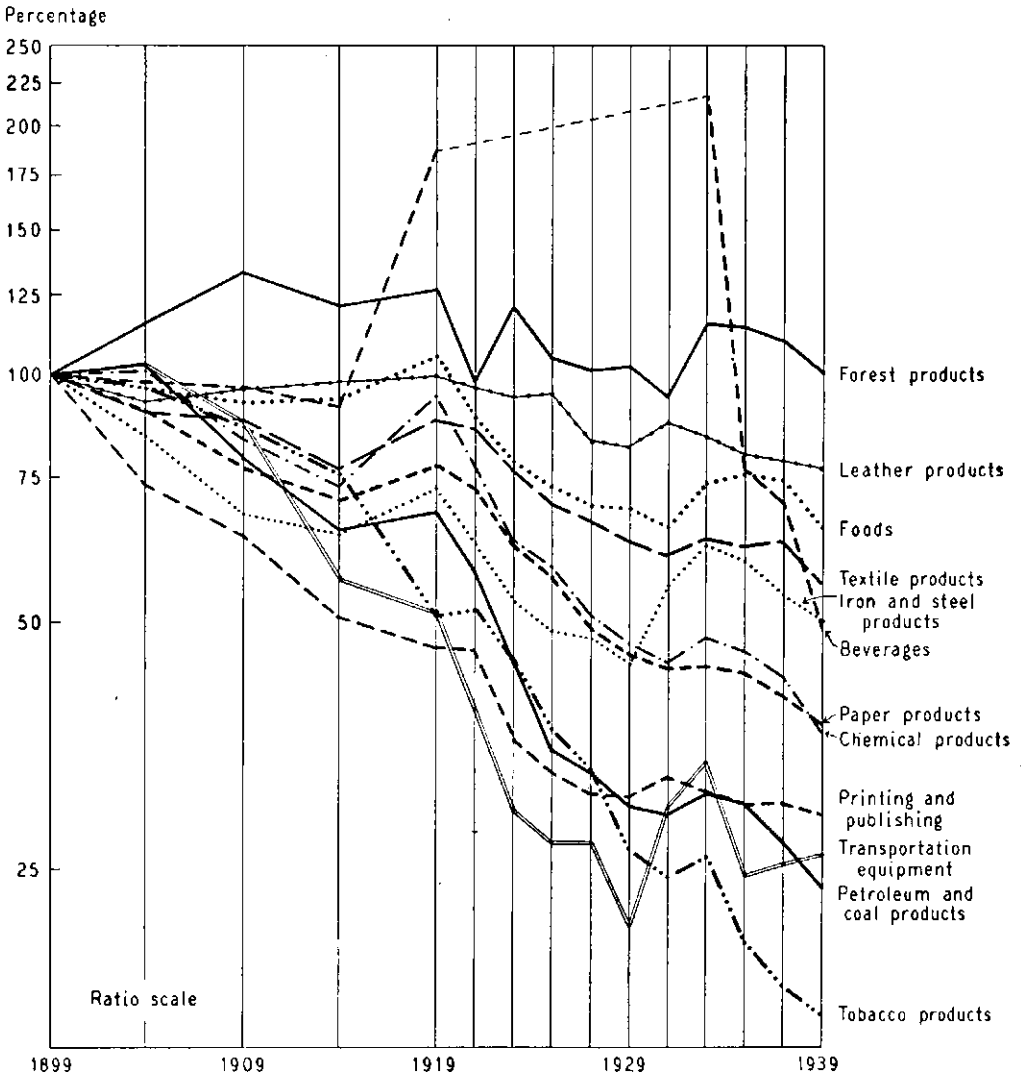
From 1899 onward, the number of workers employed in making a unit of product declined in all but one group for which we have information (Chart 8).⁵ That group was forest products, which showed a slightly rising trend.

The changes in wage earners per unit between 1899 and 1937 range over a wide scale, from a net rise for forest products of 10 percent to a drastic cut of 80 percent in the group of industries making tobacco products. Transportation equipment, petroleum and coal products, and printing and publishing were all characterized by extreme declines in the employment-output ratio: in 1937 these industrial groups employed only one fourth as many wage earners per unit of product as they had 38 years earlier. In the paper products

⁵ Indexes for the major groups, as well as for individual industries, are given for Census years only. Because annual data on employment, output, or both, are inadequate for most groups and industries, no attempt has been made to estimate indexes for intercensal years.

Chart 8

MAJOR GROUPS OF MANUFACTURING INDUSTRIES
 Number of Wage Earners Employed per Unit of Product
 (1899 : 100)



and chemicals groups the declines, though smaller, exceeded 50 percent; in all the remaining groups the cut in workers per unit was less than the 50 percent average for manufacturing as a whole.

INTERRELATIONS BETWEEN OUTPUT AND EMPLOYMENT

In practically all groups, as we have noted, employment declined in relation to output, but the kind of divergence between output and employment varied from group to group. By examining the separate series on employment and output (Chart 9), we can determine some of the relationships between these quantities.

There is clear evidence that in groups with sharply rising output the number of wage earners usually went up at a rapid pace. The greatest increases in both employment and production came in the industries manufacturing petroleum and coal products, and transportation equipment. Similarly, relatively slow growth in output was accompanied by lagging increase in employment. In forest products, which declined in output between 1899 and 1937, there was only a minute increase in employment; and in the leather group, whose production rose by a relatively small percentage, the rise of employment was slight as well. The outstanding exception to the general correlation is the tobacco products group, which attained a substantial increase in output while reducing the number of workers employed by 30 percent, a more drastic cut than has been observed for any other group.⁶

The addition of a series on employment per unit of product, when set beside those for output and number of workers, brings out another set of relationships among the major industrial groups. Though they are less easy to describe in a simple statement than the positive correlation between rising output and rising employment, these relationships, as the tabulation on page 36 shows,⁷ are just as meaningful for an interpretation of our industrial development. Thus the

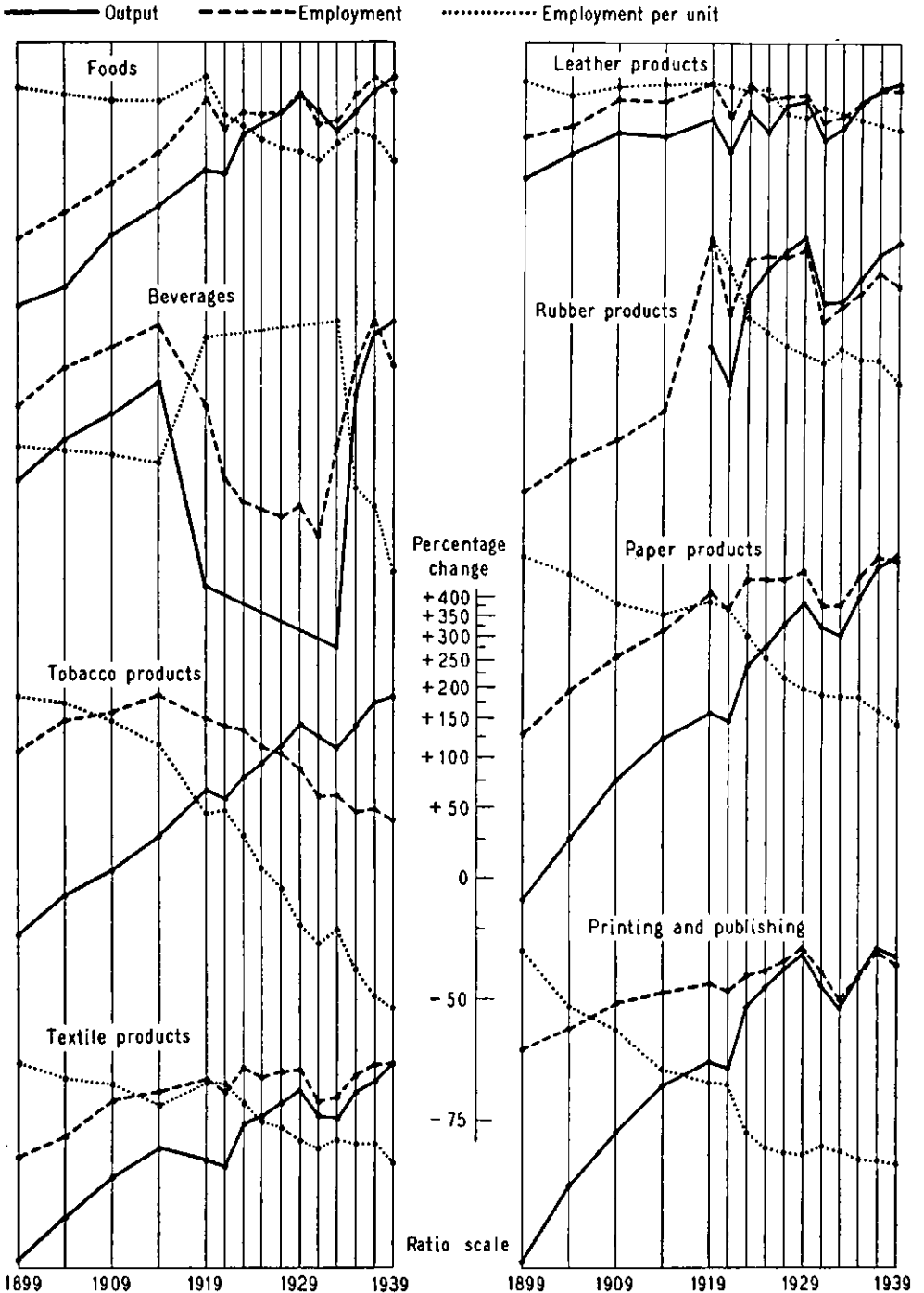
⁶ The unusual difference between trends in employment and output in tobacco manufacture is explained in part in the following section.

⁷ Computed from indexes presented in detail in Appendix F.

Chart 9

MAJOR GROUPS OF MANUFACTURING INDUSTRIES

Wage-Earner Employment, Physical Output, and Number of Wage Earners Employed per Unit of Product

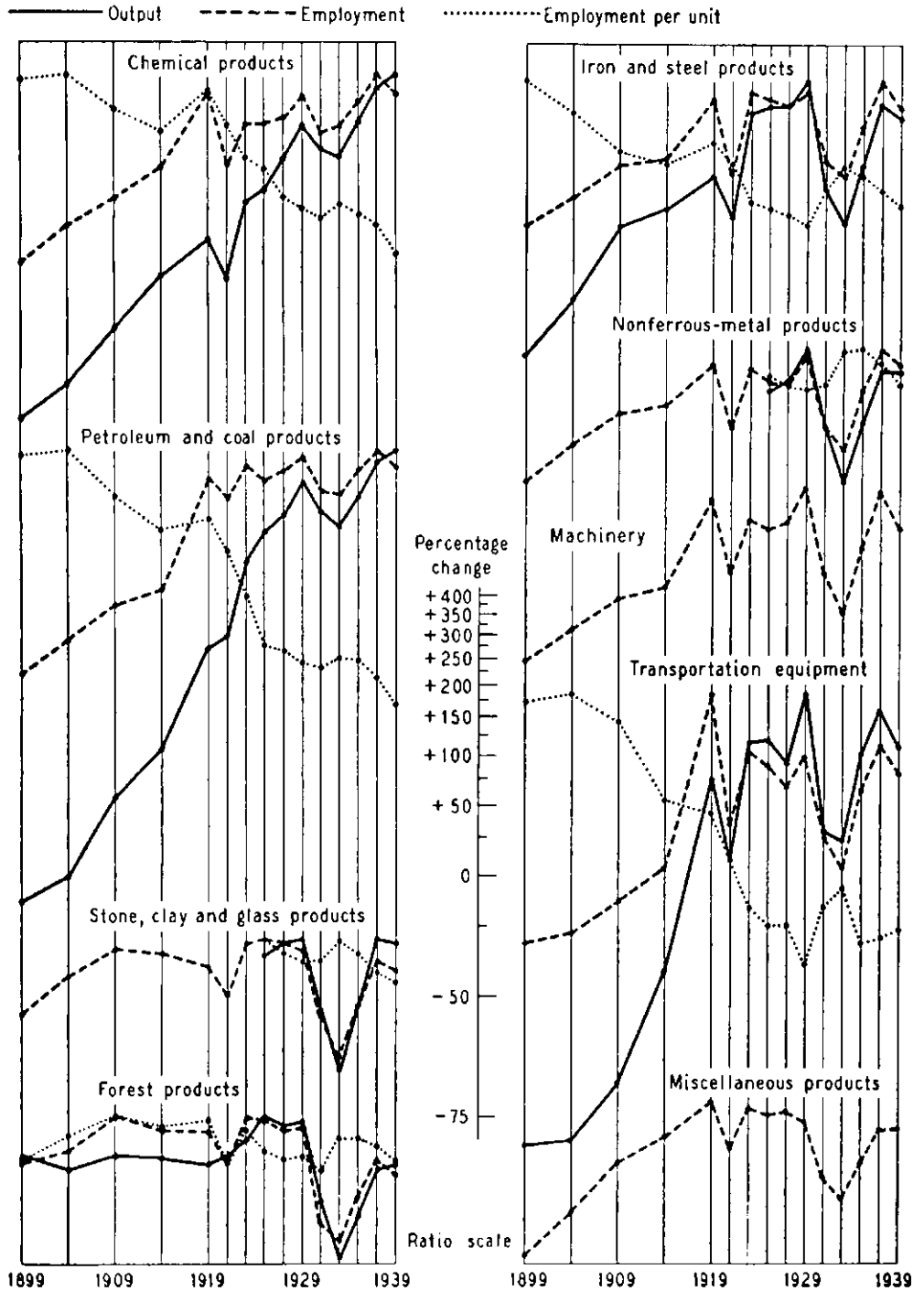


Based on Table F-1

Chart 9 (concl.)

MAJOR GROUPS OF MANUFACTURING INDUSTRIES

Wage-Earner Employment, Physical Output, and Number of Wage Earners Employed per Unit of Product



*Percentage Change in Relation to
Total Manufacturing, 1899 to 1937*

<i>Group</i>	Physical Output	Wage Earners	Wage Earners per Unit of Product
Forest products	-75	-47	+112
Leather products	-55	-30	+55
Beverages	-38	-15	+37
Textile products	-25	-8	+23
Foods	-8	+34	+46
Tobacco products	+5	-63	-65
Iron and steel products	+14	+21	+6
Printing and publishing	+58	-7	-41
Chemical products	+77	+49	-16
Paper products	+78	+44	-19
Transportation equipment	+231	+66	-50
Petroleum and coal products	+248	+84	-47

petroleum and coal products group, which is outstanding for its great increases in both output and employment, is characterized by an unusually sharp reduction in employment per unit. The same trend is observable for most of the expanding industrial groups. Again, rises in both output and employment less than those for total manufacturing, as in the case of forest products, have been associated with declines in employment per unit also less than the average. There are some exceptions, of course, but a fairly pronounced relationship can be traced over the 38-year period as a whole.

The foregoing conclusion applies to changes in group indexes in relation to corresponding changes in the indexes for total manufacturing. Something more may be said about the relation between changes (1899 to 1937) in output, employment and employment per unit taken by themselves, and not merely in comparison with the total indexes. Only in one group, tobacco products, was a reduction in unit labor requirements accompanied by an actual decline in number of workers employed. In ten of the twelve groups there was a net increase in employment despite the fact that the number of workers per unit fell rather considerably. In forest products, the lone group in which unit labor requirements

increased from 1899 to 1937, the number of jobs scarcely rose at all. It is reasonable to conclude, therefore, that the group indexes indicate no long-term tendency for employment to fall when the number of workers utilized per unit is reduced. On the contrary, large declines in employment per unit between 1899 and 1937 have usually been accompanied by substantial increases in employment and, of course, by even larger increases in output.

EFFECTS OF CHANGES IN THE COMPOSITION OF OUTPUT

Each of the major groups consists of several industries which differ from one another not only as to the character of the final product, but also as to the number of workers they employ per unit of product. Because of variation in the latter respect, a change merely in the composition of the output of a particular group may cause a shift in its employment-output ratio. In tobacco products, for example, if the cigarette industry (with its low ratio of workers employed to units produced) increased its output much faster than the cigar industry (in which the ratio is high) then the employment-output ratio for the two industries combined would have dropped even if there had been no change whatever in the number of workers employed per unit of product by either of them. From this instance alone it is clear that we cannot regard a change in a group's employment-output ratio simply as a direct reflection of corresponding changes in the ratios of the individual constituent industries. An alteration in the group's ratio of employment to output may, upon analysis, turn out to have been in some degree the result of a shift in the relative contributions of component industries to the output of the group as a whole.

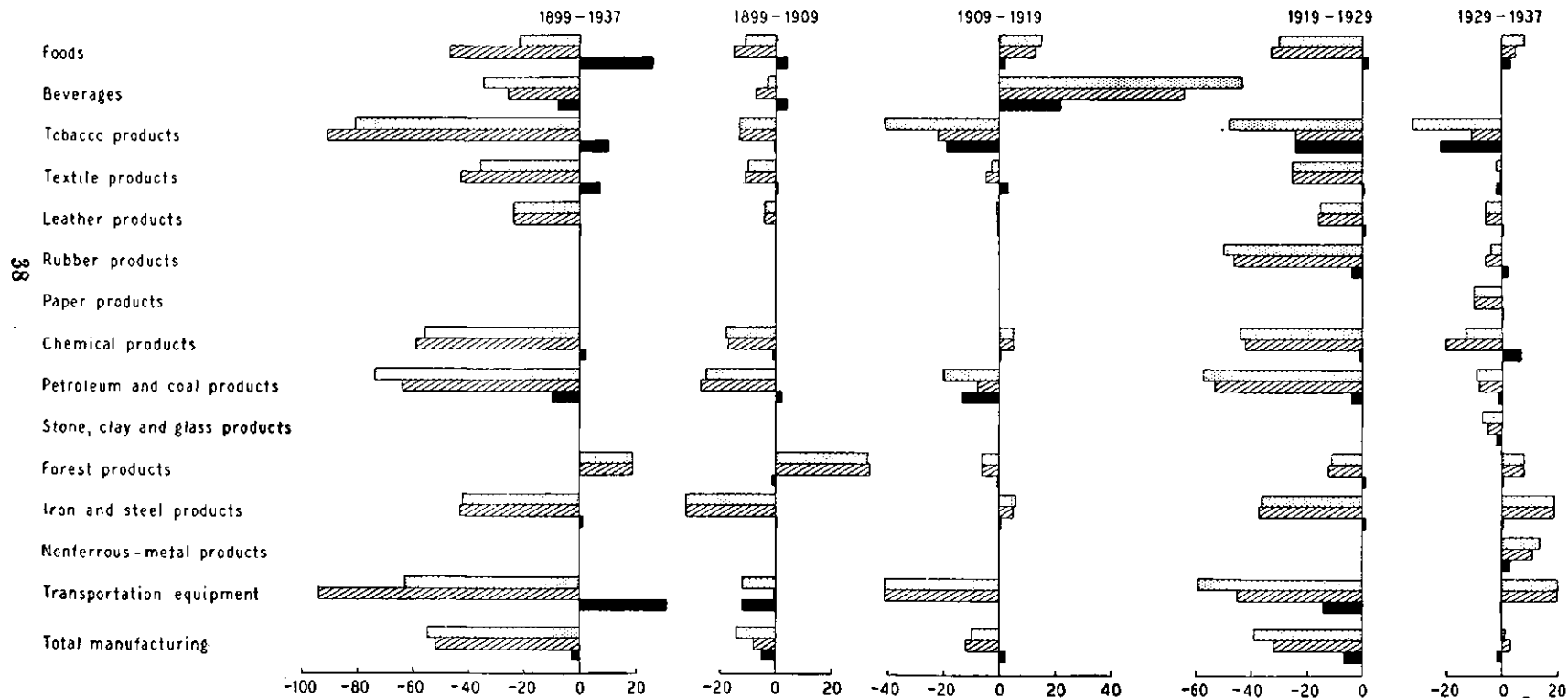
In Chart 10 the changes in employment per unit of product for the several groups and for all industries combined

Chart 10

MAJOR GROUPS AND TOTAL MANUFACTURING

Components of Percentage Change in Employment per Unit of Product, Selected Periods

- ▨ Total percentage change in wage earners employed per unit of product
- ▨ Percentage change in wage earners employed per unit reflecting average change in the corresponding ratios for individual industries
- Percentage change in wage earners employed per unit reflecting change in composition of group's output



Based on Table G-1

are broken down into two parts.⁸ One set of bars measures the effect of changes in the employment-output ratios of the individual industries, the other the effect of changes in the composition of their output.⁹ As the chart indicates, alterations in the industrial composition of output did have substantial influence on some of the group employment-output ratios, in several instances outweighing the effect of changes in the employment-output ratios of the component industries. For the tobacco products group the findings are particularly striking: in three periods half or more of the decline in wage earners per unit was accounted for by the rapid rise of cigarette manufacture at the expense of the industries

⁸ For a discussion of method see Appendix G. The ratios analyzed in Chart 10 differ slightly from those discussed earlier (see Appendix H).

Changes in the reciprocal of the employment-output ratio, i.e., the number of units of output produced per wage earner, also may be analyzed into two components: (1) change in the output-employment ratios for the individual industries, and (2) change in the relative contribution of each industry to total wage-earner employment. The results of this analysis would, of course, supply a different view of the facts described in the text.

As a general qualification of the sort of analysis summarized in Chart 10, it must be stated that the results obtained depend on the industrial classification provided by the Bureau of the Census. The more detailed the classification, the more informative will the analysis be. When a group or group sample consists of only one industry, as does printing and publishing, the second component will necessarily be of zero force. For this reason, some of the groups appearing earlier in this chapter are not listed in Chart 10.

⁹ Since units of physical output differ among industries, it has been necessary to reduce them to a common denominator for purposes of measurement. In one industry the unit may be a motorcar selling for several hundred dollars, in another it may be a ton of sulphuric acid worth 8 dollars, or a yard of rayon goods valued at less than a dollar. To circumvent this difficulty we have defined a unit of output as the physical quantity valued at \$1 (or to which \$1 of value has been added) in some selected period called the "weight-base." Units in different industries, when thus defined, are therefore comparable with one another since they all represent a value of \$1 in the selected period. (The unit may, of course, be defined as \$10,000 worth, as well as \$1 worth, so long as it is the same for all groups.)

The weight-base periods are the same as those used in the construction of our indexes of physical output, namely, the average of the pair of years compared. That is, our unit in the comparison of 1919 with 1929 is the quantity of product which, when multiplied by $\frac{1}{2}(p_{29} + p_{19})$, amounts to \$1. See *The Output of Manufacturing Industries, 1899-1937*, p. 80, footnote 10, for a more detailed explanation.

producing cigars and smoking and chewing tobacco.¹⁰ The cigarette industry, as already noted, employs relatively few workers per \$10,000 of products; the industries making cigars and other tobacco products, which require the labor of many more workers for the same dollar amount of output, failed to raise their levels of production from 1899 to 1937. And in the case of another industry, transportation equipment, virtually the entire decline of 12 percent in wage earners per unit from 1899 to 1909 is attributable to the increased importance of automobiles, rather than to any reduction in the employment-output ratios of the individual industries making up the group.

The average change in labor per unit in the component industries was uniformly of the same sign as the change in the ratio for the group. This was not true of those changes in a group's unit labor consumption that were caused by shifts in the composition of group output. These shifts sometimes acted as a counterforce, making the decline in the group ratio less steep than it would have been if the composition of output had remained constant. In the food group, for example, workers per unit dropped 22 percent from 1899 to 1937. During this period the constituent food industries actually cut labor per unit by as much as 47 percent on the average, but at the same time several of those with large unit labor requirements increased their shares in the group's output, causing a rise of 26 percent in workers per unit of output for the group as a whole. The 22 percent decline, then, is the net result (rounded off) of a drop of 47 percent and an increase of 26. A similar situation is found in the transportation equipment group for the same period. During

¹⁰ It is almost certain that if as much detail were available for the tobacco products group for the comparison of 1899 with 1937 and for 1899-1909 as for the later short periods (i.e., if data on employment were available for cigars and cigarettes separately in 1899), the second component for this group would be found to be more important than, or as important as, the first in all periods.

the 38 years the average decline in employment per unit for the group was 63 percent, a reflection not only of the average decline in the employment-output ratios of the various transportation equipment industries, but also of the development of the motorcar at the expense of other means of transportation. The automobile industry employed 6.5 workers per \$10,000 of product, the carriage and wagon industry 5.7 workers, the railroad car industry 5.2, locomotive construction 3.6, and shipbuilding 5.5.¹¹ The decline of 63 percent in workers per unit of transport equipment, though large, ranks the group only in third place in this respect; it follows tobacco and petroleum products, in which the corresponding changes in employment per unit of product between 1899 and 1937 were 81 and 74 percent respectively. If the effect of the shift in the relative importance of motorcars were excluded, however, the average decline in employment per unit in the transport equipment group would be 94 percent, much larger than the corresponding cut for any other group.¹²

As we have just noted, shifts in composition of output were frequently significant. Yet the general impression derived from a study of Chart 10 as a whole is that changes in the

¹¹ These figures represent the average of 1899 and 1937. In 1937, of course, the number of workers employed in automobile fabrication per \$10,000 of value added (valued at the mean of 1899 and 1937 prices) was far smaller than the corresponding numbers in the other transportation equipment industries: only 1.4 as against 4.6, 6.0, 5.0, and 6.8. In 1899, however, the figure for motorcar production was 11.6 workers per \$10,000, compared with 6.9, 4.3, 2.2 and 4.2, respectively, in the other industries included in the group.

¹² Although we have distinguished between the effect of changes in the industrial pattern of production and the effect of changes in employment per unit of product, we must confess that the separation is in an important sense artificial. The situation is similar to that encountered in a breakdown of changes in values into changes in prices and in quantities, where it is necessary to assume that the prices and quantities are independent of one another. Just as this assumption falls short of strict validity, so also does the assumption that changes in the pattern of production may be divorced from changes in employment per unit of product. The evidence cited earlier (Chart 9 and the tabulation on p. 36) hints at a relationship, to be developed in Chapter 4, between changes in employment per unit and changes in relative contributions to output.

number of wage earners employed per unit were, in most groups and in most periods, the result of corresponding changes in the employment-output ratios for the individual industries making up the group samples. As a rule, then, the change in a group employment-output ratio was substantially equal to the weighted average change in the corresponding ratios for the individual industries comprising the group. These ratios for individual industries are discussed in the following chapter.

Chapter 3

Labor per Unit of Product in Individual Industries

THE factors making for change in the ratio of employment to product have acted on all industries, but in varying degree. For this reason the trends in labor per unit have differed not only among groups of manufacturing industries, as we observed in the preceding chapter, but also among industries within the same group. These movements are examined in the present chapter.

INDUSTRIAL VARIATION AMONG TRENDS IN LABOR PER UNIT

The reader may recall from Chapter 1 that by 1937, in all manufacturing industries combined, the number of workers employed per unit of product had dropped to approximately one half of the number required to produce the same amount of goods in 1899. This average for manufacturing in the aggregate conceals wide variations from industry to industry. Thus Chart 11, which provides a summary of the indexes of workers per unit for 51 industries (the only ones for which data spanning the period 1899–1937 are available) shows an index of less than 20 percent at one extreme and an index of 225 at the other. The majority of the 51 industries are found within a fairly wide belt: in the middle two thirds, representing 33 industries, the ratio of labor to product in 1937 ranged from less than 40 percent to about 90 percent of the 1899 ratio. In only 8 of the 51 industries are indexes of employment per unit of product found above the 1899 level.

The details are presented in Table 1 (pp. 47-51). Besides the industries covered in the chart, for which data are available for 1899 and 1937, many others with series which do not go all the way back to 1899 or forward to 1937 appear here, as do also several for which we have been able to push our indexes even farther back than 1899. This table differs further from Chart 11 in that the measures represent average annual percentage rates of change in wage earners per unit, rather than indexes for 1937 relative to 1899.

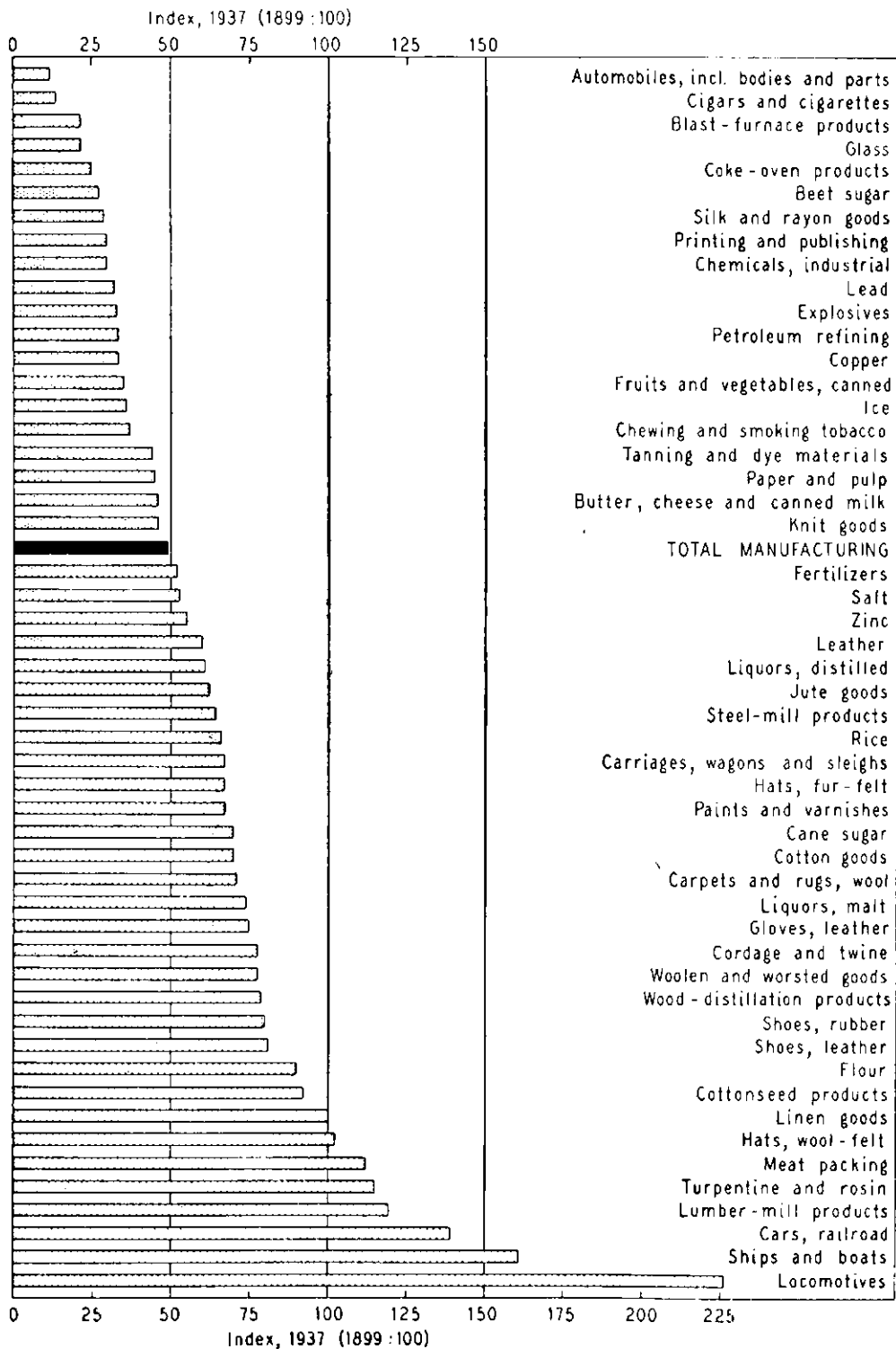
There was a variety of trends in employment per unit of output not only within manufacturing as a whole, as was indicated by Chart 11, but also within each of the major categories into which the individual industries are grouped in Table 1. Among the industries in the food group, for example, the most rapid rate of decline over the period 1899-1937 was 3.5 percent per annum in beet sugar manufacture, while in meat packing during the same period there was an average annual rise of 0.3 percent. An even more striking illustration of wide dispersion is provided by the transportation equipment group: in automobiles there was an average annual decline of 5.4 percent and in locomotives an annual rise of 2.2 percent between the years 1899 and 1937. These two industries producing transportation equipment are, of course, the extremes which are found also in Chart 11.

The addition of industries for which the indexes apply to less than 38 years provides some instances of decline in labor per unit even more spectacular than that found in automobile manufacture. In three of the industries for which the period covered is shorter than 38 years—nonalcoholic beverages, knit cloth, and pens and penpoints—the annual rate of decline exceeded 10 percent. Nevertheless when we add up all the industries for which data are available, including those for which the series apply to more as well as less than 38 years, the proportion with increases in wage earners per

Chart 11

INDIVIDUAL MANUFACTURING INDUSTRIES

Index of Wage Earners Employed per Unit of Product, 1937 (1899 : 100)



Based on Table 1

unit goes up. Whereas among the industries which appear in Chart 11 (covering 1899–1937) less than 14 percent showed rises in the employment-output ratio, among the entire collection of industries for which there are data (here the periods covered range from 1869–1939 in some industries to 1931–1939 in one) the percentage of those with rises in the ratio of workers to product is almost 19. This increased proportion may be explained by the fact that most of the added indexes are rather short series which cover only the more recent years (1927 or 1929 to 1937 or 1939) during which there was little decline, on the average, in wage earners per unit. The longer series cover not only this period of little change but also preceding periods during which employment per unit declined rapidly. The differences between the last two columns of Table 1 therefore reflect primarily the presence of fluctuations in the rate of decline in employment per unit. These fluctuations will be considered later in this chapter.¹

Rises in employment in relation to output must reflect cuts in the work week, or increases in the number of man-hours required per unit of product, or both. As we have already seen, reductions in hours per week occurred in manufacturing considered as a whole. There were cuts also in every

¹ A word must be said about total employment (including proprietors and salaried personnel as well as wage earners) per unit of product. Total employment offered by all manufacturing industries combined rose a little more rapidly during the last four decades than did the number of wage earners alone. For this reason all workers per unit of product fell a little less rapidly than wage earners per unit. The close correspondence is found not only in aggregate manufacturing, but also in individual industries. Total employment per unit fell a little less rapidly (or rose a little more rapidly) than wage earners per unit in 33 out of 61 industries, was equal to the latter in one industry, and fell somewhat more rapidly (or rose a little less rapidly) in 27 industries. In practically all cases the differences between the two were slight. Only in one industry was there a difference of sign: in wire manufacture wage earners declined slightly in relation to output, while total employment rose. (The preceding comparison relates to the period 1909–37. The complete series for individual industries, available at best for 1904–39, appear in Appendix F.)

TABLE 1

INDIVIDUAL MANUFACTURING INDUSTRIES

Average Annual Percentage Changes in Wage Earners per Unit of Product

Industry	Number of Wage Earners Employed in 1929 (1,000)	Period Covered	Average Annual Percentage Rate of Change	
			In Period Covered	1899- 1937
<i>Foods</i>				
Meat packing	122	1879-1939	0.5	0.3
Sausage	6	1929-1939	-1.7	
Oleomargarine	2	1925-1939	-6.5	
Shortenings	3	1927-1939	1.4	
Flour	27	1869-1939	-0.9	-0.3
Feeds	10	1927-1939	1.2	
Cereals	6	1925-1939	1.4	
Rice	2	1899-1939	-1.2	-1.1
Macaroni	5	1927-1939	-0.6	
Bread and cake	167	1923-1939	1.1	
Biscuits and crackers	34	1923-1939	-3.1	
Fish, canned	14	1904-1939	0.6	
Fruits and vegetables, canned	99	1899-1939	-3.1	-2.7
Butter, cheese and canned milk	30	1899-1939	-2.2	-2.0
Milk, canned	7	1904-1939	-4.3	
Butter	19	1904-1939	-1.8	
Cheese	3	1904-1939	-0.9	
Ice cream	22	1923-1939	-4.9	
Beet sugar	7	1899-1939	-3.5	-3.5
Cane sugar, total	16	1899-1939	-0.8	-1.0
Cane sugar, not elsewhere made	2	1909-1939	-1.1	
Cane-sugar refining	14	1909-1939	-0.0	
Confectionery	64	1925-1939	-3.3	
Chocolate	6	1921-1939	-5.0	
Corn products	7	1909-1939	-1.3	
Baking powder	3	1927-1939	-0.1	
Ice	32	1899-1939	-2.9	-2.7
<i>Beverages*</i>				
Liquors, malt	b	1899-1939	-1.3	-0.8
Liquors, distilled	1	1899-1939	-1.1	-1.3
Malt	1	1925-1939	-0.7	
Liquors, vinous	*	1923-1939	-8.5	
Beverages, nonalcoholic	28 ^b	1931-1939	-10.4	
<i>Tobacco products</i>				
Cigarettes and cigars	105	1899-1939	-5.0	-5.0
Cigarettes	21	1904-1939	-5.9	
Cigars	84	1869-1939	-1.0	
Chewing and smoking tobacco	11	1899-1939	-2.4	-2.6

For footnotes see page 51.

TABLE 1 (continued)

INDIVIDUAL MANUFACTURING INDUSTRIES

Average Annual Percentage Changes in Wage Earners per Unit of Product

Industry	Number of Wage Earners Employed in 1929 (1,000)	Period Covered	Average Annual Percentage Rate of Change	
			In Period Covered	1899- 1937
<i>Textile products</i>				
Cotton goods	425	1869-1939	-1.4	-0.9
Lace goods	7	1914-1939	-2.9	
Woolen and worsted goods	147	1879-1939	-0.7	-0.6
Woolen goods	58	1909-1931	-0.4	
Worsted goods	88	1909-1931	-0.2	
Silk and rayon goods	130	1879-1939	-3.4	-3.2
Knit goods, total	208	1869-1939	-1.8	-2.0
Hosiery, knit	130	1923-1939	-2.4	
Underwear, knit	41	1923-1939	-2.0	
Outerwear, knit	29	1923-1939	-2.8	
Cloth, knit	8	1923-1931	-10.7	
Carpets and rugs, wool	33	1899-1939	-1.2	-0.9
Asphalted-felt-base floor covering and linoleum	8	1919-1939	-2.0	
Asphalted-felt-base floor covering	2	1921-1937	-2.4	
Linoleum	6	1921-1937	-0.1	
Oilcloth and artificial leather	4	1923-1939	-1.5	
Oilcloth	1	1904-1937	0.8	
Artificial leather	3	1923-1937	-0.8	
Cordage and twine	14	1899-1939	-1.0	-0.7
Jute goods	5	1899-1939	-1.7	-1.3
Linen goods	2	1899-1939	0.2	0.1
Clothing, men's, incl. work clothing	189	1927-1939	0.3	
Gloves, textile	9	1927-1939	2.2	
Shirts and collars, men's	63	1927-1939	0.4	
Clothing, women's	188	1927-1939	0.6	
Corsets	14	1927-1937	-0.9	
Handkerchiefs	6	1927-1939	-1.8	
Elastic woven goods	4	1927-1939	-3.0	
Hats, fur-felt	16	1899-1939	-1.3	-1.0
Hats, cloth	6	1927-1937	0.0	
Hats, straw, men's	3	1927-1939	-1.3	
Hats, wool-felt	2	1879-1939	-0.3	0.1
Wool shoddy	2	1889-1933	-1.5	
<i>Leather products</i>				
Leather	50	1889-1939	-0.7	-1.3
Shoes, leather	206	1869-1939	-0.9	-0.6
Gloves, leather	9	1899-1939	-0.9	-0.8
Belting, leather	3	1927-1939	1.1	

<i>Industry</i>	<i>Number of Wage Earners Employed in 1929 (1,000)</i>	<i>Period Covered</i>	<i>Average Annual Percentage Rate of Change</i>	
			<i>In Period Covered</i>	<i>1899- 1937</i>
<i>Rubber products</i>				
Shoes, rubber	26	1899-1939	-0.7	-0.6
Rubber goods, other, incl. tires and tubes	123	1919-1939	-4.3	
Tires and Tubes	83	1921-1939	-4.3	
Rubber goods, other	40	1927-1939	-1.6	
<i>Paper products</i>				
Paper and pulp	128	1879-1939	-2.7	-2.1
Paper	103	1927-1939	-1.8	
Pulp	25	1927-1939	-3.7	
Wall paper	5	1929-1939	-1.5	
<i>Printing and publishing</i>				
Total	358	1899-1939	-3.0	-3.1
<i>Chemical products</i>				
Chemicals, industrial, incl. rayon and compressed gases	105	1899-1939	-3.4	-3.1
Chemicals, industrial	62	1927-1939	-3.4	
Gases, compressed	3	1927-1939	-4.0	
Rayon	39	1923-1939	-7.8	
Cottonseed products	16	1899-1939	-0.5	-0.2
Linseed products	3	1923-1939	-0.5	
Carbon black	2	1914-1939	-4.3	
Soap	14	1904-1939	-2.3	
Wood-distillation products and charcoal	5	1921-1939	-2.9	
Wood-distillation products	5	1899-1937	-0.6	-0.6
Charcoal	*	1921-1937	-1.4	
Explosives	6	1889-1939	-2.5	-2.9
Fertilizers	21	1899-1939	-1.7	-1.7
Glue and gelatin	3	1927-1939	-2.5	
Paints and varnishes	29	1899-1939	-1.3	-1.0
Salt	6	1869-1939	-1.8	-1.7
Tanning and dye materials	2	1899-1939	-2.6	-2.2
<i>Petroleum and coal products</i>				
Petroleum refining	81	1879-1939	-3.6	-2.8
Coke-oven products	21	1879-1939	-2.2	-3.6
Fuel briquettes	*	1909-1939	-1.9	

TABLE 1 (concluded)

INDIVIDUAL MANUFACTURING INDUSTRIES

Average Annual Percentage Changes in Wage Earners per Unit of Product

Industry	Number of Wage Earners Employed in 1929 (1,000)	Period Covered	Average Annual Percentage Rate of Change	
			In Period Covered	1899- 1937
<i>Stone, clay and glass products</i>				
Asbestos products	8	1927-1937	1.7	
Roofing	6	1929-1939	0.5	
Cement	33	1904-1939	-2.9	
Lime	9	1904-1939	-1.5	
Wallplaster and board	7	1927-1939	-1.1	
Concrete products	16	1925-1939	-3.8	
Sand-lime brick	1	1914-1939	-2.4	
Clay products	93	1914-1939	-0.9	
Glass	68	1899-1939	-3.7	-3.8
<i>Forest products</i>				
Lumber-mill products	419	1899-1939	0.2	0.5
Planing-mill products	90	1925-1939	-0.7	
Boxes, wooden, cigar	4	1927-1939	-1.4	
Cooperage	11	1927-1939	1.6	
Caskets and coffins	13	1927-1939	-2.0	
Excelsior	1	1925-1939	0.3	
Turpentine and rosin	40	1899-1939	-0.3	0.4
<i>Iron and steel products</i>				
Blast-furnace products	25	1889-1939	-3.4	-3.9
Steel-mill products	395	1869-1939	-2.2	-1.2
Wire	22	1909-1939	-0.4	
Wrought pipe	11	1925-1939	0.6	
Cast-iron pipe	20	1914-1939	0.4	
Files	4	1929-1939	0.1	
Firearms	7	1921-1939	-3.1	
Tin cans and tinware	32	1927-1939	-4.6	
<i>Nonferrous-metal products</i>				
Primary nonferrous metals	31	1899-1939	-2.5	
Copper	14	1899-1937	-2.8	-2.8
Lead	5	1899-1937	-3.0	-3.0
Zinc	12	1899-1937	-1.6	-1.6
Secondary metals, nonprecious	4	1925-1939	-0.3	
Collapsible tubes	2	1925-1939	-2.1	
Nonferrous-metal products, not elsewhere classified	79	1925-1939	-0.9	
Clocks, watches, and materials	21	1927-1939	-1.9	

Industry	Number of Wage Earners Employed in 1929 (1,000)	Period Covered	Average Annual Percentage Rate of Change	
			In Period Covered	1899- 1937
<i>Machinery</i>				
Agricultural implements	42	1921-1931	2.6	
Phonographs	14	1899-1929	-0.4	
Refrigerators, mechanical	17	1927-1939	-9.6	
Scales and balances	4	1927-1937	-2.2	
Sewing machines	10	1927-1939	0.8	
Typewriters	17	1921-1937	-1.6	
Washing and ironing machines	8	1927-1939	-5.3	
<i>Transportation equipment</i>				
Automobiles, incl. bodies and parts	447	1899-1939	-5.1	-5.4
Carriages, wagons and sleighs	3	1889-1939	-1.1	-1.0
Cars, railroad	40	1899-1939	1.6	0.9
Locomotives	11	1889-1939	2.4	2.2
Ships and boats	55	1899-1939	0.7	1.3
Motorcycles and bicycles	4	1899-1929	-3.4	
Carriages and sleds, children's	7	1925-1939	-3.0	
<i>Miscellaneous products</i>				
Organs	2	1904-1935	-0.3	
Pianos	10	1904-1939	-2.3	
Buttons	9	1914-1939	-2.2	
Brooms	5	1927-1939	-0.3	
Pencils	6	1929-1939	-4.5	
Pens and points	5	1929-1939	-10.6	
Sporting goods	11	1929-1939	-0.3	

Source: Number of wage earners from data in Appendix Table B-1. Rates of change based on the indexes given in detail in Appendix F.

* 500 or less.

^a Employment in the legal liquor industries was very low in 1929 because of enforcement of the prohibition amendment. In 1937 wage-earner employment was as follows:

	(1,000)
Liquors, malt	47
Liquors, distilled	6
Malt	2
Liquors, vinous	3
Beverages, nonalcoholic	28

^b The malt liquor industry was not shown separately in 1929; it was included in nonalcoholic beverages.

individual industry of which we have record. The most comprehensive data available for individual industries, the Census reports on full-time hours for 1909 (adjusted roughly to an actual-time basis) and the Census and Bureau of Labor Statistics data on hours actually worked in 1937, indicate that all of 38 separate industrial series on hours declined from 1909 to 1937 (Table 2). The decline in hours per week was as large, in one case, as 24 hours (or 38 percent of the 1909 figure), and in none was it less than 9 hours (or 18 percent of the 1909 level).

The cuts in hours help to explain why the employment-output ratios of some industries failed to drop. It is true that reductions in hours tend to cause declines in manhours per unit of product by enhancing labor efficiency. But in the exceptional industries which did not reduce the employment-output ratio this indirect influence apparently was too weak (taken together, of course, with other factors affecting manhours per unit) to negate the direct effect upon employment of reductions in hours. As we see when we combine the information on changes that occurred in the length of the work week with what we know about workers per unit, and thus measure changes in manhours per unit (Table 3), the reduction in manhours per unit was so slight in some industries that there the decline in hours was sufficient to cause employment (in terms of number of workers) to rise in relation to output.

In view of the industrial variation with respect to curtailment of working time, it is pertinent to inquire whether hours were cut most severely in the industries which effected the greatest reduction in number of workers per unit and much less drastically in those which achieved only slight declines. Recourse to the data reveals no very significant correlation between long-term changes in hours in individual industries and corresponding changes in employment per

TABLE 2

INDIVIDUAL MANUFACTURING INDUSTRIES

Hours Worked per Week per Wage Earner, 1909 and 1937

Industry ^a	1909	1937	Change	
			Number	Percent
Cement	61	38	-23	-38
Cane-sugar refining	60	38	-22	-38
Carpets and rugs, wool	53	33	-20	-38
Blast-furnace products	66	42	-24	-36
Cotton goods	55	35	-20	-36
Woolen and worsted goods	54	34	-20	-36
Knit goods	54	35	-19	-35
Petroleum refining	55	36	-19	-34
Automobiles, incl. bodies and parts	53	35	-18	-34
Silk and rayon goods	53	35	-18	-34
Hats, fur-felt	50	33	-17	-34
Steel-mill products	57	38	-19	-33
Chemicals, industrial, incl. rayon and gases	58	39	-19	-32
Zinc	58	39	-19	-32
Canned fish, fruits and vegetables	56	38	-18	-32
Wire	55	37	-18	-32
Shoes, leather	52	36	-16	-31
Glass	52	36	-16	-31
Sugar, beet	64	45	-19	-30
Tobacco products, total	50	35	-15	-30
Paper and pulp	58	41	-17	-29
Fertilizers	57	40	-17	-29
Leather	54	38	-16	-29
Soap	52	38	-14	-29
Ships and boats	52	37	-15	-28
Liquors, distilled	55	40	-15	-27
Explosives	55	40	-15	-27
Cars, railroad	53	39	-14	-27
Lime	57	42	-15	-26
Lead	55	42	-13	-24
Meat packing	54	41	-13	-24
Flour	57	44	-13	-22
Lumber-mill products	56	43	-13	-22
Locomotives	56	44	-12	-21
Paints and varnishes	52	41	-11	-21
Cottonseed products	65	52	-13	-20
Printing and publishing, total	47	38	-9	-19
Copper	55	45	-10	-18

Source: Appendix Table C-2. Only those industries for which indexes of physical output are available are listed here.

^a Ranked according to percentage change in hours.

TABLE 3

INDIVIDUAL MANUFACTURING INDUSTRIES

Aggregate Wage-Earner Hours and Wage Earners Employed per Unit of Product: Percentage Changes, 1909-37^a

<i>Industry^b</i>	<i>Total Change</i>		<i>Average Annual Rate of Change</i>	
	<i>Wage-Earner Hours per Unit</i>	<i>Wage Earners per Unit</i>	<i>Wage-Earner Hours per Unit</i>	<i>Wage Earners per Unit</i>
Automobiles, including bodies and parts	-92	-87	-8.5	-7.1
Tobacco products, total	-85	-79	-6.7	-5.5
Glass	-78	-68	-5.3	-4.0
Silk and rayon goods	-77	-66	-5.1	-3.7
Blast-furnance products	-75	-60	-4.8	-3.2
Chemicals, industrial, incl. rayon and gases	-73	-61	-4.6	-3.3
Liquors, distilled	-67	-54	-3.9	-2.8
Knit goods	-67	-49	-3.9	-2.4
Beet sugar	-65	-51	-3.7	-2.5
Petroleum refining	-64	-45	-3.6	-2.1
Printing and publishing, total	-62	-53	-3.4	-2.7
Cement	-61	-38	-3.3	-1.7
Paper and pulp	-61	-45	-3.3	-2.1
Canned fish, fruits and vegetables	-60	-41	-3.2	-1.9
Explosives	-59	-43	-3.1	-2.0
Copper	-56	-46	-2.9	-2.2
Soap	-55	-39	-2.8	-1.8
Lead	-55	-41	-2.8	-1.9
Leather	-54	-35	-2.8	-1.5
Fertilizers	-54	-35	-2.8	-1.6
Lime	-54	-37	-2.7	-1.6
Carpets and rugs, wool	-51	-22	-2.5	-0.9
Cotton goods	-50	-22	-2.4	-0.9
Hats, fur-felt	-47	-20	-2.3	-0.8
Zinc	-45	-20	-2.1	-0.8
Shoes, leather	-43	-19	-2.0	-0.7
Woolen and worsted goods	-42	-13	-2.1	-0.5
Cane-sugar refining	-42	-8.2	-2.0	-0.3
Steel-mill products	-40	-11	-1.8	-0.4
Paints and varnishes	-39	-24	-1.8	-1.0
Flour	-37	-20	-1.7	-0.8
Lumber-mill products	-32	-12	-1.4	-0.5
Wire	-32	0.9	-1.3	0.0
Cottonseed products	-31	-14	-1.3	-0.5
Cars, railroad	-21	4.9	-0.9	0.2
Meat packing	-17	11	-0.6	0.4
Ships and boats	0.8	41	0.0	1.2
Locomotives	142	209	3.2	4.1

Footnotes to Table 3 at bottom of next page.

unit of product. The amount by which hours were reduced in industries that cut employment per unit sharply differed only slightly from the amount by which hours were shortened in industries that lagged in decreasing employment per unit.² This does not mean that long-run declines in hours are entirely unrelated to changes in employment per unit; it points rather to the universality of the cut in the working week among all types of industries, including those with low rates of decline in manhours per unit.³

Manhours per unit of product fell in all but two of the industries for which we have reasonably adequate information. The exceptions are locomotive manufacture and shipbuilding, which were found among the eight industries listed above (Chart 11) as those in which *workers* per unit of prod-

² The coefficient of rank correlation between changes in hours (Table 2) and changes in workers per unit (Table 3) is .19 for 38 industries.

³ Much the same phenomenon seems to characterize hourly earnings, as we shall see in Chapter 4.

Source: Appendix F.

^a For several industries not listed in Table 3, or not shown separately, there are available data on manhours per unit for somewhat shorter periods; see Appendix F.

For a few industries the 1909 Census data on full-time hours may be carried back to 1899 by indexes based on samples collected by the Bureau of Labor Statistics (see source cited in Appendix C). Indexes of manhours per unit for these industries may therefore be computed for 1899-1937 and percentage changes between these years determined:

Industry	Total Percentage Change, 1899-1937		
	Wage Earners per Unit of Product	Hours per Week	Manhours per Unit of Product
Meat packing	12	-24	-15
Cotton goods	-30	-38	-56
Knit goods	-54	-38	-71
Silk and rayon goods	-71	-35	-81
Shoes, leather	-19	-33	-46
Lumber-mill products	19	-25	-10
Printing and publishing, total	-70	-25	-78
Cars, railroad	39	-30	-2.0
Steel-mill products	-36	-32	-57

^b Ranked according to change in aggregate wage-earner hours per unit.

uct rose. As for the other six, when labor is measured in terms of manhours instead of men, we find that they too are to be classed with the industries which reduced the amount of factory work needed to turn out a unit of product.⁴

Both locomotives and ships improved substantially in quality. No doubt the exceptional position in Table 3 of the industries manufacturing these products is to be attributed in some degree to our inability to take statistical account of such advances. The average tractive power of steam locomotives in operation on American railroads rose from 27 thousand pounds in 1910 to 49 thousand in 1937, indicating a very considerable increase in the power of new locomotives produced. And this, of course, points merely to one of many improvements. It is likely that a similar explanation applies to some of the other industries that lagged in reducing labor per unit of output; railroad cars and even meat-packing products have undergone considerable quality change requiring the expenditure of labor effort.⁵

Even the most drastic declines shown in Table 3 may

⁴ For the industries producing linen goods, wool-felt hats, and turpentine and rosin, no data on hours are available for 1937. Here, however, the increases in wage earners per unit were slight. Even a comparatively moderate decline in the hours worked in these industries (say, a decline of 18 percent, the smallest in Table 2) would mean a reduction in manhours per unit.

⁵ It is possible, too, that industries engaged in producing locomotives, ships and railroad cars have been changing the character of the materials they assemble into the final products. If the parts they require were formerly machined in other industries but then came to be machined in the assembly industries themselves, we should expect this increasing burden to be reflected in a rise in manhours of work relative to the number of units of final product. This sort of trend might be caused simply by change in the definitions of the various industrial categories set up by the Bureau of the Census, as well as by actual shifts between industries whose scope has not undergone revision. Unfortunately, no reliable information is available on this point.

Note should be made also of a factor affecting all industries, namely, change in the composition of output. As demonstrated in Chapter 2, such changes may have considerable effect on the ratio of labor to product. For information on changes in composition of the output of individual industries see Part Two of *The Output of Manufacturing Industries, 1899-1937* (National Bureau of Economic Research, 1940).

understate the actual cuts in unit labor requirements because they do not allow for quality improvements, and for the same reason most of the percentages given in the table should be regarded as conservative estimates of the reductions in man-hours per unit since 1909. Yet even these figures, with all their tendency to understatement, record rapid declines in manhours per unit for many industries. In comparison with the 2.7 percent decline in manhours per unit for all manufacturing combined some of the per annum rates for individual industries are phenomenal. In the automobile industry the average annual reduction was 8 percent (over the period 1909-37); in tobacco manufacture, 7 percent; and in glass, silk and rayon goods, blast-furnace products, and industrial chemicals, 5 percent. Reductions in the manhour-output ratio of 10, 15, or 20 percent were therefore sometimes a matter of a few years, not of decades; an average annual decline of, say, 5 percent, amounts in three years to 14 percent. As we shall see in the next section, in some periods the annual rates were substantially above the averages for all periods combined. Evidently important changes often took place well within the span of a single business cycle.

CHANGE IN THE RATE OF DECLINE IN LABOR PER UNIT

None of the average rates of decline recorded in Table 3 reflects the tempo of change during each portion of the period since 1909. The averages, in other words, fail to show variation in the rate of change in the ratio of employment, or of manhours, to product.

Besides short-period fluctuations the rate of decline in labor per unit also underwent more persistent changes, which become evident when periods of around 10 years are compared with one another. Limited though our information

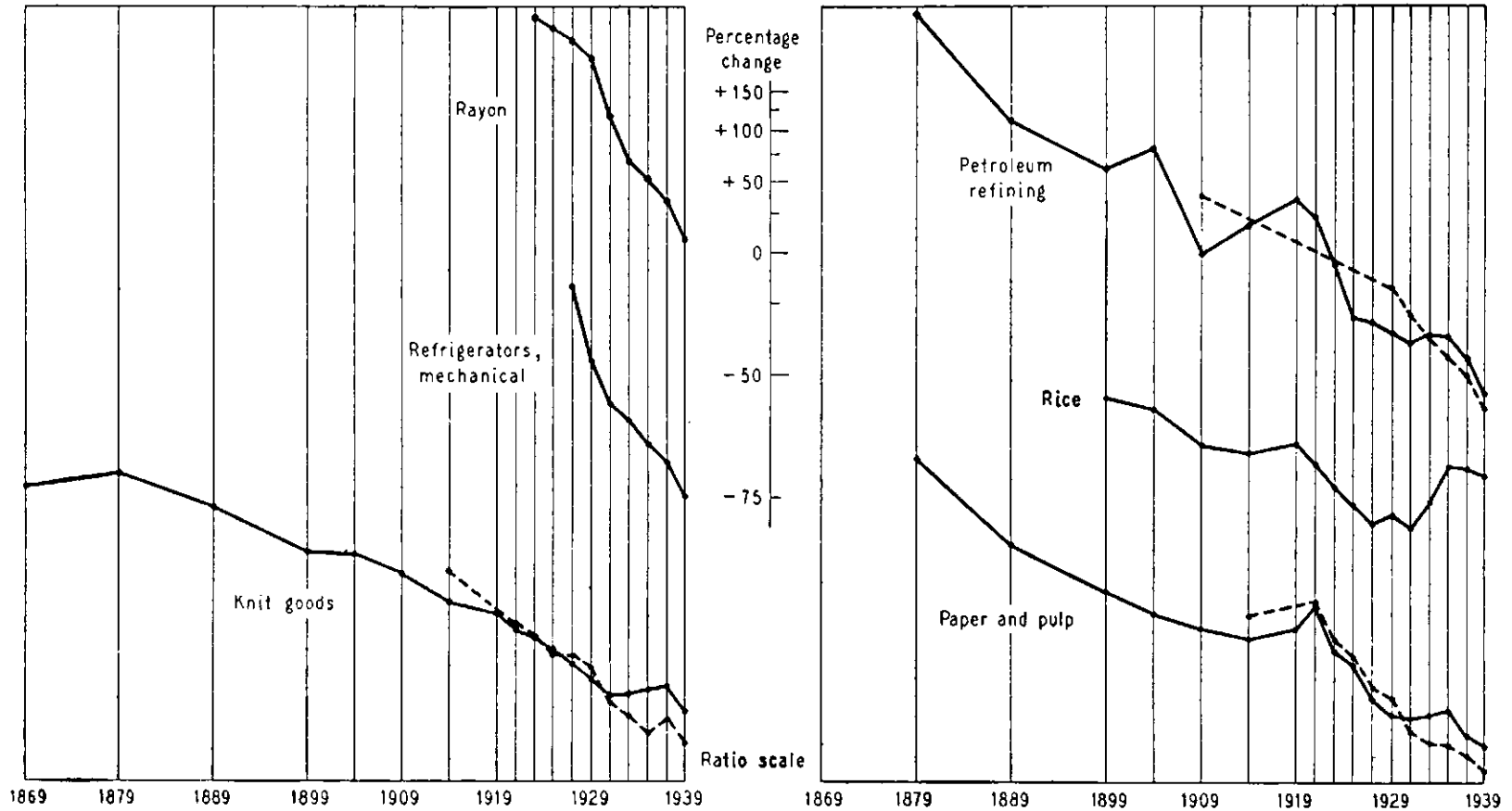
is to crude measures of shifts between selected years (Table 4, pp. 65-67), it is quite clear that the rate of decline in wage earners per unit fluctuated in practically all industries. From Chart 12, in which the course of labor per unit is plotted for a number of industries, one can observe, for example, that in cotton goods production the number of wage earners employed per unit rose at a rate of 0.1 percent per annum between 1909 and 1919 and again between 1929 and 1937, but fell at annual rates ranging from 0.3 percent to 2.9 percent during the other 5 decades covered in the table. In steel mills, though employment per unit declined on the average by as much as 5.1 percent annually between 1879 and 1889, it actually rose 2.8 percent per annum during the 1930's. The extraordinary average annual rate of decline in unit labor requirements for motor vehicle manufacture, 5.4 percent, is seen to be an average of extreme rates of decline, 11.8 and 9.5, a moderate rate of decline, 0.6, and a 2.2 percent rate of increase. The available data on manhours per unit, though less comprehensive and covering somewhat different periods than those on number of workers per unit, bear out this impression of widespread change in rate of decline (Chart 12; and Table 5, p. 68).

Now that we have found that the labor-output ratio declines at a variable rate, we should like to determine whether the variation in tempo follows some general pattern from stage to stage in the development of an industry. The most interesting possibility is that the decline decelerates from stage to stage. In terms of absolute changes per annum (or annual changes expressed as a percentage of a fixed base), there can hardly be any question that on the average there has been retardation in the rate of decline in employment per unit. For example, the reduction in the number of factory workers needed to assemble a dozen motorcars, from seven in 1899 to less than one in 1937, cannot be matched in

Chart 12

SELECTED MANUFACTURING INDUSTRIES

Indexes of Wage Earners per Unit of Product (————), and Manhours per Unit of Product (-----)

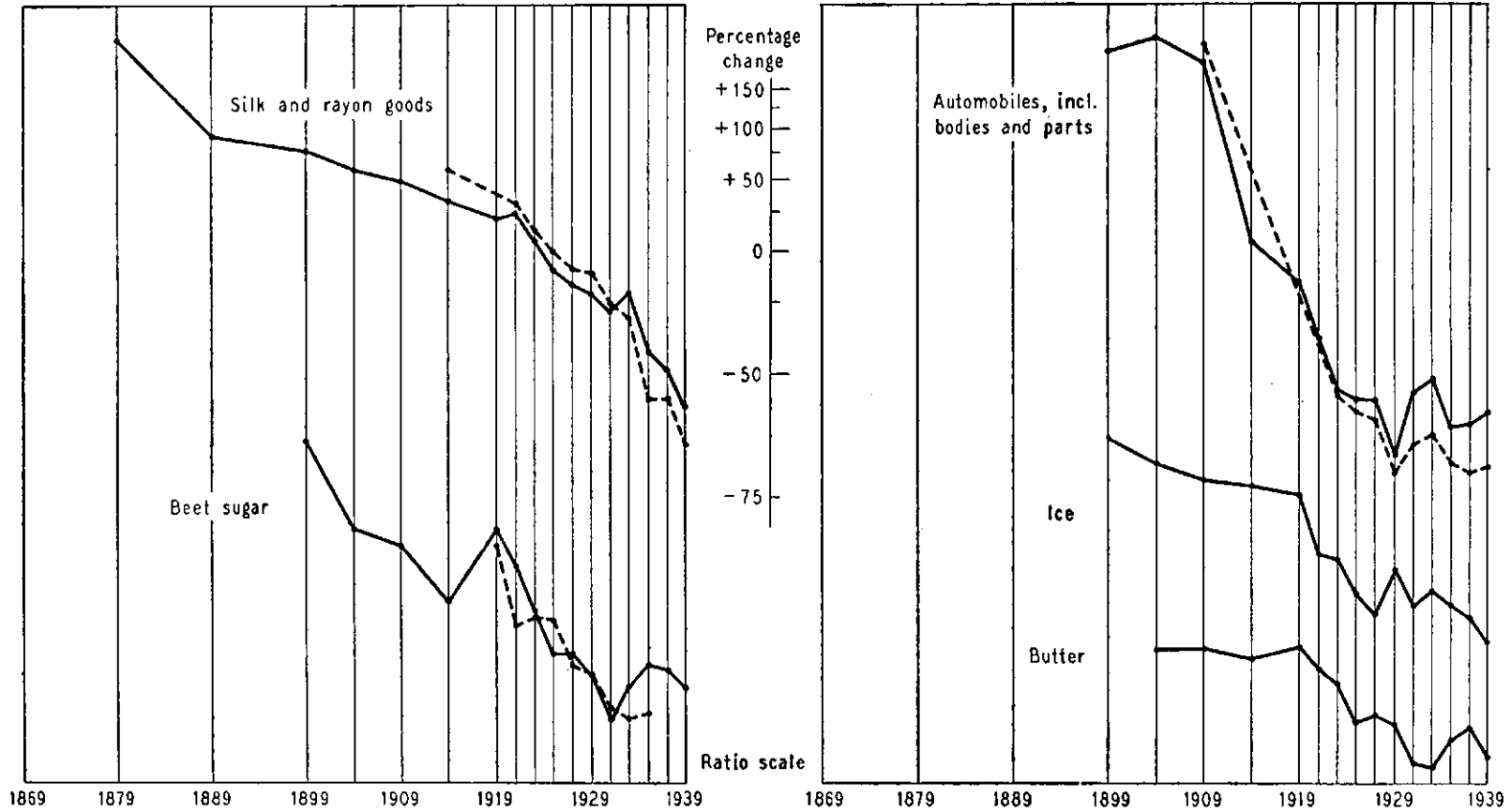


Based on Table F-1

LABOR PER UNIT

SELECTED MANUFACTURING INDUSTRIES

Indexes of Wage Earners per Unit of Product (————), and Manhours per Unit of Product (-----)

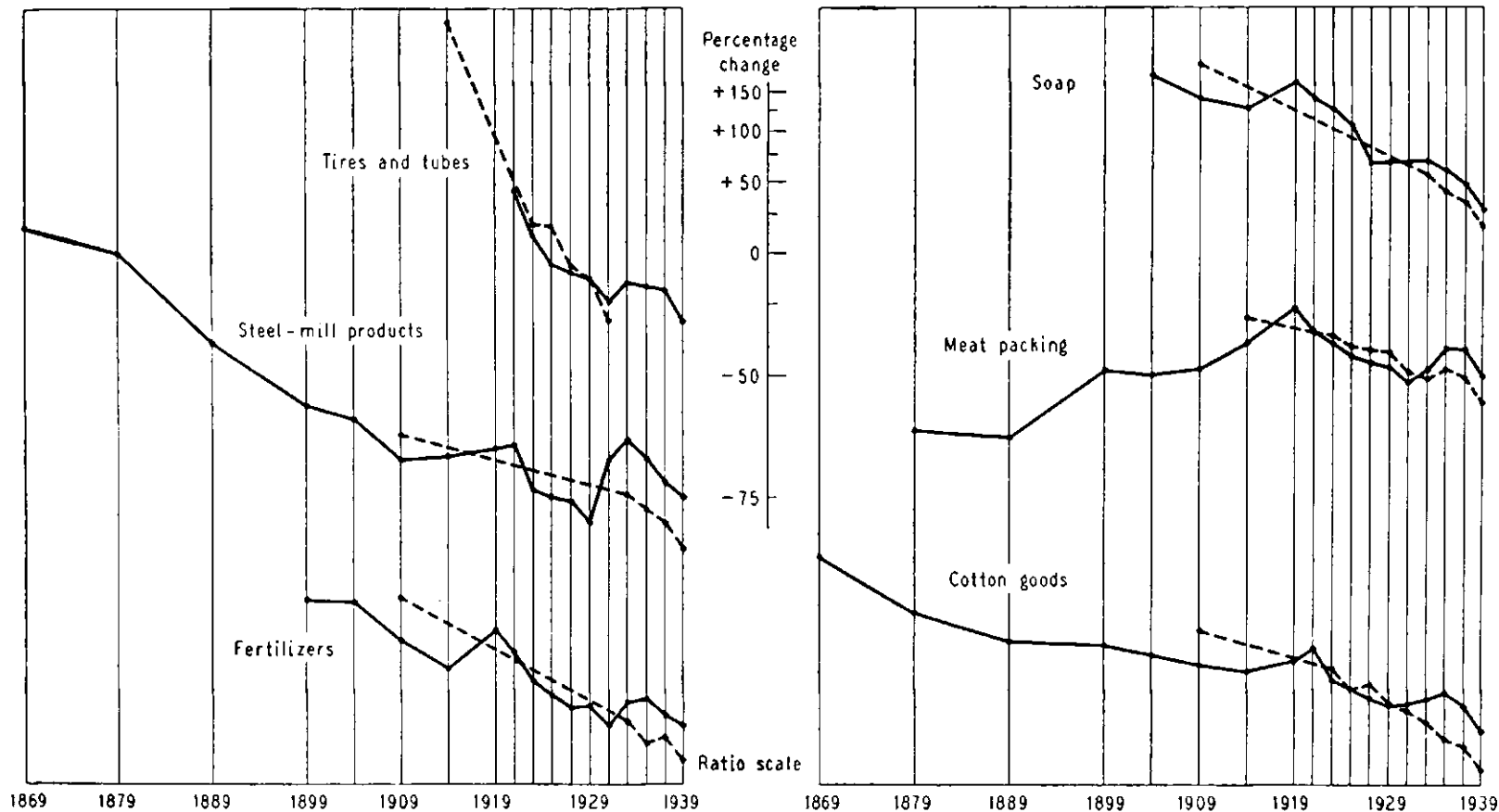


Based on Table F-1

Chart 12 (cont.)

SELECTED MANUFACTURING INDUSTRIES

Indexes of Wage Earners per Unit of Product (————), and Manhours per Unit of Product (-----)

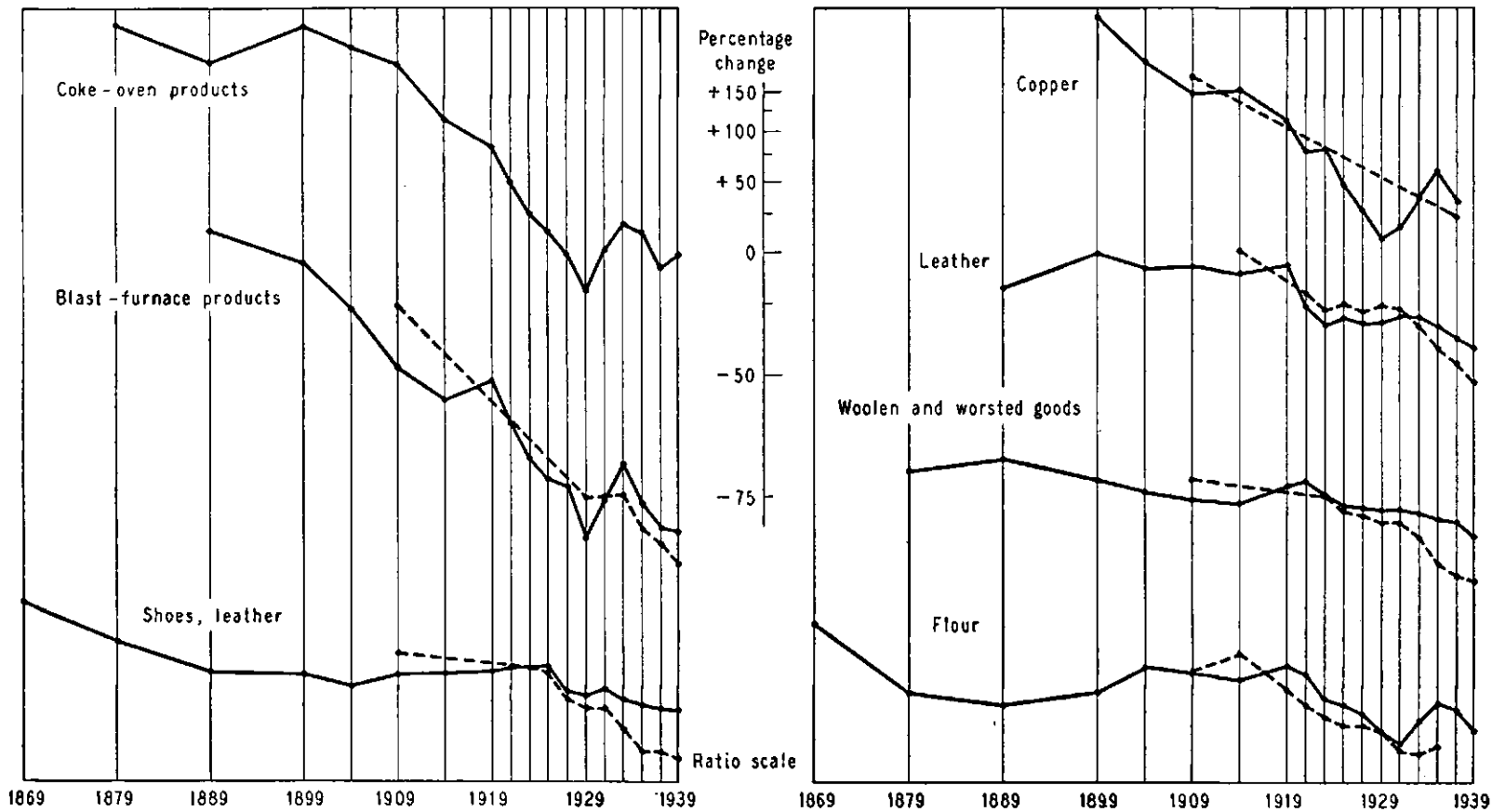


Based on Table F-1

Chart 12 (cont.)

SELECTED MANUFACTURING INDUSTRIES

Indexes of Wage Earners per Unit of Product (————), and Manhours per Unit of Product (-----)

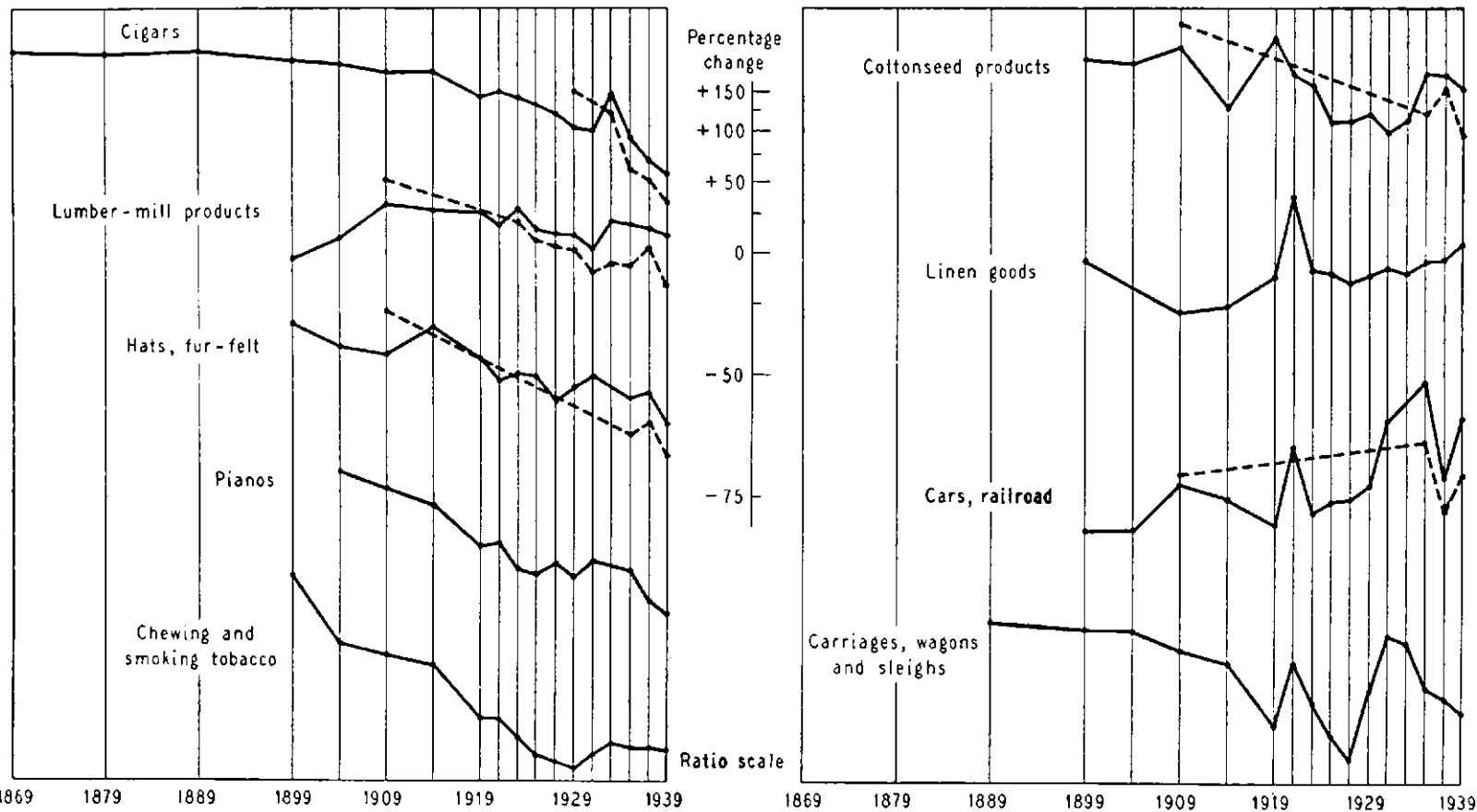


Based on Table F-1

Chart 12 (concl.)

SELECTED MANUFACTURING INDUSTRIES

Indexes of Wage Earners per Unit of Product (————), and Manhours per Unit of Product (-----)



Based on Table F-1

the future. But whether there is a decline in the rate of change in labor per unit when the latter is expressed as a percentage of the preceding year's level is quite another question. It is true that some authors have explained retardation of growth in output ⁶ in part by the slowing down of technical progress, which implies, of course, a slackening in the rate of decline in labor per unit.⁷ Such a slackening should be expected also if unit labor requirements are a function of the scale of an industry's operations; for the scale expands, as does output, at a decelerating rate. But these hypotheses cannot be put to the test. Lack of sufficiently long series on manhours worked per unit unfortunately precludes a definite answer to the question posed. The data on workers per unit are seriously affected by changes in hours, as a comparison of the fluctuations in Tables 4 and 5 shows. Even if one could conclude unequivocally that manhours per unit do fall at a declining rate, the finding might be unimportant. For it is possible that such deceleration, if it could be proven, would take the form not of a series of gradual changes from stage to stage, but of a single rather abrupt change from a very rapid rate of decline during the first stages of an industry's growth to a moderate rate persisting with little change during the rest of its career. That is, the shape of an industry's labor-output curve could reasonably be approximated by two connected straight lines, the first (with a sharp negative slope) covering the early life of the industry, and the second (with a mild negative slope) covering the later and major portion. If this were the situation, the phenomenon of deceleration would hardly be observable in the available data, which seldom cover the very early years of an industry's life. If there were gradual deceleration in an industry's unit

⁶ See the discussion in Chapter 5.

⁷ Evidence of a slackening in the rate of technical progress in the cotton, woolen and worsted, iron and steel, shoe, paper, and copper industries is presented in Simon Kuznets' *Secular Movements in Production and Prices* (Houghton Mifflin, 1930), Ch. 1.

TABLE 4

INDIVIDUAL MANUFACTURING INDUSTRIES

Wage Earners per Unit of Product: Average Annual Rates of Change between Selected Years

Unit: 1 percent

<i>Industry</i>	<i>Average Annual Rate of Change</i>						
	1869 to 1879	1879 to 1889	1889 to 1899	1899 to 1909	1909 to 1919	1919 to 1929	1929 to 1937
<i>Foods</i>							
Meat packing		-0.3	3.9	0.0	3.5	-3.4	1.3
Flour	-3.8	-0.7	0.8	1.1	0.4	-3.8	1.6
Rice				-2.8	0.0	-4.0	3.5
Fish, canned					1.4	-0.7	3.2
Fruits and vegetables, canned				-4.0	-2.1	-3.4	-1.0
Butter, cheese, and canned milk				-1.1	-1.0		
Milk, canned					-3.5	-8.0	-0.1
Butter					0.1	-4.2	-0.4
Cheese					-0.5	-3.0	0.3
Beet sugar				-6.0	1.0	-8.1	0.5
Cane sugar, tota				-3.0	3.7		
Cane sugar, not elsewhere made					7.1	-7.2	-0.7
Cane-sugar refining					3.0	-4.9	1.6
Corn products					1.0	-5.0	2.7
Ice				-2.6	-0.7	-4.3	-3.2
<i>Beverages</i>							
Liquors, malt				-1.0	2.5		
Liquors, distilled				2.9	20.9	1.5	-29.8
<i>Tobacco products</i>							
Cigarettes					-9.7	-8.7	-1.0
Cigars	-0.1	0.2	-0.6	-0.7	-1.3	-1.8	-2.3
Chewing and smoking tobacco				-4.4	-3.7	-2.8	1.5
<i>Textile products</i>							
Cotton goods	-2.9	-1.6	-0.3	-1.0	0.1	-2.6	0.1
Lace goods						-0.8	-3.2
Woolen and worsted goods		0.2	-1.0	-1.1	0.8	-1.5	-0.8
Silk and rayon goods		-5.3	-0.8	-1.7	-2.3	-4.1	-5.0
Knit goods	0.7	-1.9	-2.5	-1.1	-2.3	-3.9	-0.5
Carpets and rugs, wool				-1.0	-1.4	-1.3	0.3
Asphalted-felt-base floor covering and linoleum						-2.2	-0.1

TABLE 4 (concluded)

INDIVIDUAL MANUFACTURING INDUSTRIES

Wage Earners per Unit of Product: Average Annual Rates of Change between Selected Years

Unit: 1 percent

<i>Industry</i>	<i>Average Annual Rate of Change</i>						
	1869	1879	1889	1899	1909	1919	1929
	to 1879	to 1889	to 1899	to 1909	to 1919	to 1929	to 1937
<i>Textile products (concluded)</i>							
Oilcloth					6.6	-7.0	4.0
Cordage and twine				-1.0	0.7	-2.7	0.6
Jute goods				-1.8	-0.0	-2.1	-1.0
Linen goods				-2.9	2.1	0.0	1.2
Hats, fur-felt				-1.8	-0.1	-1.7	-0.5
Hats, wool-felt		-0.6	-0.5	2.3	-0.8	1.1	-3.1
Wool shoddy			-0.1	-1.6	-0.8	-3.9	
<i>Leather products</i>							
Leather			2.0	-0.7	-0.0	-3.2	-1.2
Shoes, leather	-2.3	-1.4	-0.3	-0.0	0.0	-1.4	-0.9
Gloves, leather				-3.6	-1.3	-0.5	3.2
<i>Rubber products</i>							
Tires, tubes and other rubber goods						-7.2	0.0
Shoes, rubber						-1.1	-3.5
<i>Paper products</i>							
Paper and pulp		-4.8	-2.8	-2.1	0.4	-5.1	-1.3
<i>Printing and publishing</i>							
Total				-4.4	-3.1	-4.1	-0.3
<i>Chemical products</i>							
Chemicals, industrial, incl. rayon and compressed gases				-2.4	0.2	-6.8	-3.2
Cottonseed products				0.7	0.3	-4.1	3.0
Carbon black						-4.2	-1.9
Soap					0.8	-4.5	-1.4
Wood-distillation products				-0.9	2.8	-3.6	-0.6
Explosives			-1.1	-5.4	-0.3	-5.5	0.5
Fertilizers				-2.2	0.7	-4.4	-0.7
Paints and varnishes				-1.4	0.8	-3.4	-0.1
Salt	-1.5	-5.1	0.6	-2.0	0.1	-2.9	-1.7
Tanning and dye materials				-3.5	1.8	-7.6	1.7

<i>Industry</i>	<i>Average Annual Rate of Change</i>						
	1869	1879	1889	1899	1909	1919	1929
	to 1879	to 1889	to 1899	to 1909	to 1919	to 1929	to 1937
<i>Petroleum and coal products</i>							
Petroleum refining		-5.9	-2.8	-4.7	3.2	-7.4	-1.8
Coke-oven products		-2.2	1.8	-2.0	-4.6	-8.1	1.7
Fuel briquettes					-3.1	-6.3	3.9
<i>Stone, clay and glass products</i>							
Cement					-3.2	-2.9	1.9
Lime					-0.3	-5.2	1.4
Sand-lime brick						-5.2	1.2
Clay products						-2.5	0.7
Glass				-3.2	-2.4	-5.6	-4.0
<i>Forest products</i>							
Lumber-mill products				3.1	-0.5	-1.4	0.8
Turpentine and rosin				2.2	-1.6	0.9	0.0
<i>Iron and steel products</i>							
Blast-furnace products			-1.9	-5.9	-0.6	-8.7	0.6
Steel-mill products	-1.4	-5.1	-3.4	-3.4	0.7	-4.0	2.8
Wire					0.5	-2.4	2.5
Cast-iron pipe						-3.8	3.3
<i>Nonferrous-metal products</i>							
Copper				-4.4	-1.4	-6.7	2.7
Lead				-5.9	-1.4	-7.3	4.6
Zinc				-3.6	1.3	-4.6	1.5
<i>Machinery</i>							
Phonographs				1.5	-1.2	-0.9	
<i>Transportation equipment</i>							
Automobiles, incl. bodies and parts				-0.6	-11.8	-9.5	2.2
Carriages, wagons and sleighs			-0.4	-1.1	-4.3	1.8	-0.4
Cars, railroad				2.8	-2.3	2.2	1.0
Locomotives			0.8	-3.1	4.6	2.9	5.0
Ships and boats				1.3	2.5	-2.4	4.3
Motorcycles and bicycles				-5.6	-1.3	-3.1	
<i>Miscellaneous products</i>							
Organs					0.9	1.3	
Pianos					-2.9	-2.0	-1.8
Buttons						-3.4	0.7

Source: Appendix F.

TABLE 5

INDIVIDUAL MANUFACTURING INDUSTRIES

Aggregate Wage-Earner Hours per Unit of Product:
Average Annual Rates of Change between Selected Years

Unit: 1 percent

Industry	Average Annual Rate of Change							
	Estimate ^a	1914	1921	1929	Estimate ^a	1909	1923	1929
		to 1921	to 1929	to 1937		to 1923	to 1929	to 1937
Meat packing	B	-1.3	-1.6	-1.7	A	0.5	-1.4	-2.2
Flour	A+B	-4.0	-1.9	-0.5				
Beet sugar	A+B		-5.3	-3.5				
Cotton goods					A	-1.6	-3.2	-3.0
Knit goods	A	-3.9	-3.1	-3.7				
Silk and rayon goods	A	-2.7	-4.9	-8.6				
Woolen and worsted goods	B	-0.4	-2.0	-4.2	A	-0.8	-2.5	-3.6
Leather	B	-3.5	-1.0	-3.9	A+C		-1.3	-3.6
Shoes, leather	B	-1.8	-2.4	-2.6	A	-0.6	-3.7	-3.1
Rubber products, total	B		-5.7	-4.1				
Paper and pulp	B	1.2	-6.7	-3.9				
Printing and publishing, total	B	-1.9	-4.6	-2.2	A	-4.2	-2.8	-2.3
Paints and varnishes	B	-1.2	-2.7	-2.9				
Chemical products, total	B	-1.1	-5.9	-4.1				
Cement	A+B		-5.6	-0.3				
Clay products	A+B		-1.0	3.8				
Lumber-mill products					A	-1.8	-2.6	0.2
Blast-furnace and steel-mill products	B	0.4	-5.4	-2.3	A	-2.6	-4.3	-0.2
Automobiles, incl. bodies and parts	B	-9.3	-7.4	-1.3	A	-13.3	-7.3	0.0

^a The estimates are identified in Appendix F, where the indexes are presented in detail.

labor requirements, but at a low rate, it could not be found in the available statistics because of the presence of long cycles and erratic movements.⁸

There is some reason to expect a pulsating, though not necessarily periodic, rate of decline in unit labor requirements: startling innovations, for example, are not introduced in every year, although minor improvements in techniques may be effected almost continuously. The data in Tables 4 and 5 are not inconsistent with this hypothesis.

One might speculate also on the possibility that long cycles in unit labor requirements are more or less synchronous in different industries. General waves of rationalization (which many economists believe did occur during the 1920's), extensive changes in the work week and in labor relations, generally high levels of output and capital investment and similar developments could account for such a phenomenon. The data given in detail in Table 4 and summarized in Charts 13 and 14 lend support to the view that there has been synchronization of rates of change in wage earners per unit. Amidst the very considerable variation between columns and lines in Table 4 a certain degree of order can be detected. The first and third decades of the twentieth century are characterized, rather generally, by sharp declines in employment per unit of product, and the second and fourth by rises or

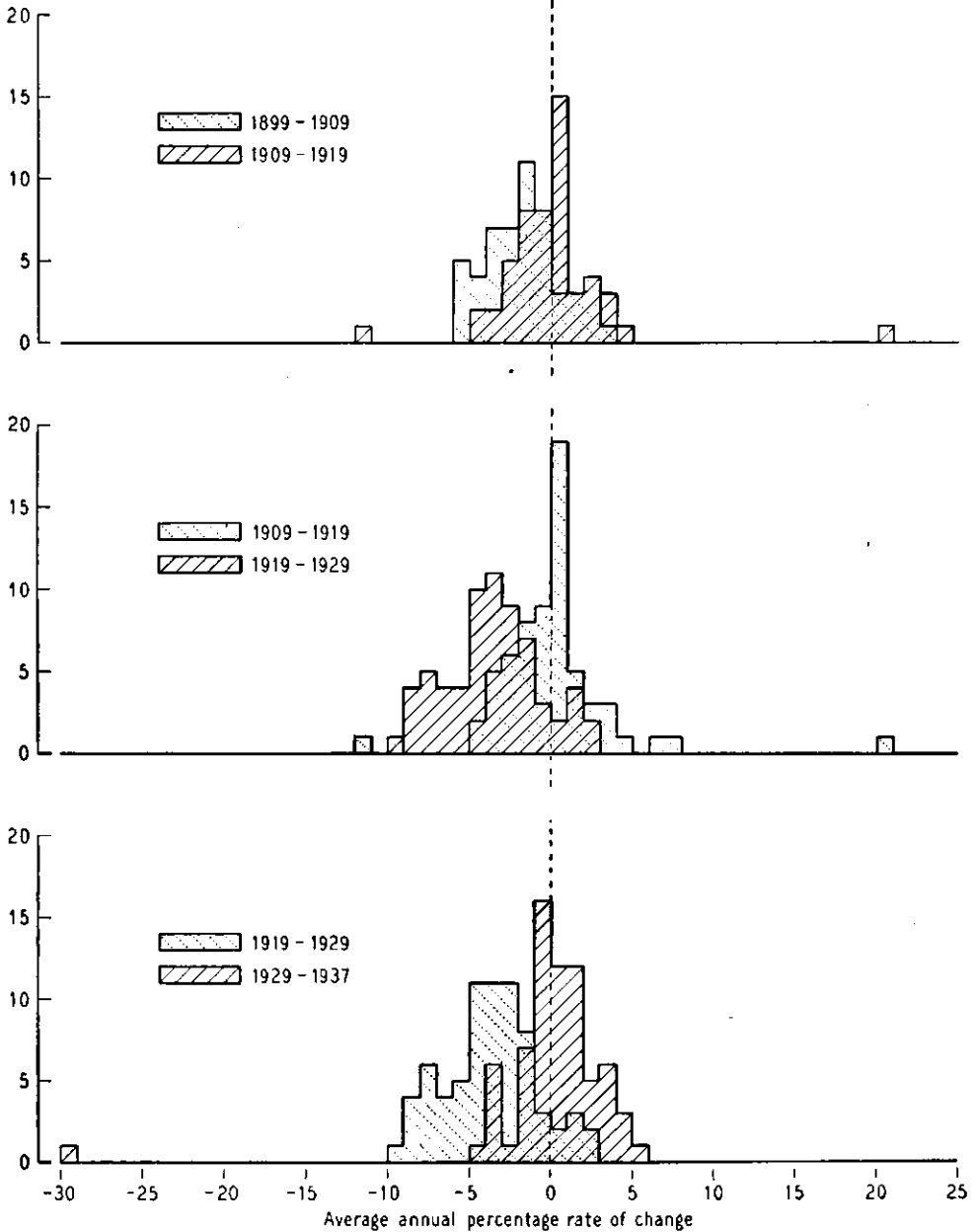
⁸ Material in the following chapter indicates a negative correlation between trends in output and in employment per unit of output. Since, as we shall see, the rate of growth in output declines progressively as an industry approaches maturity, one might infer the existence of retardation of rate of decline in the employment-output ratio. But such an inference is dangerous. The rate of increase in production characteristic of a given stage of development is not necessarily or even usually identical from industry to industry (barring that stage wherein output is at a maximum and not growing at all, which by definition would be the same stage in every industry's development). Thus, in an industry characterized by rapid growth to an early maximum, it is possible that output may rise during the period including the inflection point in the industry's curve of output (traced on an arithmetic scale) at a rate that is greater than the corresponding one characteristic of an industry growing more slowly and reaching maturity much later.

Chart 13

WAGE EARNERS PER UNIT OF PRODUCT

Frequency Distributions of Individual Manufacturing Industries by Average Annual Rate of Change between Selected Years

Frequency
(Number of industries)



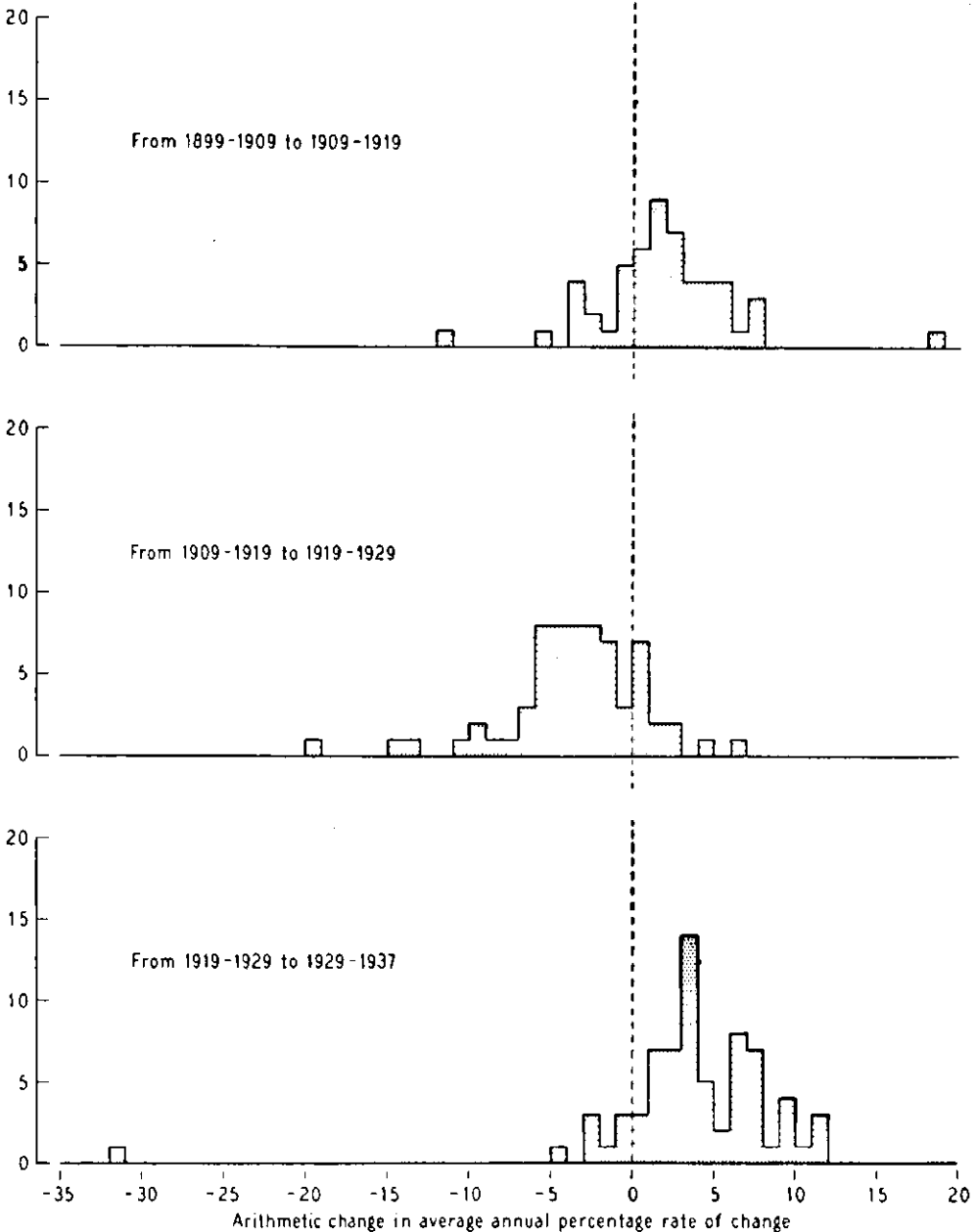
Based on Table G-2

Chart 14

WAGE EARNERS PER UNIT OF PRODUCT

Frequency Distributions of Individual Manufacturing Industries by Changes in Average Annual Rate of Change between Selected Years

Frequency
(Number of industries)



Based on Table G-2

The number of industries included in the 1899-1909 and 1909-1919 comparison is 53; in the 1909-1919 and 1919-1929 comparison, 66; and in the 1919-1929 and 1929-1937 comparison, 71.

slight declines.⁹ Comparisons of somewhat different periods, say 1899–1914 with 1914–19, or 1923–29 with 1929–37, produce like results.

The similarity of these cycles in employment per unit among different industries may well be attributed to the drastic reductions in hours of labor that have occurred more or less simultaneously in various branches of manufacturing. Between 1914 and 1919 and again between 1929 and 1937 there were large and fairly general reductions in the hours of labor per week. As a consequence, the ratio of employment to product usually did not fall as rapidly during these periods as it did when changes in hours were relatively slight.¹⁰

Whether changes in hours were the sole factor or only one of several causes of the widespread fluctuations in workers per unit is more difficult to determine because data on hours are inadequate; and for this reason too one cannot make definite statements concerning changes between successive periods in the rates of decline in *manhours* per unit. Accurate data on hours are not available for all of the Census years after 1909, or for all individual industries. Such scanty information as can be mustered (Table 5) shows that the rate

⁹ Though the data (Table 4) are hardly adequate to establish this definitely, it is noteworthy that the period 1889–99 was characterized by rates of decline in employment per unit that were rather low relative to the rates in the preceding and following decades.

¹⁰ This fact alone makes it impossible to consider Table 4 as establishing retardation in the rate of decline in employment per unit. Suppose we were to compare rates of change in wage earners per unit between 1869 and 1879 with those between 1879 and 1889, and so on for all contiguous periods, representing each increase in rate of change (i.e., a decrease in rate of decline) by a plus, and each decrease in rate of change (increase in rate of decline) by a minus. Then, of the 231 comparisons made possible by Table 4, we would find 134 to be plus, 96 minus, 1 zero. This would seem to indicate a slight tendency toward decrease in rate of decline. But preponderance of pluses would be found merely because most of our series cover only the last four decades, during the second and fourth of which there was widespread decline in hours and, therefore, widespread deceleration in rate of decline in wage earners per unit. This, too, would account for the fact that 43 of the 76 industries listed in the table are characterized by more pluses than minuses, as just defined.

of decline in manhours per unit during the earlier war period was usually (though not always) less rapid than during the 1920's. As for any change in trends after 1929, the picture is even less definite, though it seems reasonably safe to say that the rate of decline was usually more rapid during the 1920's than during the 1930's. Yet it is true, too, that the average rate of fall in manhours per unit during the troubled years between 1929 and 1937 was rather speedy in quite a few industries, and in several compared favorably with the rate of decline during the preceding period of prosperity and expansion.¹¹

UNIT LABOR REQUIREMENTS AND INDUSTRIAL EVOLUTION

The most striking conclusion brought out by the figures presented in this chapter is that nearly all industries effected a long-run reduction in the labor they employed per unit of product. Output soared appreciably higher than manhour employment in industries producing different kinds of commodities, making use of different sorts of manufacturing processes, and at different stages of development. Because the products and processes are so numerous and diverse in manufacturing industries, the immediate means by which labor per unit has been cut must have been correspondingly heterogeneous.

Even for single industries the list of changes in the process of fabrication has commonly been long. It is true, of course, that now and then in almost every industry there are developments so spectacular that they come to the attention even of the outsider. In the automobile industry, for example, one of the most revolutionary advances in the manufacturing

¹¹ Note, however, the possible effect on this comparison of changes in quality of product, mentioned above, p. 20.

process was the straight-line system of routing and dividing work by means of mechanical conveyors; and it is largely to the introduction of this system that the annual decline of more than 10 percent in workers employed per automobile, between 1909 and 1919, has been ascribed. In cigar manufacture the invention of the automatic cigar-making machine goes far to explain the cut of almost half in the number of workers employed per thousand cigars between 1909 and 1939, a reduction far exceeding that which took place during the half-century preceding 1909. In the manufacture of pneumatic tires the outstanding change during the 1920's was the displacement of the core process of tire building by the flat-drum process; this new technique helps to account for the two-fifths reduction in workers per unit in the rubber-tire industry between 1921 and 1929. But besides the great upheavals in manufacturing processes which occur from time to time, there are always the less spectacular but more frequent minor changes in almost all industries. These small improvements, which affect the industrial organization of the enterprise, the layout of the job, and the equipment used, have a powerful cumulative effect. One observer holds that minor advances of this sort are ultimately of greater importance, as a rule, than the major changes which are introduced only occasionally.¹²

The technical and organizational modifications that affect labor per unit are naturally conditioned by the kind of product and process predominant in a particular industry. Because these improvements take on special characteristics in each industry, and because they are so very numerous, the changes that have occurred in factories since 1899 cannot even be listed in a report devoted to all manufacturing industries. Yet no single industry exists in a vacuum, separated

¹² Boris Stern, "Labor Productivity in the Automobile Tire Industry," *Bulletin* 585, Bureau of Labor Statistics, Washington, 1933, p. 24.

from contact with other industries. If we care to look beneath the peculiarities of the changes in each industry, we can detect and remark upon certain common features even in an over-all report such as the present one.

One common characteristic of the manifold changes that have affected manufacturing processes is their origin in the fund of ideas current at the time. New ideas eventually become common property. Efficient arrangements of work initiated in one plant are sooner or later copied in other plants of the industry, and, after experiment and adaptation to different conditions, are taken over by outside industries. Thus the straight-line system which helped to revolutionize the automobile industry was suggested by methods already in successful use in Chicago meat-packing establishments.¹³ Its adaptation to motorcar manufacture stimulated its spread to many more industries, with cotton garment manufacture most notable among these in recent years.¹⁴

Scientific plant and labor management is another development that has permeated industry fairly generally since the 1890's. Frederick W. Taylor and his followers worked out their ideas and made their experiments in metalworking, construction, shipbuilding, steel manufacture, machinery production, and arsenals. It is true that even as late as 1912 there was some question as to the practicability and usefulness of modern management methods, but the war years following brought fruition to the ideas which had been developing during the preceding decades. During the 1920's profit-sharing plans for reducing occupational hazards and diseases, and studies of labor turnover began to appear in many widely different fields. Incentive wage plans, for example, were operating in 37 industries in 1924.¹⁵ Systematic

¹³ Henry Ford, *My Life and Work* (Doubleday Page, 1923), p. 81.

¹⁴ N. I. Stone, "Productivity of Labor in the Cotton-Garment Industry," *Bulletin 662* (Bureau of Labor Statistics, Washington, 1938), Ch. IV.

¹⁵ L. P. Allford, *Laws of Management Applied to Manufacturing* (Ronald Press, 1928).

research and application of ideas of this sort have been changing the organization of plants in many different industries and altering the activities of the working force within the factory walls. The resulting elimination of waste and the reduction of effort and time have played an important role in increasing the productivity of industry. Taylor, with the enthusiasm of the innovator, felt that the general adoption of scientific management would of itself readily double the productivity of the average worker in industry.¹⁶ At any rate, there can be little doubt that advance in managerial technique is to be counted among the important factors that have aided in doubling the average output of the factory worker since 1899.

Accounting and statistical controls have spread from industry to industry, furthered by enterprises manufacturing devices used in these systems or rendering services in their application. Again, standardization has been widely accepted in most industries in one form or another. Standard weights and measures are old, of course; the requirement that parts be interchangeable was written into contracts for pistols and muskets given Simeon North and Eli Whitney at the end of the eighteenth century. But the widespread systematic application of standardization is essentially modern, and in many respects a phenomenon of the 1920's. Uniformity of dimensions, essential to secure interchangeability and interworking, of necessity implies standards set up through cooperation between plants, regions and industries. The post-war drive toward standard quality specifications, testing methods, machinery ratings, grading and simplification¹⁷ was fostered throughout industry by organizations cutting across industrial boundaries: technical and professional societies, national and international standardizing societies and the National Bureau of Standards. It was widely stimulated also by govern-

¹⁶ *Principles of Scientific Management* (Harper, 1911), p. 142.

¹⁷ Reduction of number of types, sizes and grades.

ment purchasing requirements, trade associations and some large companies. The setting of standards for materials purchased has in turn encouraged the creation of similar standards for products sold, and so in this way too standardization has spread. Its influence is now felt in every department of contemporary industrial and domestic life.

Besides ideas concerning arrangement, combination, procedure, control, and so forth, new instruments become generally available to industry at large. The steam engine, of early assistance in mining, was soon exploited, in one form or another, in many fields. So also runs the history of the electric motor and the electric light, and the application of such relatively new devices as air conditioning may well follow a similar pattern. Machine tools are not restricted to use by one or two industries; nor are typewriters and bookkeeping machines employed only in banks.

Instruments used as indicators, recorders and controllers of pressure, temperature, fluid flow, liquid level, speed, concentration of solution, composition of gases, and duration of process, are found in varying degree and form in practically every industrial plant.¹⁸ These instruments are making possible the use of large capacity machines which cannot be controlled manually, result in more uniform and better products, and lessen the danger of breakdown and excessive wear.¹⁹ Savings of fuel and greater safety of operation are also credited to the use of control instruments.

The flow of goods through plants of all kinds has been accelerated by steam and electric shovels, belt conveyors, trucks, portable conveyors and loaders, chutes, pneumatic

¹⁸ George Perazich, Herbert Schimmel and Benjamin Rosenberg, *Industrial Instruments and Changing Technology* (National Research Project, Philadelphia, 1938), pp. 20, 51.

¹⁹ David Weintraub ("Effects of Current and Prospective Technological Developments upon Capital Formation," *American Economic Review, Supplement*, Mar. 1939) cites a test case in which boilers under hand control had to be rebricked every three months, whereas with instrument control even annual rebricking was unnecessary.

devices, cranes, and electric hoists. These developments have not been limited to the heavy industries alone. Belt conveyors, for instance, are utilized in packing foods and in the manufacture of auto seat covers and backs.

The electric motor is an especially interesting example of a labor-saving device now in universal use. Its contribution to the development of automatic tools can hardly be exaggerated. Without the individual electric motor, which can be started and stopped in an instant and can be controlled automatically even at a distance, most automatic machines and processes could not have been developed. And on still another count the displacement of the nonelectric by the electrically-driven motor has contributed to a reduction of labor requirements, for it has meant a shift in the production of the power used in factories from the factory itself to the central power station.

New and improved materials also make their way into various industries. Artificial leather is a familiar example. The extraordinary new metals, metallic alloys, and coated metals which are resistant to acids, durable,²⁰ light, with good edging properties, or with combinations of these and other virtues, have found their uses in cans for foods and beverages, motorcars, home appliances, and tools and machines of all kinds. Rayon, nylon and plastics are repeating the old story. Cellophane and paper boxes have displaced other wrapping materials in many different lines of business. Electric lights have rendered obsolete other means of illumination, and now the electric filament bulb is being superseded, in turn, by the gas-filled fluorescent type.

Improvements in such materials as paints, varnishes and

²⁰ Research in corrosion and in protective coatings and the development of alloy steels raised the average life expectancy of all iron and steel from 15 years in 1899 to 22 years in 1910 and 35 years in 1935. F. T. Sisco, in National Resources Planning Board, *Research—A National Resource* (Washington, 1940), Part II, p. 169.

lacquers have affected the many industries using them. Easier application to the object to be covered, quicker drying time, and greater durability of the surface have reduced the amount of labor required and resulted also in savings of space and inventory of work in process.

Business concerns purchase from other enterprises not only equipment and materials but also services. The important services rendered by the transportation and communication systems have improved very greatly, and since these services have been extensively utilized by all industry, the resulting advantages have been enjoyed at large. Contributing significantly to increased efficiency are the professions of accountancy and management engineering, the commercial laboratories, the trade associations and trade journals, professional societies of all kinds, and government in certain of its activities.

A striking development of recent years is the growing habit of industrial research—the “mass production of ideas,” as Charles F. Kettering calls it.²¹ Before 1914, though academic research and the creative work of individual inventors had of course affected many industries, organized industrial research was relatively rare. Since then, however, research has become to a considerable extent a function of industry itself, carried on by individual companies in many diverse fields. Research expenditures in relation to dollar output (gross sales or value added) and number of research employees in relation to total employment are highly variable, it is true; in such industrial groups as chemicals and electrical machinery they have acquired impressive proportions, but in no industrial group are they altogether absent.²² In addition

²¹ Hearings before the Temporary National Economic Committee (Washington, April 1940), Part 30, p. 16292.

²² See National Resources Planning Board, *op. cit.*, pp. 122, 125 and 181; and George Perazich and P. M. Field, *Industrial Research and Changing Technology* (National Research Project, Philadelphia, 1940), p. 21.

to research carried on by individual companies, some work of this kind is done by trade associations and commercial laboratories, and by foundations set up by industry. The ideas thus developed, because they have originated at many separate points in industry and are extensively exchanged and broadcast through elaborate media of communication, have affected virtually all factory products and processes.

The advances we have just mentioned have meant much more than mere savings of labor. They have contributed also to economies in materials and machines, and to improvements in quality of product.²³ Indeed, there may be some cases in which labor per unit of product has been increased in order to effect savings of plant space and equipment, utilize byproducts, reduce waste, and so on. But more generally, when reductions in nonlabor factors of production have taken place they have coincided with cuts in unit labor requirements. The secular rise in the level of wages, the more or less steady decline in hours of work, the improvements in working conditions—themselves made possible by the increased productivity of the industrial system—have made labor expensive in relation to other factors of production. This costliness of labor has acted as a powerful incentive to the development and application of techniques, ideas and tools which promise to reduce the amount of labor needed to produce a unit of goods. The competition for labor, capital and materials by almost all new industries—and in particular the encroachment of new products in the sales markets

²³ The money spent for research in the iron and steel industry in 1938 was distributed, according to American Iron and Steel Institute, *Steel Facts* (Aug. 1938), p. 4, approximately as follows:

<i>Project</i>	<i>Percent</i>
Improving quality	33
Improving methods of manufacture and reducing cost	19
Developing new products	20
Developing new uses and markets	28

—has caused even relatively unenterprising managements to resort to the latest ideas, devices, machines and materials, and thus, whether incidentally or intentionally, to reduce labor input per unit of product. Here too, legislation setting minimum wage standards, restricting hours, and so on, has supplied added impetus to the great drive to reduce costs.

The widespread decline in unit labor requirements, it should now be apparent, can be explained in part by the fact that many of the forces instrumental in this reduction are at the command of all types of industry. Though superficially diverse in character, labor-saving means and methods in different industries have a common core. Efficient plant layout and labor management, powerful tools like the electric-motor, useful devices such as the telephone—all these can be applied in one form or another and in greater or less degree in all manufacturing industries. Similarly, the basic factors that impel management to cut labor per unit operate in all industries. As we have seen, reductions in unit labor requirements in one industry stimulate reductions in other industries, through competitive cuts in prices and increases in wage rates.

The industrial changes noted here have not appeared with equal prominence in all sectors of manufacturing, and as we now know, the rate of decline in labor per unit has varied from industry to industry. Technical conditions differ widely among industries, for one thing, and it will take some time for even a revolutionary improvement to win the approval of every entrepreneur. Perhaps in the failure of some industries to expand output one can find a more cogent reason for the uneven use made of new ideas, devices and methods, and the uneven rate of decline in unit labor requirements. It is certain, at any rate, that the industries which made the most exhaustive use of new ideas and processes, and thus effected especially drastic cuts in labor per unit, usually increased

output faster than the average. This relationship will be considered in the following chapter, in which we shall study the varied movements of employment and output, and try to assess the role of capital investment, unit costs and prices in the changing status of American manufacturing industries.

Chapter 4

Employment, Output and Related Quantities in Individual Industries

IN THE preceding chapter, which was devoted to trends in labor per unit, we found that in five out of every six industries covered by our data there was a reduction in the number of workers employed to make a unit of product. In turning now to observe the behavior of employment and of output in individual industries, we shall try to determine how growth in these magnitudes was related to the rate at which their unit labor requirements declined. Once we have established the relationship, we shall consider what factors might have helped to shape it, and in particular whether growth in capital and reductions in costs and prices have played significant roles in its formation.

EMPLOYMENT, OUTPUT AND LABOR PER UNIT

As one might well expect, individual industries varied widely with respect to changes in both employment and output from 1899 to 1937. At the same time there is observable a high degree of correlation between the trends in production and in number of workers within particular industries (Table 6). Employment fell to one twenty-fifth in the industry making carriages, wagons and sleighs and was multiplied 210 times in automobile manufacture; the same industries supply the extremes for changes in output, the former registering a decline to one twentieth and the latter an 1800-

TABLE 6
 INDIVIDUAL MANUFACTURING INDUSTRIES
 Percentage Changes in Physical Output, Number of
 Wage Earners, and Wage Earners per Unit of
 Product, 1899-1937

<i>Industry</i>	<i>Physical Output</i>	<i>Wage Earners</i>	<i>Wage Earners per Unit of Product</i>
	Percentage Change, 1899-1937		
<i>Foods</i>			
Meat packing	66	85	12
Flour	-8	-18	-10
Rice	416	241	-34
Fruits and vegetables, canned	792	213	-65
Butter, cheese and canned milk	460	157	-54
Beet sugar	1,690	375	-73
Cane sugar	86	29	-30
Ice	668	173	-64
<i>Beverages</i>			
Liquors, malt	60	19	-26
Liquors, distilled	315	153	-39
<i>Tobacco products</i>			
Cigars	0.0	-44	-44
Chewing and smoking tobacco	-6	-65	-63
<i>Textile products</i>			
Cotton goods	101	42	-30
Woolen and worsted goods	60	25	-22
Silk and rayon goods	512	79	-71
Knit goods	506	177	-54
Carpets and rugs, wool	52	8	-29
Cordage and twine	38	7	-23
Jute goods	134	45	-38
Linen goods	-44	-43	0.3
Hats, fur-felt	26	-16	-33
Hats, wool-felt	90	92	2
<i>Leather products</i>			
Leather	61	-3	-40
Shoes	87	52	-19
Gloves	29	-3	-25
<i>Rubber products</i>			
Shoes	59	28	-20
<i>Paper products</i>			
Paper and pulp	518	177	-55

<i>Industry</i>	<i>Physical Output</i>	<i>Wage Earners</i>	<i>Wage Earners per Unit of Product</i>
	Percentage Change, 1899-1937		
<i>Printing and publishing</i>			
Total	494	78	-70
<i>Chemical products</i>			
Chemicals, industrial, incl. com- pressed gases and rayon	2,500	693	-70
Cottonseed products	63	51	-8
Wood-distillation products	259	184	-21
Explosives	267	20	-67
Fertilizers	248	80	-48
Paints and varnishes	391	228	-33
Salt	82	-3	-47
Tanning and dye materials	292	71	-56
<i>Petroleum and coal products</i>			
Petroleum refining	1,920	583	-66
Coke-oven products	380	21	-75
<i>Stone, clay and glass products</i>			
Glass	553	50	-77
<i>Forest products</i>			
Lumber-mill products	-32	-20	19
Turpentine and rosin	-32	-22	15
<i>Iron and steel products</i>			
Blast-furnace products	171	-41	-78
Steel-mill products	313	162	-36
<i>Nonferrous-metal products</i>			
Copper	272	28	-66
Lead	51	-51	-68
Zinc	318	132	-45
<i>Transportation equipment</i>			
Automobiles, incl. bodies and parts	180,000	21,300	-88
Carriages, wagons and sleighs	-95	-96	-33
Cars, railroad	-22	9	39
Locomotives	-79	-53	126
Ships and boats	-17	33	61

Source: Appendix F.

fold rise.¹ Though less spectacular than the great increases in the automobile industry, growth in both output and employment was very rapid also in the manufacture of chemicals, in petroleum refining and in fruit and vegetable canning; and at the other end of the scale there was slow growth or even decline in output and employment not only in carriages and wagons but in the industries producing railroad locomotives, lumber-mill products, flour, and chewing and smoking tobacco.

While changes in output and employment were closely related, increases in output tended to be greater than the corresponding rises in employment, as we already know from study of the labor-product ratio. More novel is the finding, plotted in Chart 15, that the breach between growth in output and growth in employment was usually wider among the rapidly growing industries than among the laggard ones. This is shown by the fact that the slopes of the regression lines (the dotted lines) fitted to the points in Chart 15 are both greater than 45 degrees (the slope of the solid line). The difference between rate of growth in output and employment is measured also, of course, by the decline in workers per unit. This decline was greatest in the automobile industry, which is to be credited also with the greatest expansions in output and employment. In industrial chemicals the product increased 2,500 percent and employment 690 percent, but employment per unit fell by 70 percent, a very sharp decline indeed. In lumber mills, on the other hand, output actually fell by 32 percent and employment by 20 percent; the result was a 19 percent *increase* in employment per unit.

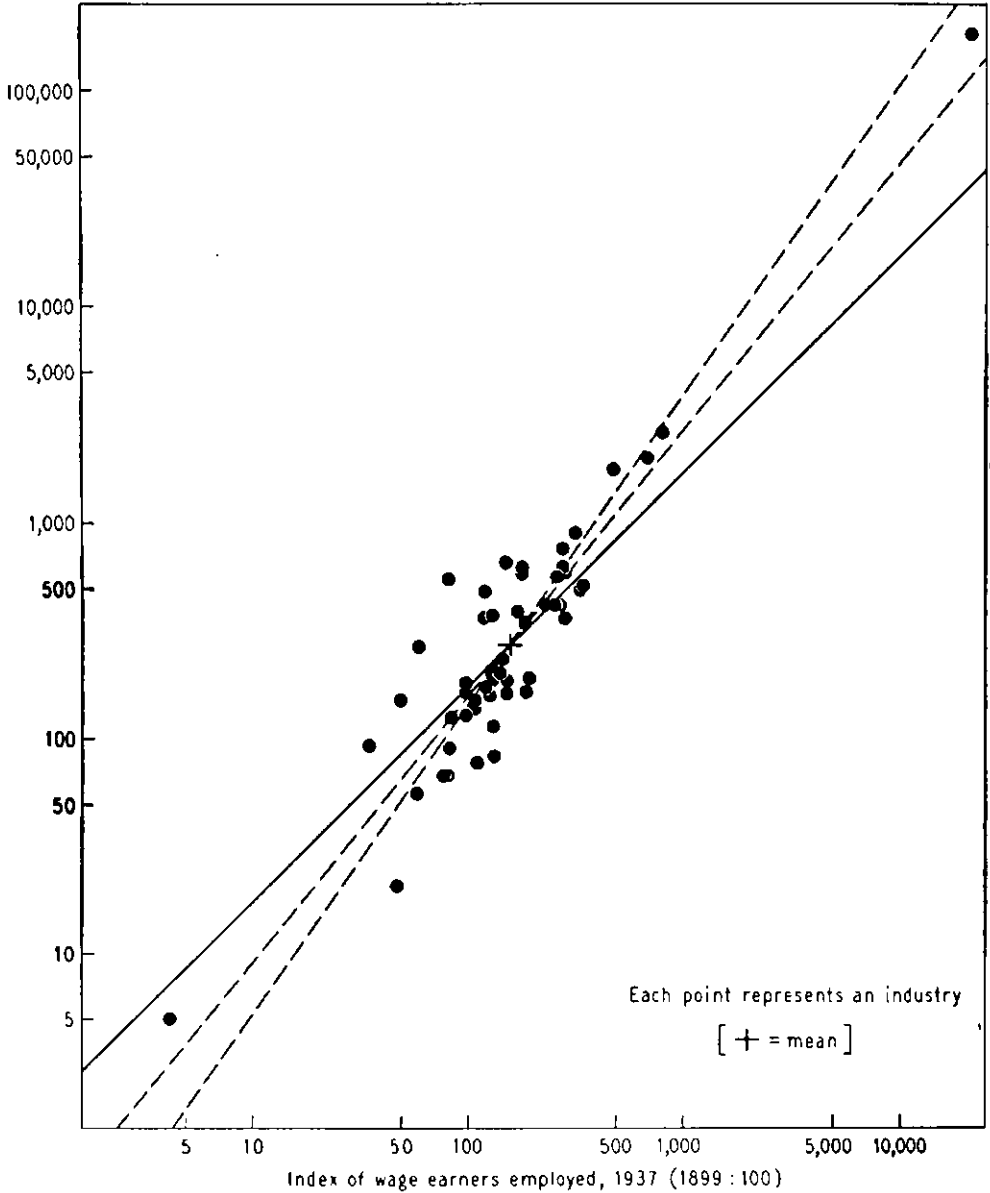
There are some exceptions to the general findings just set forth. In meat packing, for example, the number of workers employed increased 85 percent, almost as much as in total

¹ The coefficient of rank correlation between percentage changes, 1899-1937, in output and employment in the 51 industries listed in Table 6 is .86. The coefficient of correlation between logarithms of the original indexes is .93.

Chart 15

RELATION BETWEEN INDEXES OF WAGE-EARNER EMPLOYMENT AND OF PHYSICAL OUTPUT, 1937 (1899 : 100)

Index of physical output, 1937
(1899 : 100)



Based on Table 6

For an explanation of the lines see the accompanying text

Double logarithmic scale

manufacturing, yet employment per unit of product rose 12 percent. A few other industries also fail to conform to the dominant pattern. But by and large there was an inverse relation between change in both output and employment and the movement of labor per unit of product.²

² The coefficient of rank correlation between change in employment and in employment per unit is $-.31$; and between change in output and in employment per unit of output, $-.73$. The former coefficient is so low that it scarcely seems to differ significantly from zero. However, it should be noted that errors of measurement would in themselves tend to cause a *positive* correlation between changes in employment and those in employment per unit, and a *negative* correlation between changes in output and those in employment per unit.

The relations found above may be checked by fitting regression lines to the logarithms of the points in Chart 15. The lines obtained are as follows, with Q representing the index of output (1937 on the 1899 base), N the index of employment, and a and A being constants which need not be specified:

$$\begin{aligned}\log Q &= a + 1.23 \log N, \text{ and} \\ \log Q &= A + 1.43 \log N.\end{aligned}$$

(Exclusion of the extreme point for automobiles or of the extreme points for both automobiles and carriages and wagons does not change the slopes of the regression lines in any important degree.) These equations may be transformed into:

$$\begin{aligned}\log \frac{N}{Q} &= -a - .23 \log N, \text{ and} \\ \log \frac{N}{Q} &= -A - .43 \log N;\end{aligned}$$

or

$$\begin{aligned}\log \frac{N}{Q} &= a' - .19 \log Q, \text{ and} \\ \log \frac{N}{Q} &= A' - .30 \log Q.\end{aligned}$$

According to these results, the relation between $\frac{N}{Q}$ and N is inverse, as is also the relation between $\frac{N}{Q}$ and Q . This confirms the signs of the correlations given in the preceding paragraph.

As noted above, random errors tend to cause employment (or output) and employment per unit of product to be correlated. It is for this reason that we have studied these relations indirectly, through the data on employment and on output. But the employment and output indexes are also subject to error, and to some extent to common errors. Those of the latter type (e.g., variation in degree of coverage by the Census) will cause measurable changes in employment and output to be related. However, these errors affect both indexes to the same relative extent; they therefore tend to cause the slopes of the regression lines to be 45 degrees, not what we find them to be.

The inverse relation noted between the 38-year changes in employment and

These relationships are expressed somewhat differently in Chart 16, in which industries are ranked in descending order of increase in output. The bars representing declines in the employment-output ratios shrink from left to right, just as do the bars that stand for changes in output and employment. (If the industries were to be arranged in descending order of increase in employment, we would find a similar order for output, and an inverse order for employment per unit, though there would be less regularity of relationship.) In the industries that expanded output rapidly, even a substantial cut in the number of men employed per unit was not usually accompanied by a decline in jobs. In those with only a moderate rise in output, a decline in the ratio of men employed to units produced ordinarily meant rather slow growth in employment, and sometimes actually fewer jobs. On the other hand, the few industries that increased the number of workers per unit usually reduced the total number of their employees because they were the ones to suffer declines in output.

The same general conclusions apply to the relations between output, aggregate manhours, and manhours per unit of product. According to the records given in detail below

in employment per unit is absent for shorter periods. Indeed, the measurable correlations appear to be mildly positive, though these may easily be due to chance errors of measurement. For output and employment per unit, on the other hand, the correlations are negative even during the shorter periods; but these results, too, must be qualified because of the possibility of spurious correlation. The coefficients of rank correlation between percentage changes in employment and employment per unit, and output and employment per unit, are as follows:

<i>Period</i>	<i>Coefficient of Rank Correlation between Changes in:</i>	
	Employment and Employment per Unit of Product	Output and Employment per Unit of Product
1899-1909	+ .17	— .46
1909-1919	+ .12	— .25
1919-1929	+ .03	— .57
1929-1937	+ .17	— .54

Percentage change

200,000

20,000

10,000

8,000

6,000

4,000

2,000

1,000

800

600

400

200

100

0

-20

-40

-60

-80

-90

-95

1

2

3

4

5

6

7

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Chart 16

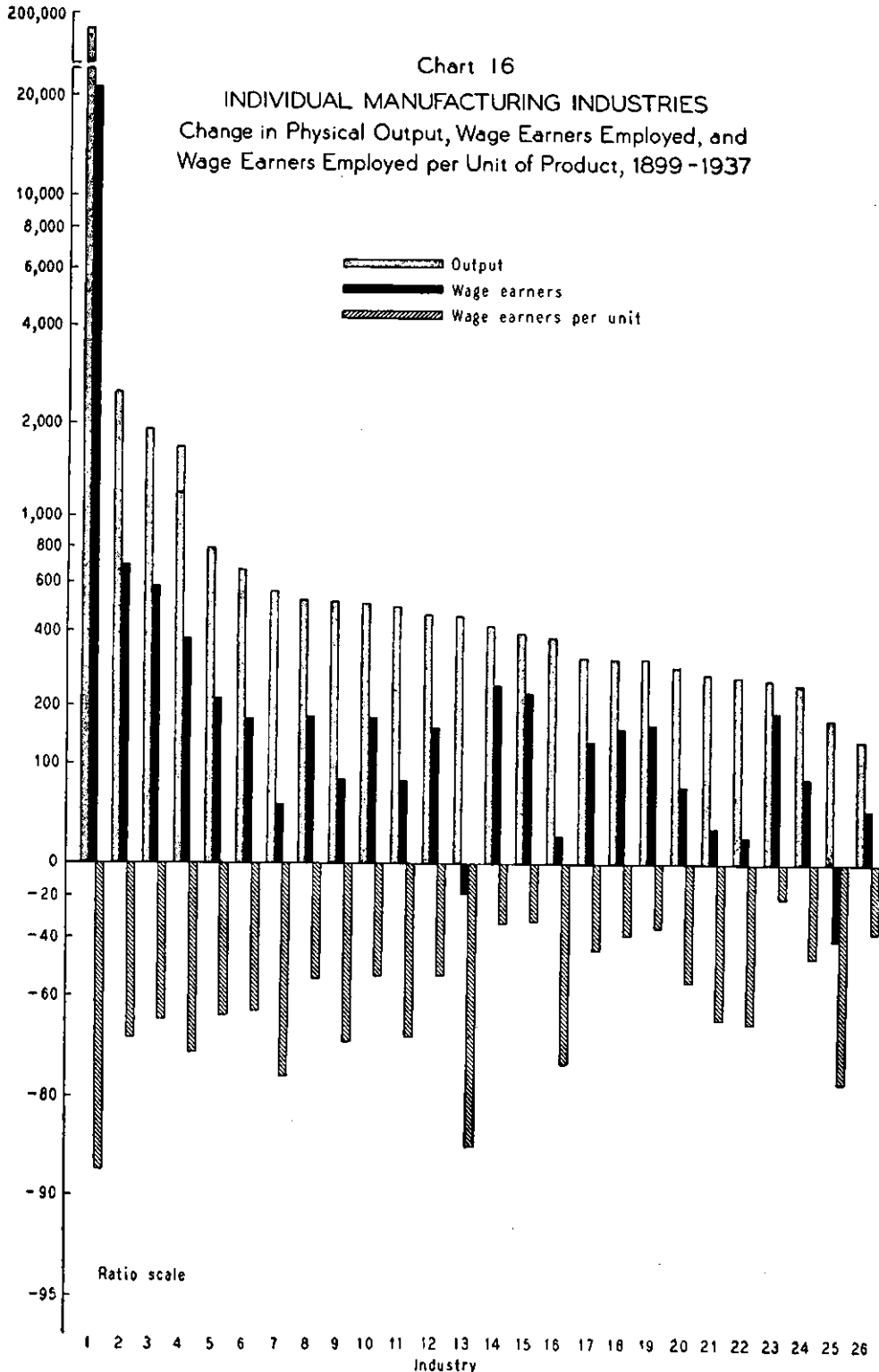
INDIVIDUAL MANUFACTURING INDUSTRIES

Change in Physical Output, Wage Earners Employed, and Wage Earners Employed per Unit of Product, 1899 - 1937

Output
Wage earners
Wage earners per unit

Ratio scale

Industry

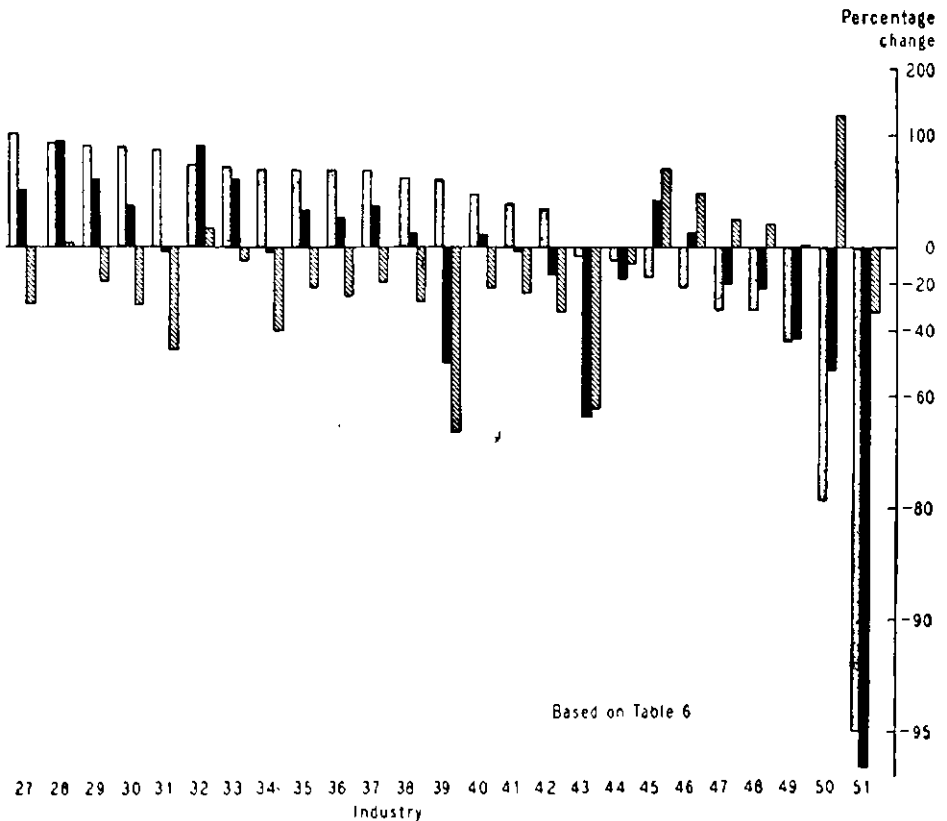


INDUSTRY

- 1 Automobiles, incl. bodies and parts
- 2 Chemicals, industrial, incl. compressed gases and rayon
- 3 Petroleum refining
- 4 Beet sugar
- 5 Fruits and vegetables, canned
- 6 Ice
- 7 Glass
- 8 Paper and pulp
- 9 Silk and rayon goods
- 10 Knit goods
- 11 Printing and publishing, total
- 12 Butter, cheese and canned milk
- 13 Cigars
- 14 Rice
- 15 Paints and varnishes
- 16 Coke-oven products
- 17 Zinc
- 18 Liquors, distilled
- 19 Steel-mill products
- 20 Tanning and dye materials
- 21 Copper
- 22 Explosives
- 23 Wood-distillation products
- 24 Fertilizers
- 25 Blast-furnace products
- 26 Jute goods

INDUSTRY

- 27 Cotton goods
- 28 Hats, wool-felt
- 29 Shoes, leather
- 30 Cane sugar
- 31 Salt
- 32 Meat packing
- 33 Cottonseed products
- 34 Leather
- 35 Woolen and worsted goods
- 36 Liquors, malt
- 37 Shoes, rubber
- 38 Carpets and rugs, wool
- 39 Lead
- 40 Cordage and twine
- 41 Gloves, leather
- 42 Hats, fur-felt
- 43 Chewing and smoking tobacco
- 44 Flour
- 45 Ships and boats
- 46 Cars, railroad
- 47 Lumber-mill products
- 48 Turpentine and rosin
- 49 Linen goods
- 50 Locomotives
- 51 Carriages, wagons and sleighs



(Table 8, pp. 102-04), available only for 1909-37 and for fewer than 51 industries, exceptionally rapid growth in output was associated with above-average increase in total manhours and with unusually drastic cuts in manhours per unit. Slow growth or actual decline in output was accompanied by less-than-average increase in total manhours and by relatively small declines in the manhour-output ratio.³

The interrelations among trends in employment, in output and in labor input per unit of manufactured goods pose a number of problems. They bring into question, for example, the role played by capital investment and other factors of production in growing and declining industries; the connection between unit labor requirements and wage costs; the effect of changes in costs of materials and overhead; the course of selling prices in relation to changes in unit labor requirements. Because of the limited scope of this report and also because data are inadequate, we cannot deal with all these problems, or fully with any of them. In the remainder of this chapter we shall, however, inquire briefly into long-run changes in one kind of capital, namely, that represented by fixed capital assets, and into modifications in hourly earnings of labor, labor costs, value added per unit, and selling

³ There is one important difference between the conclusions concerning change in number of workers and those concerning change in number of manhours. Since hours of labor fell, an above-average increase in manhours frequently meant a rather slight absolute increase in manhours, while an above-average rise in number of workers indicated an unusually large absolute increase in number employed. Similarly, a below-average change usually meant for manhours a rather severe absolute reduction, rather than the slow rate of growth or mild decline that a below-average change indicated for absolute number employed. (The data in Table 8 apply, of course, to the shorter period 1909-37, and exclude the decade of expanding output and employment beginning with 1899. It is partly for this reason that so few increases in manhours appear in the table. But it is hardly likely that extension of the table back to 1899, if this could be done accurately, would materially affect the conclusion stated in the text.) Thus, only 10 of the 19 industries in Table 8 with above-average increase in output and decline in manhours per unit had increases in manhours, while 17 had increases in number of wage earners. Of the other 19 industries, 17 were characterized by declines in manhours, and 5 showed rises in employment.

prices, in an endeavor to determine the relation between these developments and those already noted for output, employment and labor per unit. Since the industrial classification of capital assets varies from that of costs and prices, and because there is no uniformity in the time periods for which data are available, we shall have to treat capital assets apart from the other factors to be reviewed.

CAPITAL ASSETS

A swelling stock of capital goods is only one of the means by which the level of output is raised, and there may be cases of industrial growth in which capital assets have increased only slightly, or not at all. It is conceivable, too, that capital assets, by displacing other factors of production, have grown even in some declining industries. Yet what we can learn of industrial history from the rather crude information at hand bears out the generalization that the expansion of an industry has seldom been accomplished without an influx of capital; and that the aggregate volume of assets in declining industries has, as a rule, contracted. In the automobile industry, for example, total assets rose from less than \$6 million in 1899 to \$1,780 million in 1919. By 1937 automobile manufacturers held over \$3,100 million in assets.⁴ In rayon, another rapidly growing industry, total investment in the principal companies (measured in this case by stockholders' investment plus long-term borrowing) increased from \$8 million in 1915 to \$30 million in 1919, \$228 million in 1929, and \$281 million in 1937.⁵ On the other hand, total

⁴ The figures for 1899 and 1919, which include assets other than fixed assets, are taken from the Census of Manufactures; that for 1937 has been obtained from *Statistics of Income, 1937, Part II*. The last figure covers all assets held by automobile corporations, including investments in business other than motor vehicles.

⁵ Principal rayon companies, covering 99 percent of total production of rayon and yarn and staple fiber in 1920, 94 percent in 1929, and 88 percent in 1937. A Study Submitted by the Federal Trade Commission to the Temporary National Economic Committee, *Part 31* (1941), pp. 17982 and 17988.

assets held by manufacturers of carriages and wagons, including materials and parts, amounted to \$152 million in 1904, \$175 million in 1909, \$177 million in 1914, and—despite the great rise in prices—only \$97 million in 1919. And for marble and stone work, another industry which reached its peak early in the period, the corresponding figures are: \$79 million in 1904; \$115 million in 1909; \$118 million in 1914; and \$113 million in 1919.⁶

Allowance for price changes, revaluations, differences in coverage and other incomparabilities in the statistics would modify the contours of these pronounced trends only slightly. Yet this statement is an admission, too, that available data on capital are difficult to interpret when trends are not so well defined as to obviate the need for precise statistics.⁷ Even from such sparse information as we can command it is possible, however, to make a few observations.

It was noted above that employment rose most rapidly in the industries whose output also rose at record speed. If, in addition, better-than-average increases in output have been associated with a rising volume of capital equipment, as is likely, then growth in capital has coincided with growth in employment more often than with decline in employment. Despite some deficiencies, the available statistics reinforce this inference. In Table 7 we present percentage changes between 1904 and 1937⁸ in book values of net capital assets and other series for groups of manufacturing industries and for two individual industries. The capital data are uncorrected for price changes, their industrial classification is not quite identical with that underlying the employment and output data, and the groupings are often rather heterogeneous. Yet certain conclusions are obvious. The largest in-

⁶ Figures for both declining industries are from the Census of Manufactures. Data for subsequent years are not available.

⁷ See Appendix E.

⁸ Unfortunately, lack of data prevents comparisons over periods consistent in length with those used in other tables in this volume.

TABLE 7

GROUPS OF MANUFACTURING INDUSTRIES

Indexes of Output, Number of Wage Earners, Net Book Value of Capital Assets and Derived Ratios, 1937 relative to 1904

1904: 100

<i>Industrial Group</i>	<i>Physical Output</i>	<i>Number of Wage Earners</i>	<i>Capital Assets^a (net book value)</i>	<i>Wage Earners per Unit of Product</i>	<i>Capital Assets per Wage Earner</i>	<i>Capital Assets per Unit of Product</i>
Foods	281	217	432	77	199	154
Beverages	183	130	188	71	144	102
Tobacco products	313	59	283	19	483	90
Textile products	223	155	230	70	149	103
Leather products	147	125	126	85	101	86
Rubber products	..	294	890	..	303	..
Paper products	467	212	621	45	293	133
Printing and publishing	386	158	292	41	185	76
Petroleum refining	1,660	496	5,450	30	1,100	329
Chemical and coal products	542	218	443	40	203	82
Stone, clay and glass products	..	110	363	..	329	..
Forest products	100	95	308	95	325	309
Iron and steel products	309	198	432	64	218	140
Nonferrous-metal products	..	175	267	..	153	..
Electrical machinery	..	483	781	..	162	..
Machinery, other than electrical	..	188	258	..	138	..
Automobiles, incl. bodies and parts	36,000	3,980	12,300	11	308	34
Transportation equipment, other than automobiles	58	76	308	131	407	534
Miscellaneous products	..	162	773	..	478	..
TOTAL MANUFACTURING	302	166	438	55	264	145

Sources: The indexes of output are from Appendix F, except that for chemical and coal products, which was specially computed for this table, according to our usual procedure. The indexes of wage earners are based on data in Appendix Table B-1; and those of capital assets are constructed on the basis of information collected in Appendix E.

* Exclusive of land.

creases in employment over the 33-year period 1904-37 occurred in those groups in which fixed capital investment also rose most rapidly. Automobile manufacture, petroleum refining, electrical machinery, chemicals and rubber products stand out in this respect. And among the groups with relatively slight growth in employment are also those with less-than-average increases in capital assets: tobacco, beverages, leather, textiles, forest products, and transportation equipment (other than automobiles). Exceptions exist, of course—one of them is nonelectrical machinery manufacture—but the correlation remains impressive.⁹

Not only has there been a strong bond between employment and capital trends in manufacturing industries, but there has been a tendency for capital assets per worker, as well as for total capital assets, to rise more rapidly in growing than in declining industries.¹⁰ Increase in means of production—machines, tools, structures—has accompanied rise in output and, at the same time, decline in unit labor requirements.

Investment lessens employment per unit of product by increasing the volume of capital assets made available to each worker, and by augmenting the scale of operations and the volume of output. Since capital additions are likely to be improvements over existing equipment, investment helps to reduce labor per unit further than would otherwise be the case. Indeed it provides one of the major channels through which technological advances cut into unit labor input. Many such technological innovations take on concrete form only through changes in the character of new capital goods. Such embodiment of new ideas may occur not only in net additions to capital, but also through the reinvestment of funds freed by capital consumption, such as depreciation, though

⁹ The coefficient of rank correlation is .71.

¹⁰ The coefficient of rank correlation between changes in output and in capital assets per worker is .27. The coefficient of rank correlation between changes in aggregate capital assets and in output is .71.

the speed with which improvements in tools, equipment and structures are put into operation is stepped up when the stock of capital assets is growing and not merely maintained. Even if the stock of capital assets held by an industry rises less rapidly than employment—and even if aggregate assets (deflated for price changes) decline—new investment or replacement can help reduce labor per unit. Although employment fell in relation to output in all groups listed in Table 7, in some of them the rises in book value of capital assets per worker were almost negligible, and in some there were actual declines in capital assets per unit of product.¹¹

The conclusions just stated derive quite simply from the premise that improvements are continually being effected in the capital goods utilized by all industries. If we can assume further that the rate of innovation in techniques has been greater, on the average, in rapidly growing industries than in the mature or stagnant ones—and this is not at all unlikely—then the rate of increase in the average “quality” of capital goods would usually be higher in the growing industries. Thus capital investment would tend still further to cut unit labor requirements in the thriving industries, and to stimulate even greater increases in their output.

UNIT COSTS AND PRICES

In preceding pages we have considered certain aspects of the development of manufacturing industries since 1899. We have found that the most rapidly growing industries were, as a rule, those with better-than-average increases in employment and capital assets as well as output, and with the

¹¹ Even the increases in book value of capital assets per worker shown in Table 7 do not all reflect growth in the physical stock of capital goods per worker. Some part of these increases is attributable to the upward movement of prices. Rises of as much as 50 percent in capital assets per worker or per unit of product might easily be accounted for by the price increases between 1904 and 1937. For all manufacturing combined the most acceptable estimate of the rise in the prices underlying book values of capital assets is around 80 percent. (See Appendix E.)

sharpest reductions in labor per unit. The industries that lagged in pushing up output were also usually backward in raising the number of their workers and the stock of their capital goods; moreover they tended either to cut labor per unit only slightly or actually to raise it. In this section we shall trace the course followed by unit costs and prices in growing and declining industries, and note how costs and prices have behaved in relation to growth in output and employment and to decline in labor per unit. First of all we shall describe briefly the pattern we discover among the changes in the several indexes.

Chart 17 brings together the various quantities for 25 industries: unit wage costs, unit value added (selling price minus unit cost of materials and fuel), and selling price, in addition to manhours, output, and manhours per unit—material already familiar to the reader. By ranking each industry, as we do in the chart, with respect to each of the 6 series,¹² the rather complex picture described by the original indexes (given in Table 8 below), is seen in a clearer light.

Even a casual glance at the chart indicates a tendency toward similarity of ranks. For example, the automobile industry ranks high, while lumber manufacture stands low, in respect of each quantity. Averages of the ranks in each row of Chart 17 differ from one another more widely than one would expect if the variation were a matter merely of chance.¹³

A still simpler picture emerges if the 25 industries in

¹² Unit labor requirements, value added per unit, wage cost per unit, and selling price are ranked in reverse order.

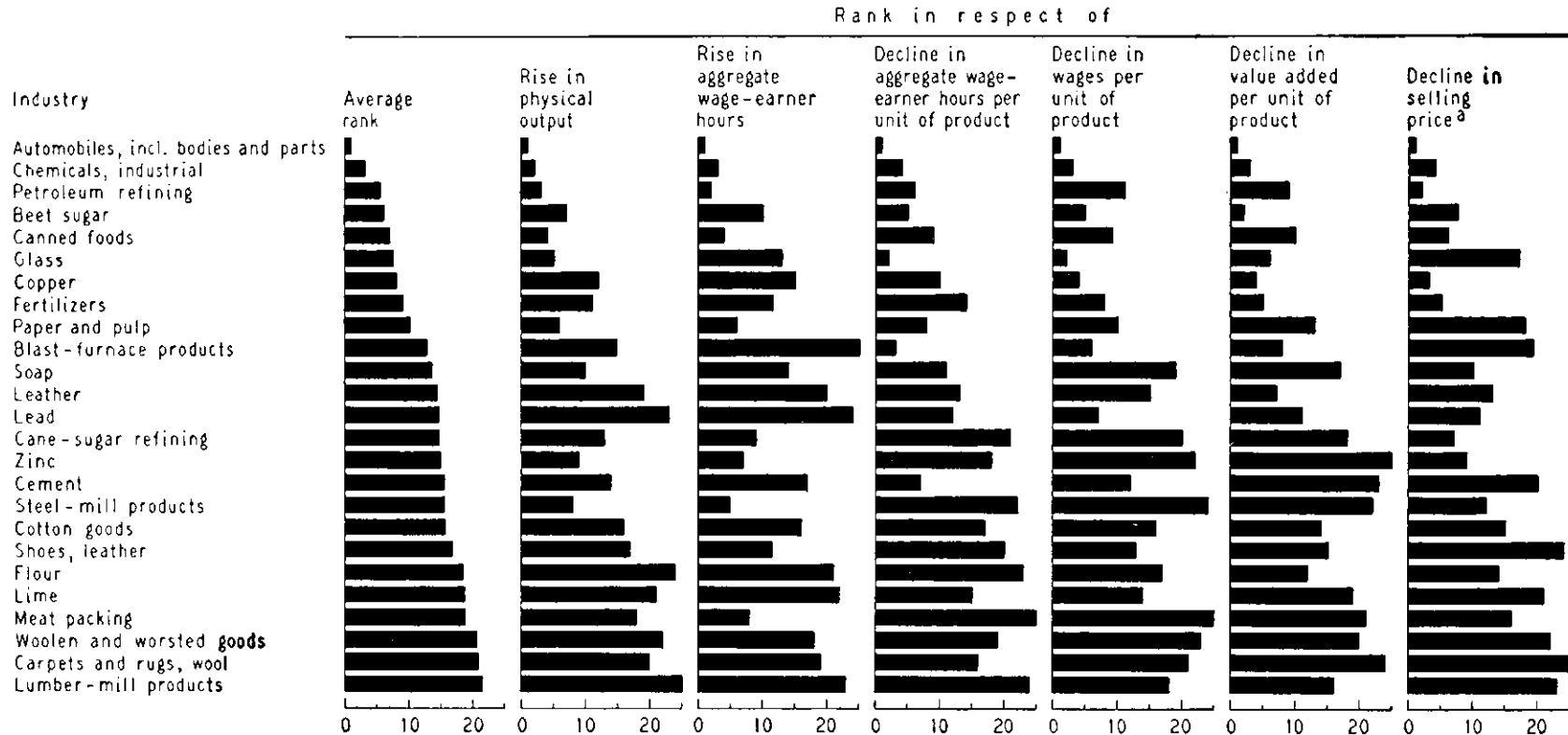
¹³ Milton Friedman's "method of ranks" (*Journal of the American Statistical Association*, Dec. 1937, pp. 675-701) was applied as a test, with the result indicated in the text.

The "coefficient of concordance" for the ranked data in Chart 17 is .57. Since the value of this ratio approaches unity when all ranks in each row become identical, and zero when they are entirely unrelated (see W. Allen Wallis, *Journal of the American Statistical Association*, Sept. 1939, pp. 533-38), there is an appreciable degree of concordance among the ranks of all six series.

Chart 17

INDIVIDUAL MANUFACTURING INDUSTRIES

Ranked According to Change in Unit Costs, Prices and Other Economic Quantities,
1909 - 37^a



Based on Table G-3

^a Percentage changes in selling prices are from 1913 to 1937

Chart 17 are divided into two groups, the 12 in the upper half with respect to each one of the quantities, and the 13 in the lower half. If the rankings were purely matters of chance, we would expect no pronounced consistency of position. About one third of the industries would be ranked above average in respect of three quantities and below average in respect of the other three; about one half consistently above (or below) average for four quantities and below (or above) for two; about one fifth, consistently above (or below) average for five quantities; and the remainder, less than one twentieth, consistently above (or below) average for all six quantities.¹⁴ In fact, we find almost the reverse frequencies. Ten of the 25 industries are consistently high (or low) for all 6 series; 6, for 5 series; 5, for 4 series; and 4 are divided equally. In other words, five industries—automobiles, petroleum refining, chemicals, beet sugar and canned foods—are above average in increase in output, increase in manhours of employment, decrease in unit labor requirements, decrease in wage cost per unit, decrease in value added per unit, and decrease in selling price of products. Five others—cotton goods, woolen and worsted goods, carpets and rugs, lime, and lumber—are below average in all these respects. Fertilizers and copper are above average in five respects; meat, flour, leather and shoes, below average in five respects.¹⁵

It is clear that a pattern is to be found in the mosaic of changes defined summarily by Chart 17 and in detail by Table 8. Industries with most rapid rates of growth in output and employment and deepest cuts in labor per unit (three concomitant characteristics, as was noted in earlier sections), are also those with lowest increases (or actual decreases) in wage cost per unit, value added per unit, and selling price.

¹⁴ These theoretical frequencies were computed by reference to the coefficients of the terms in the binomial expansion of $(\frac{1}{2} + \frac{1}{2})^6$. A slightly more correct procedure would be based on $(\frac{12}{25} + \frac{13}{25})^6$, but this is hardly worth while.

¹⁵ Some degree of spurious correlation undoubtedly affects these results, but it is impossible to say just how seriously. It is very difficult to believe that the spurious element alone accounts for the relations noted.

And the laggard industries, in which output and employment fell or rose but slightly, are characterized not only by rises or modest cuts in labor per unit but also by greater-than-average increases in unit wage costs, in value added per unit, and in selling price.

So much for a summary of the pattern outlined by Chart 17. A more detailed description of the interrelationships defined by the chart will be obtained if we trace the rather devious connection between changes in labor per unit and changes in volume of output. In the course of this analysis we shall note (1) how reductions in manhours per unit have tended to coincide with reductions in costs; (2) how lowering of costs has been associated with downward revisions of price; and finally, (3) how decline in price has been accompanied by increase in sales. In studying these links in the chain between labor per unit and output we shall cover all the factors included in Table 8 and mention some others in addition.

The first relationship to be described is that between unit costs and unit labor requirements. Here it is necessary to look into changes in wage rates and their bearing on unit wage costs; and then note the possible effects of changes in non-labor costs, as well as wage costs, upon total costs per unit of product.

Now it is true that reductions in manhours per unit were accompanied by increases in wage cost per unit more frequently than by cuts.¹⁶ One reason, of course, is the rise in the general level of wage rates. As the data assembled in Table 8 indicate, wage rates (measured roughly by average hourly earnings)¹⁷ rose in all manufacturing industries between 1909 and 1937, with increases ranging from 87 to 300

¹⁶ Labor per unit may be measured either by workers per unit or by manhours per unit. Workers per unit did not move identically with manhours per unit, but changes in the two are sufficiently proportionate to permit interchangeable citation in the present context. This is true also of aggregate employment and aggregate manhours.

¹⁷ Average hourly earnings should not be regarded as exact measures of wage rates because, among other reasons, they relate to groups of workers inconstant with respect to occupation and skill.

TABLE 8
INDIVIDUAL MANUFACTURING INDUSTRIES
Indexes of Unit Costs, Prices and Other Economic Quantities,
1937 relative to 1909^a
1909:100

<i>Industry</i>	<i>Physical Output</i>	<i>Aggregate Wage- Earner Hours</i>	<i>Wages</i>	<i>Value Added</i>	<i>Aggregate Wage- Earner Hours per Unit of Product</i>	<i>Wages per Hour</i>	<i>Wages per Wage Earner</i>	<i>Wages per Unit of Product</i>	<i>Value Added per Unit of Product</i>	<i>Selling Price*</i>
<i>Foods</i>										
Meat packing	130	110	338	244	85	306	234	260	188	152
Flour	84	53	141	116	63	268	210	169	138	145
Canned fish, fruits, and vegetables	445	179	538	583	40	302	205	121	131	104
Beet sugar	264	91	244	184	35	267	188	92	70	111
Cane-sugar refining	162	94	284	278	58	303	191	175	171	111
<i>Beverages</i>										
Liquors, distilled	319	106	406	44	33	382	277	127	14	..
<i>Tobacco products</i>										
Total	270	39	103	376	15	261	183	38	139	..
<i>Textiles</i>										
Cotton goods	146	74	241	218	50	328	212	164	148	145
Woolen and worsted goods	111	62	226	199	56	367	234	203	179	170
Silk and rayon goods	342	78	240	203	23	307	203	70	59	..
Knit goods	350	116	445	377	33	383	248	127	108	..
Carpets and rugs, wool	118	58	207	252	49	357	224	176	213	226
Hats, fur-felt	80	42	125	126	53	297	196	157	158	..

<i>Industry</i>	<i>Physical Output</i>	<i>Aggregate Wage-Earner Hours</i>	<i>Wages</i>	<i>Value Added</i>	<i>Aggregate Wage-Earner</i>	<i>Wages per Hour</i>	<i>Wages per Wage Earner</i>	<i>Wages per Unit of Product</i>	<i>Value Added</i>	<i>Selling Price^a</i>
					<i>Hours per Unit of Product</i>				<i>per Unit of Product</i>	
<i>Leather products</i>										
Leather	126	57	191	146	46	334	234	152	116	140
Shoes, leather	143	81	207	214	57	256	178	145	149	193
<i>Paper products</i>										
Paper and pulp	328	129	430	474	39	334	237	131	144	154
<i>Printing and publishing</i>										
Total	286	108	314	355	38	290	234	110	124	..
<i>Chemicals</i>										
Chemicals, industrial, incl.										
rayon and compressed gases	1,370	365	1,210	1,190	27	332	227	88	87	85
Cottonseed products	113	78	146	165	69	187	151	129	146	..
Soap	178	80	307	296	45	385	284	173	167	129
Explosives	151	62	200	196	41	322	233	133	131	..
Fertilizers	177	81	206	191	46	254	180	116	108	87
Paints and varnishes	291	176	518	494	61	293	233	178	170	..
<i>Petroleum and coal products</i>										
Petroleum refining	1,080	392	1,430	1,300	36	365	240	132	120	64
<i>Stone, clay and glass products</i>										
Cement	158	62	222	334	39	360	225	141	211	160
Lime	112	52	163	197	46	313	229	145	176	168
Glass	361	80	258	412	22	323	225	72	114	153

exercise considerable influence on its unit labor cost. But it is total fabricational cost, rather than labor cost alone, that may be expected to affect prices and output. And changes in labor costs and in total costs of manufacture are never in precise one-to-one correspondence, because changes in nonlabor costs usually differ from changes in wage costs, and because the proportion of total factory cost accounted for by payrolls varies from industry to industry.²⁰ Yet there has been a strong correlation between changes in the total cost of fabrication and changes in aggregate manhours employed, as well as between fabricational costs per unit and unit labor requirements (Table 8).²¹ Despite the rise in wholesale prices already mentioned, value added (costs of fabrication, including profits) per unit fell in 6 industries, 5 of these being among those which cut wage cost per unit. Just as unit labor requirements declined most in the industries that grew most rapidly in terms of output, so the value added to each unit fell most (or rose least) in the advancing industries; and in the backward industries, just as unit labor requirements shrank least, so value added per unit also declined least.²² The obvious explanation is that labor cost constitutes an important portion of the total costs of fabrication. It is possible, too, that nonlabor factory costs tend to drop more sharply in rapidly growing, than in stagnant, industries. If this is true, and the data on capital assets previously discussed seem to suggest that

²⁰ See Charles A. Bliss, *The Structure of Manufacturing Production, A Cross-Section View* (National Bureau of Economic Research, 1939), pp. 63 and 70. Dr. Bliss shows in his detailed analysis of the Census data for 1929 that wage costs ranged from less than 5 percent of value of product to slightly more than 55 percent, and from less than 10 percent of value added (value of product less cost of materials and fuel) to a top figure of 65 percent.

²¹ The coefficient of rank correlation between unit labor requirements and fabricational cost per unit (measured by value added, the difference between value of products and cost of materials) is .78.

²² The relation between growth in output and change in value added or value per unit is discussed in more detail in Chapter 5 of *The Output of Manufacturing Industries, 1899-1937* (National Bureau of Economic Research, 1940), pp. 104-20.

it is,²³ then reductions in nonlabor costs per unit would tend to augment, rather than to offset, the effects of reductions in unit labor requirements.

Up to this point we have looked into the relation between labor per unit and costs of fabrication per unit. We have found that the industries in which labor per unit fell drastically are also those in which wage cost per unit of product usually fell or rose less than the average, and that the value added by these industries per unit (i.e., their unit costs of fabrication, including profits) was reduced or pushed up only slightly in comparison to the increase in total value added per unit in all factories. Industries in which reductions in labor per unit lagged were also slow to reduce unit wage costs and costs of fabrication per unit.

The next link in the chain we are tracing between unit labor requirements and output is that between unit costs of fabrication and unit prices. Here the relation is quite naturally affected by the cost of materials per unit of product, by the character of the particular industry, and the prevailing state of competition. The unit cost of materials is a function not only of the price of materials, but also of the amount of materials consumed per unit of product. But changes in prices of materials and savings in materials used per unit are too complex to be dealt with summarily. It is also impossible to remark both briefly and accurately upon the extent of, and the industrial variation in, the degree of monopoly. Aside from the weighty theoretical problem of measuring monopoly power, there are the serious practical difficulties arising not only from the lack of statistical data but from the changing status of individual industries in respect of the control they can exercise over the relation between their unit costs and their prices. Ironically enough, the very fact that an industry may be highly integrated makes it impossible for the Bureau

²³ Though here, too, there is danger of spurious correlation.

of the Census to publish separate data for it without revealing confidential information. For this reason the aluminum industry, among others, has never been shown separately in the Census of Manufactures.²⁴ Despite the paucity of data, there is no doubt that material costs and price controls, as well as changes in costs of fabrication, affect selling prices, and that they do so in varying degree from industry to industry. Here also, therefore, there is loose articulation in the structure of the relationships we are tracing, and considerable room for variation, as is observable from the indexes of selling prices collected in Table 8. Owing to gaps in the data, the indexes of selling prices cover the period 1913-37 rather than 1909-37, but the difference of 4 years is hardly likely to affect the results appreciably. Outweighing by far this slight disadvantage is the fact that the indexes of selling prices were obtained from a non-Census source.²⁵ There is therefore no danger of spurious correlation, so that one does not tend to question the fairly considerable degree of correlation found to exist between changes in value added per unit and in selling prices.²⁶ Between wage cost per unit and selling price, and between unit labor requirements and selling price, too, the correlation is fairly definite.²⁷

So far we have seen that industries at the head of the list with respect to reductions in manhours per unit are also, as a rule, those with greatest reductions in unit costs of fabrication and selling prices. The final link between labor per unit and output is the connection between selling price and output. This relation depends on the nature of the demand for the product, which is conditioned, of course, by the prices

²⁴ Up through 1937 aluminum production was included in "industrial chemicals," and beginning with 1939 in "primary nonferrous metals."

²⁵ Prices could have been derived from Census reports, and for practically all industries for which output data are available, but the advantage of an independent source would have been lost.

²⁶ The coefficient of rank correlation is .57.

²⁷ The coefficients of rank correlation are, respectively, .49 and .39. These measures, too, are free from spurious correlation.

of related commodities, whether competitive or complementary. Thus the demand for gasoline at a specified price depends on such variables as the number of motor cars competing for road space, the price of rubber tires, and so on; and the nature of the demand for lumber is a function of the price of steel, brick, and cement, as well as of wage rates in the construction industry. Since elasticities of demand vary from industry to industry and period to period, no single or rigid relation between the trends we have analyzed is to be expected. Yet the correlation between changes in output and those in selling price is quite definitely negative, and fairly substantial (Table 8).²⁸

Actual cuts in selling price, despite the average rise in wholesale prices, were effected in the industries producing fertilizers, copper, chemicals, petroleum products and automobiles. The last three increased their output far more than the other industries listed in the table. The first two also pushed up production more than the remaining industries for which we have indexes of selling prices. The greater increases in price, on the other hand, apply to those products, notably lumber and flour, which usually either lagged in growth or actually declined.

The foregoing analysis has proceeded from change in unit labor requirements to change in output, in an attempt to trace the connection between them. We have observed that rate of decline in labor per unit has been associated with rate of decline in unit cost of fabrication; that costs of fabrication, in turn, have fallen or risen with selling price; and finally, that selling price has dropped most precipitately in industries in which output has climbed most rapidly. The causal sequence may run in the other direction as well. Growth in output, whatever the initial stimulus, will tend to eventuate in economies of large-scale production, one of which frequently is a reduction in unit labor requirements. Capital

²⁸ The coefficient of rank correlation is $-.66$.

equipment is more readily acquired when output is rising. As we have noted above, there is a fairly strong correlation between trends in output and in capital assets. Organizational changes are more easily introduced in growing industries. Even the rate of improvement and innovation in equipment, methods and organization may be stimulated more in growing than in declining industries. In this concatenation of relationships, also, we find reason to anticipate some degree of correlation (though not a high one) between decline in employment per unit of output and growth in output.

We have now completed a rather sketchy survey of the intricate chain of relationships between changes in unit labor requirements and changes in output. We have said nothing, however, about the character of the equally complex relation between changes in manhours of employment and in unit labor requirements. It will be remembered that these also have been negatively correlated, just as have changes in output and in unit labor requirements.

The basis for an understanding of the inverse relation between labor per unit and manhours is implicit in the evidence already presented in Table 8. We can develop it further by taking explicit note of one aspect, not previously mentioned, of the relation between trends in unit labor requirements and in output, and showing how it illuminates the relation between trends in unit labor requirements and in manhours. The fact to be observed is that movements in labor per unit, in contrast to output movements, were tightly clustered together. The changes in labor per unit ranged, for the industries listed in Table 8, from a decline of 92 percent to a rise of 142 percent, whereas the changes in output varied from a drop of 80 percent to a gain of 4,900 percent. That is, extraordinarily large increases in output, relative to the average change in output, were associated with comparatively moderate decreases in unit labor requirements, also measured in relation to the average movement;

while large declines in output (again compared with the average change in output) were associated with relatively moderate declines in manhours per unit. This relation is not difficult to explain. New uses for a product develop after its unit labor requirement, initially, and its price, eventually, have fallen, and old uses formerly too costly for wide application no longer are impracticable. It is probable, too, that the industries with the most rapid rates of growth are also predominantly those whose products are characterized by demands elastic with respect to income or price or both. Even moderate reductions in labor per unit and thus in selling price would then be accompanied by large increases in output. It is this that explains why trends in unit labor requirements have been negatively correlated with trends in man-hour employment, as well as with trends in output.²⁹

Employment trends, it should be apparent by now, are an important thread in the pattern of industrial development

²⁹ Let us consider the relation that would exist between labor per unit and employment if the degree of variation in labor per unit equaled or exceeded the degree of variation in output (remembering always, of course, that labor per unit and output are negatively correlated). Let us suppose, first, that given percentage changes in output (relative to the average change) were negatively associated with changes of *like* degree in unit labor requirements (also measured by reference to the average). In this case, there would be *no* significant correlation, positive or negative, between trends in unit labor requirements and trends in manhours. This does not mean that manhours would not fall in relation to output, but rather that manhours would not rise *more* rapidly (or less rapidly) in industries drastically cutting unit labor requirements than in those reducing these requirements only moderately. Now suppose that given percentage changes in output (relative to the average change) were negatively associated with changes of *greater* degree in unit labor requirements (measured against the average). In this case, the correlation between trends in manhours and in unit labor requirements would be *positive* rather than negative. Especially drastic declines in unit labor requirements would then be associated with relative declines in manhours of employment rather than with relative rises; and conversely for especially moderate declines in labor per unit of product. In fact, however, neither of these cases is to be found. The degree of variation among changes in unit labor requirements was neither greater than, nor equal to, the degree of variation among changes in output. The former was less than the latter. As a consequence, then, changes in unit labor requirements were negatively correlated with changes in manhours of employment.

To restate the argument, a negative correlation between trends in unit labor requirements and trends in output is not inconsistent, at least logically,

Chapter 5

Employment during Stages of Industrial Growth and Decline

THE close bond between an industry's output and employment trends is a matter of common observation. The development and successful production of the electric light and motor gave rise to phenomenal increases in employment in these and related branches of industry. As the output of electrical products slowed down somewhat after its initial spurt, the rate of increase in the jobs the industry had to offer slackened to a more moderate pace. And now that the electrical products industry has grown to something like full stature, it resembles most other relatively mature industries in its rather stable volume of employment. Or, to take an enterprise that is now virtually defunct, we can turn to the production of horse-drawn carriages and wagons which ceased its development during the first decade of this century; its peak in output was naturally accompanied at about the same time by a peak in the number of workers this industry employed. With the subsequent decline in the output and use of carriages and wagons, most of the people who had looked to the industry as a source of livelihood had to seek jobs in other fields.

So much is obvious; but it is also rather vague. As soon as we seek to learn exactly how employment changes during the growth and decline of an industry we see the need for more systematic examination of the available facts. Does employment *always* rise with output during the growing phase of an industry's development? How does the tempo of increase in employment usually compare with that in output? In how many manufacturing industries have output and employment already reached a peak? Do the peaks in employ-

ment and output usually coincide or does one precede the other?

PEAKS IN EMPLOYMENT AND OUTPUT

Let us first determine and compare the timing of the peaks reached by employment and output in the manufacturing industries for which we have appropriate data.¹ Peak Census years in employment in all manufacturing industries for which fairly continuous data are available are summarized in Table 9.² The most striking feature of the table is the rather wide

¹ It might be thought that these facts could be inferred from information already presented to the reader. However, although we know that employment per unit of product has generally fallen, and can conclude from this earlier finding that maximum points in employment usually precede the corresponding maximum points in output, we do not know in how many industries peaks have actually been reached in these series until we look at them. And even for the industries which have passed the peaks in both employment and output, the validity of any inference as to their timing, if drawn from the declining trend in employment per unit alone, would be open to doubt. For one would have to know, in addition, whether the cycles and random fluctuations impressed on the series for output and employment are so negligible in amplitude as to have little or no effect on the position of the maximum points. This is hardly likely to be the case. Further, since cycles and random movements tend to follow similar time patterns in both output and employment (for obvious reasons), actual peaks in these series, as distinguished from the maxima of smooth primary trend lines, may coincide rather than differ in timing. For these reasons we cannot claim that the discussion of preceding chapters has told us enough about peaks in employment and output to obviate a special analysis.

² It is well to take note of the qualifications to this table. The information gathered there relates to specified years in a circumscribed period. It is possible, therefore, though not very likely, that higher points in employment were reached in some industries in the period preceding 1899. Moreover, it is probable that the industries with peaks in 1939 may go on to greater heights, aside from effects of the current war boom; some peaks even in earlier years may be exceeded after 1939. The table as originally prepared covered 1899-1937, and showed 69 industries with peaks in 1937. Some 19 of these 69 reached new highs in 1939; and 5 industries which, on the basis of data for 1899-1937, had highs in 1904, 1925, 1927, 1929 and 1935, touched even higher points in 1939, according to data for 1899-1939.

The failure to cover all years in the four decades 1899-1939 also limits the value of the results. But a check of the Census data for 30 industries, made by reference to annual series provided by the U. S. Bureau of Labor Statistics for 1919-39, indicates that this is not a serious limitation. No difference was found for 23 industries, and 1 year's difference for 5. The differences for the other 2 industries were 3 and 7 years, respectively.

distribution of high points in employment among the four decades following 1899. Although total factory employment reached its high in 1937 (if we look only at Census years), in no Census year among the 15 listed in Table 9, not even in the severe depressions of 1921, 1931 and 1933, did employ-

TABLE 9

FREQUENCY DISTRIBUTION OF INDIVIDUAL
MANUFACTURING INDUSTRIES BY CENSUS
YEAR OF PEAK EMPLOYMENT AND
OUTPUT, 1899-1939

<i>Peak Census Year</i>	Number of Industries	<i>Employment</i>		<i>Output</i>
		Number Covered by Complete Data for 1899-1939 ^a	Number for Which Indexes of Output are Available for 1925 or Earlier ^b	Number for Which Indexes of Output are Available for 1925 or Earlier ^b
1899	10	8	5	2
1904	12	6	4	2
1909	19	7	5	2
1914	10	6	4	4
1919	73	42	27	4
1921	2	2	1	..
1923	35	16	15	6
1925	12	5	6	4
1927	9	3	4	6
1929	37	19	4	23
1931	1	..	..	2
1933	2	..	..	1
1935	8	4	2	2
1937	50	32	21	15
1939	24	16	5	30
TOTAL	304 ^c	166	103	103 ^d

Source: Based on Appendices B-1 and F.

^a That is, all industries with employment series beginning in 1899 and ending in 1939.

^b In the compilation of the figures given in the last two columns the several printing and publishing industries, treated as separate branches in the first two columns, were combined and counted as one industry.

^c The 51 industries with peak employment in a Census year prior to 1919 are:

ment fail to touch a peak in at least one manufacturing industry. Of the 304 industries represented in the table, two fifths reached their peak employment in 1919 or an earlier Census

Footnotes to Table 9, concluded

Peak in 1899

Chewing and smoking tobacco
Collars, men's
Mats and matting
Gloves, leather
Charcoal
Cooperage
Turpentine and rosin
Nails and spikes
Lead
Umbrellas and canes

Peak in 1904

Malt
Linen goods
Saddlery and harness
Whips
Engraving, wood
Hones
Mirror and picture frames
Boxes, wooden, cigar
Gold leaf and foil
Carriages, wagons and sleighs
Ivory work
Organs

Peak in 1909

Regalia
Hats, fur-felt

Upholstering materials
Type founding
Lime
Marble and granite
Glass products
Lumber-mill products
Silverware
Watchcases
Windmills
Sewing machines
Carriage and wagon materials
Feathers and plumes
Buttons
Combs
Hairwork
Pianos
Pipes, tobacco

Peak in 1914

Liquors, malt
Cigars
Corsets
Flags and banners
Hats, straw, men's
Horse blankets
Jute goods
Nets and seines
Watch and clock materials
Copper

^a The 10 industries with peak output in a Census year prior to 1919 are:

Peak in 1899

Lumber-mill products
Turpentine and rosin

Peak in 1904

Carriages, wagons and sleighs
Organs

Peak in 1909

Hats, fur-felt
Linen goods

Peak in 1914

Chewing and smoking tobacco
Cigars
Cottonseed products
Liquors, malt

year, and one sixth in 1914 or earlier.³ Among the 51 industries with peaks in employment prior to 1919 appear certain related types of enterprise. We find cigars together with wooden cigar boxes; smoking and chewing tobacco with pipes; carriages and wagons with saddlery and harness, whips, horse blankets, and carriage and wagon materials; combs with hair work.

Table 9 also affords a striking contrast of peaks in employment with those in output. The only pronounced frequencies in the output column are those for 1929, 1937 and 1939; the large frequencies in the employment column are opposite 1919, 1923 and 1937, and there are only small frequencies for 1929 and 1939.⁴ Although seven tenths of the 103 industries attained their peak employment prior to 1929, only three tenths reached peak output before 1929.⁵ And only one tenth of the industries reached peak output prior to 1919, although double that proportion attained maximum employment before that year.

Now that we have counted up the rather imposing number

³ Exclusion of those industries whose employment series end before 1939 or begin after 1899 (cutting out not only industries for which data are inadequate for statistical reasons but also new industries and those now extinct or practically extinct) does not change the picture very much, as the table indicates; nor does restriction of the distribution to industries for which indexes of output are available.

⁴ Comparison with annual data on physical output for 30 industries, 1919-39, reveals no difference between peaks according to Census-year data and peaks according to annual data for 19 industries, and differences of only 1 or 2 years for 6 industries. For the remaining 5 industries the differences are 8 years (2 industries), 10 years (2 industries) and 16 years (1 industry). These differences, it should be noted, are also attributable in part to differences between the methods and data used in constructing the present indexes of physical output and those used for the annual indexes, constructed by the National Research Project (Magdoff, Siegel, and Davis, *Production, Employment and Productivity in 59 Manufacturing Industries, 1919-36*, Philadelphia, 1939) and extended by the Bureau of Labor Statistics.

⁵ Since more output than employment series begin after 1899, there is a greater likelihood that peaks in output in the latter part of the period 1899-1937 will outnumber peaks in employment. But this is not a serious qualification; see the discussion of Table 10, below.

of industries in which, apparently, peaks have already been reached in both output and employment, and have identified the years in which they appear, we see that there is wide discrepancy in the timing of peaks in output and in employment. To determine the interval between these peaks in the same industry we must go on to Table 10. Among 103 industries for which we have information, there were only one tenth in which the peak in employment followed that in output. In almost three tenths the two dates coincided. In the remaining industries—almost two thirds—employment reached a peak and began to fall off while output was still rising. And in as many as half of the latter, output reached its peak more than a decade after employment.⁶

About a third of the 103 industries reached peaks in employment, in output, or in both in 1939. For these, therefore, there is no evidence that a true maximum in one or both series had in fact been attained. If they are excluded from the tabulation, the distribution changes somewhat, although over half of the remaining industries are still characterized by a lead of employment over production.⁷

These comparisons of high points in employment and output deal with employment as measured in terms of number of wage earners. Since hours of labor in factories diminished with the passage of time, peaks in manhours of labor expended must have frequently preceded peaks in average number of workers employed. It is probable, therefore, that

⁶ Annual data are available for the period 1919-39 for 30 industries. For 15 of these there is no difference between the results shown by examination of data for Census years and those obtained from annual data, and for 8 the difference is one or two years. For the other 7 industries the differences are 4, 7, 8, 9, 10, 11, and 16 years, respectively.

⁷ Restriction of the analysis to industries with data covering the entire 4 decades, that is, beginning in 1899 and ending in 1939, also decreases the fraction with employment leading output. But this fraction still exceeds one half, whether we include or exclude industries with one or both peaks in 1939; and no greater proportion of industries is found with output leading employment.

the highest peak in *manhours* leads the highest peak in output in a proportion of industries greater than that shown in Table 10, and that the average lead of the manhour peak over the output peak is longer than the average lead of the employment peak over the output peak. Such data as are available definitely support this statement. Thus in knit

TABLE 10

FREQUENCY DISTRIBUTION OF INDIVIDUAL
MANUFACTURING INDUSTRIES BY DIFFERENCE
BETWEEN CENSUS YEARS OF PEAK
EMPLOYMENT AND OUTPUT, 1899-1939

<i>Difference in Years</i> (<i>peak year of</i> <i>output minus peak</i> <i>year of employment</i>)	<i>All Industries</i>		<i>Industries Covered by</i> <i>Complete Data for 1899-1939^a</i>	
	Total	Excluding Those with Peaks in 1939	Total	Excluding Those with Peaks in 1939
36 to 40	1	1	1	1
31 to 35	1	1	..	..
26 to 30	4	2	..	..
21 to 25	1	1	1	1
16 to 20	18	5	5	1
11 to 15	8	5	3	2
6 to 10	14	14	8	8
1 to 5	17	9	7	3
0	28	23	17	14
-1 to -5	2	2	1	1
-6 to -10	9	9	3	3
TOTAL NUMBER OF INDUSTRIES	103	72	46 ^b	34

Source: Based on Appendices B-1 and F.

^a That is, all industries with employment and output series beginning in 1899 and ending in 1939.

In the compilation of the figures given in the last two columns, the following industries, treated as separate branches in the first two columns, were

goods the peak in number of wage earners came in 1939, and in paper and pulp, paints and varnishes, petroleum refining, and automobiles, it came in 1937; in all these industries the corresponding peaks in manhours were reached in 1929.⁸

⁸Leads of peaks in wage earners over peaks in output in these industries were 0, 2, 0, 2, and -8 years, respectively; of peaks in manhours over peaks in output, 10, 8, 8, 8, and 0 years, respectively.

Footnotes to Table 10, concluded.

combined into groups and each group was counted as one industry: the four knit goods industries; industrial chemicals and rayon; copper, lead and zinc.

^bThe 46 industries covered in the third column, arranged according to the number of years elapsing between the peak in employment and that in output, are as follows. The date in parentheses is the peak year in employment and in output, if they coincide.

<i>Number of Years</i>	<i>Industry</i>	<i>Number of Years</i>	<i>Industry</i>
36	Gloves	0	Liquors (1914)
23	Jute goods	0	Flour (1919)
20	Meat packing	0	Ice (1929)
20	Tanning and dye materials	0	Rice (1939)
18	Fertilizers	0	Cigars (1914)
16	Cotton goods	0	Carpets and rugs, wool (1923)
16	Shoes, leather	0	Hats, fur-felt (1909)
15	Chewing and smoking tobacco	0	Hats, wool-felt (1939)
14	Silk and rayon goods	0	Knit goods (1939)
12	Beet sugar	0	Woolen and worsted goods (1923)
10	Cordage and twine	0	Paints and varnishes (1937)
10	Explosives	0	Turpentine and rosin (1899)
10	Coke-oven products	0	Carriages, wagons and sleighs (1904)
10	Blast-furnace products	0	Cars, railroad (1923)
10	Copper, lead and zinc	0	Locomotives (1923)
8	Shoes, rubber	0	Glass (1937)
8	Printing and publishing	0	Ships and boats (1919)
6	Salt	0	Cottonseed products
5	Linen goods	0	Steel-mill products
4	Leather	-5	Automobiles, incl. bodies and parts
2	Liquors, distilled	-8	Lumber-mill products
2	Fruits and vegetables, canned	-8	
2	Paper and pulp		
2	Chemicals, industrial, incl. rayon and gases	-10	
2	Petroleum refining		

EMPLOYMENT DURING GROWTH AND DECLINE OF OUTPUT

The preceding discussion has brought out one aspect of the development of manufacturing, namely, that peaks in employment and output have been reached in many industries. We shall now consider how employment and output have climbed to their peaks, and how they have descended.

A sample of the full series on employment and output is presented in Chart 18 (pp. 130-37), which gives some of the longer indexes (those beginning in 1899 or earlier) and a few interesting shorter series. The reader will note certain striking parallels between growth in output and employment even if he merely glances at the successive pages of this chart. There are, for example, the very rapid increases in both employment and output in automobile manufacture during the two decades 1899-1919, and the declines in cigar manufacturing production and employment after 1914. But closer examination will reveal noteworthy differences also: the far more rapid rate of increase in steel production than in steel-mill employment, up to 1914, and the decline in the number of coke-oven workers during the 1920's, while coke production continued to rise at a fairly rapid pace. These differences indicate the need for a precise statement of the rates of change in each decade. This is provided by the collection (Table 11) of average annual rates of growth, during successive decades, in output and employment.

Table 11 points to three conclusions: first, that in most industries output has grown at a decelerating rate; second, that during specific periods employment has tended to increase less rapidly than output; and third, that growth of employment, too, has usually suffered retardation. That employment has commonly fallen in relation to output we already know;⁹ but the first and third points demand rather extended attention.

⁹ See Chapter 3, above.

TABLE 11

INDIVIDUAL MANUFACTURING INDUSTRIES

Physical Output and Wage-Earner Employment:
Average Annual Percentage Changes

Industry		1869- 1879	1879- 1889	1889- 1899	1899- 1909	1909- 1919	1919- 1929	1929- 1937
<i>Foods</i>								
Meat packing	OUTPUT	6.1	1.8	2.5	2.6	0.7	-0.7	
	EMPLOYMENT	5.8	5.8	2.5	6.2	-2.7	0.5	
Oleomargarine	OUTPUT					8.6 ^a	2.9	
	EMPLOYMENT					-1.5 ^a	-2.9	
Flour	OUTPUT	3.9	1.5	2.9	0.9	1.1	-1.3	-1.9
	EMPLOYMENT	0.0	0.9	3.7	2.0	1.4	-4.9	-0.2
Cereals	OUTPUT						9.3 ^a	-3.2
	EMPLOYMENT						1.2 ^a	2.8
Rice	OUTPUT				9.8	5.4	1.2	0.7
	EMPLOYMENT				6.6	5.5	-2.9	4.3
Bread and cake	OUTPUT						4.9 ^b	-0.5
	EMPLOYMENT						4.6 ^b	2.9
Biscuits and crackers	OUTPUT						3.5 ^b	0.7
	EMPLOYMENT						-0.7 ^b	-2.0
Fish, canned	OUTPUT				3.5 ^o	0.9	1.7	0.5
	EMPLOYMENT				3.5 ^o	2.3	1.0	3.7
Fruits and vege- tables, canned	OUTPUT				5.4	6.7	6.2	5.3
	EMPLOYMENT				1.2	4.5	2.7	4.2
Milk, canned	OUTPUT				10.4 ^o	16.7	1.8	3.1
	EMPLOYMENT				4.2 ^o	12.7	-6.3	3.0
Butter	OUTPUT				4.1 ^c	4.2	5.3	0.6
	EMPLOYMENT				3.9 ^c	4.3	0.8	0.2
Cheese	OUTPUT				-0.2 ^o	4.6	1.5	3.2
	EMPLOYMENT				0.4 ^o	4.0	-1.5	3.5
Ice cream	OUTPUT						4.6 ^b	1.1
	EMPLOYMENT						-0.5 ^b	-2.3
Beet sugar	OUTPUT				20.0	4.0	4.0	2.3
	EMPLOYMENT				13.8	5.1	-4.4	2.8
Cane sugar, not elsewhere made	OUTPUT					-3.0	-2.2	8.5
	EMPLOYMENT					4.0	-9.2	7.8
Cane-sugar refining	OUTPUT					3.8	2.3	-1.5
	EMPLOYMENT					6.9	-2.7	0.1
Confectionery	OUTPUT						-2.4 ^a	1.3
	EMPLOYMENT						0.0 ^a	-2.0
Chocolate	OUTPUT						3.4 ^b	2.7
	EMPLOYMENT						-1.6 ^b	2.1
Corn products	OUTPUT					4.0	3.7	-2.2
	EMPLOYMENT					5.0	-1.5	0.5
Ice	OUTPUT				11.8	7.2	5.3	-3.5
	EMPLOYMENT				8.9	6.5	0.8	-6.6

TABLE 11 (continued)

INDIVIDUAL MANUFACTURING INDUSTRIES

Physical Output and Wage-Earner Employment:
Average Annual Percentage Changes

Industry	1869-1879		1879-1889		1889-1899		1899-1909		1909-1919		1919-1929		1929-1937	
<i>Beverages</i>														
Liquors, malt	OUTPUT						4.4	-6.8						
	EMPLOYMENT						3.3	-4.5						
Liquors, distilled	OUTPUT						2.7	-29.6			-0.8		79.3	
	EMPLOYMENT						5.6	-14.2			0.8		26.0	
Malt	OUTPUT										4.7 ^a		11.8	
	EMPLOYMENT										1.0 ^a		13.7	
Liquors, vinous	OUTPUT										-3.5 ^b		34.6	
	EMPLOYMENT										-15.7 ^b		41.6	
<i>Tobacco products</i>														
Cigarettes	OUTPUT						14.9 ^c	22.6		8.8			3.7	
	EMPLOYMENT						13.1 ^c	10.8		-0.6			2.7	
Cigars	OUTPUT	7.5	6.1	3.3	3.3	0.1	-1.2	-2.7						
	EMPLOYMENT	7.4	6.3	2.7	2.6	-1.3	-3.0	-5.0						
Chewing and smoking tobacco	OUTPUT						3.9	-0.2		-2.4		-2.3		
	EMPLOYMENT						-0.7	-3.9		-5.1		-0.8		
<i>Textile products</i>														
Cotton goods	OUTPUT	5.7	4.1	4.3	3.3	1.4	2.5	-0.1						
	EMPLOYMENT	2.6	2.4	3.9	2.3	1.5	-0.2	-0.1						
Lace goods	OUTPUT							3.4 ^d		1.4		5.5		
	EMPLOYMENT							-2.7 ^d		0.6		2.1		
Woolen and worsted goods	OUTPUT		1.3	2.6	3.7	-0.5	0.3	1.7						
	EMPLOYMENT		1.6	1.5	2.6	0.2	-1.3	1.0						
Silk and rayon goods	OUTPUT		10.9	4.6	6.0	4.9	4.6	3.8						
	EMPLOYMENT		5.0	3.7	4.3	2.5	0.3	-1.3						
Knit goods	OUTPUT	6.2	9.9	7.7	5.6	5.3	6.1	1.9						
	EMPLOYMENT	6.9	7.8	4.9	4.5	2.9	1.9	1.3						
Carpets and rugs, wool	OUTPUT						2.6	-2.3		4.9		-1.1		
	EMPLOYMENT						1.6	-3.6		3.6		-0.8		
Asphalted-felt-base floor covering	OUTPUT									10.0 ^b		4.7		
	EMPLOYMENT									5.7 ^b		4.3		
Linoleum	OUTPUT									0.2 ^b		-2.3		
	EMPLOYMENT									-2.0 ^b		-1.7		
Oilcloth	OUTPUT						11.6	-4.8		10.2		-5.0		
	EMPLOYMENT						13.1	1.5		2.3		-1.3		
Cordage and twine	OUTPUT						2.1	1.2		0.8		-1.1		
	EMPLOYMENT						1.1	1.8		-2.0		-0.4		

<i>Industry</i>		1869- 1879	1879- 1889	1889- 1899	1899- 1909	1909- 1919	1919- 1929	1929- 1937
<i>Textile products (continued)</i>								
Jute goods	OUTPUT				5.9	0.7	-1.5	4.6
	EMPLOYMENT				4.0	0.7	-3.6	3.5
Linen goods	OUTPUT				3.9	-8.1	1.5	-3.2
	EMPLOYMENT				0.9	-6.1	1.5	-2.0
Hats, fur-felt	OUTPUT				4.8	-2.9	0.6	0.0
	EMPLOYMENT				2.9	-3.0	-1.2	-0.5
Hats, wool-felt	OUTPUT	-3.5	-2.0		-2.9	-2.3	2.3	12.4
	EMPLOYMENT	-4.1	-2.5		-0.6	-3.1	3.5	9.0
Artificial leather	OUTPUT						-0.3 ^b	2.1
	EMPLOYMENT						0.8 ^b	-0.2
Wool shoddy	OUTPUT		0.5		2.2	3.7	0.2	
	EMPLOYMENT		0.4		0.6	2.9	-3.6	
<i>Leather products</i>								
Leather	OUTPUT			0.6	2.5	1.6	-0.4	1.4
	EMPLOYMENT			2.7	1.8	1.5	-3.6	0.3
Shoes, leather	OUTPUT	4.4	3.8	1.8	2.7	1.3	1.1	1.4
	EMPLOYMENT	1.9	2.3	1.5	2.6	1.3	-0.2	0.6
Gloves, leather	OUTPUT				1.5	0.7	0.6	-0.2
	EMPLOYMENT				-2.2	-0.6	0.2	2.9
<i>Rubber products</i>								
Shoes, rubber	OUTPUT				1.0 ^e	10.9 ^d	-1.4	-0.6
	EMPLOYMENT				1.8 ^e	12.0 ^d	-2.5	-4.0
Tires and tubes	OUTPUT						6.5 ^b	-2.6
	EMPLOYMENT						2.1 ^b	-3.4
<i>Paper products</i>								
Paper and pulp	OUTPUT		7.5	8.6	6.5	3.7	6.6	2.3
	EMPLOYMENT		2.4	5.6	4.3	4.1	1.2	1.0
<i>Printing and publishing</i>								
Total	OUTPUT				7.6	4.3	6.3	0.3
	EMPLOYMENT				2.9	1.1	2.0	-0.1
<i>Chemical products</i>								
Chemicals, in- dustrial, incl. rayon and com- pressed gases ^f	OUTPUT				6.6	11.2	10.7	7.0
	EMPLOYMENT				4.0	11.5	3.1	3.5
Cottonseed products	OUTPUT				3.8	4.2	-1.1	-2.3
	EMPLOYMENT				4.5	4.6	-5.1	0.6

TABLE 11 (continued)
 INDIVIDUAL MANUFACTURING INDUSTRIES
 Physical Output and Wage-Earner Employment:
 Average Annual Percentage Changes

Industry	1869-1879		1889-1899		1909-1919		1919-1929		1929-1937	
	1879	1889	1899	1909	1919	1929	1929	1937		
<i>Chemical products (continued)</i>										
Linseed							3.1 ^b		-1.9	
products							0.5 ^b		-0.4	
Carbon black					18.0 ^d		15.9		3.6	
					14.8 ^d		11.0		1.7	
Soap					6.1 ^o		3.9		1.1	
					3.4 ^o		4.6		-3.5	
Wood-distillation products					6.7		3.3		3.0	
					5.8		6.2		-0.7	
Charcoal							-4.5 ^b		-10.0	
							-9.0 ^b		-2.3	
Explosives			8.8		9.3		4.3		0.7	
			7.6		3.3		3.9		-4.8	
Fertilizers					7.0		3.0		2.2	
					4.7		3.7		-2.2	
Paints and varnishes					5.4		3.3		6.7	
					3.9		4.2		3.1	
Salt	5.4		5.8		3.9		2.3		2.7	
	3.8		0.3		4.5		0.3		2.8	
Tanning and dye materials					7.6		4.3		2.0	
					3.9		6.1		-5.6	
<i>Petroleum and coal products</i>										
Petroleum refining	8.7		4.1		6.4		12.0		11.4	
	2.4		1.3		1.4		15.4		3.2	
Coke-oven products	13.8		7.3		7.7		4.8		5.0	
	11.3		9.2		5.6		0.0		-3.5	
Fuel briquettes							10.3		16.9	
							6.9		9.5	
<i>Stone, clay and glass products</i>										
Cement					18.0 ^o		2.8		5.8	
					8.9 ^o		-0.5		2.7	
Lime					2.5 ^o		-1.6		2.7	
					4.6 ^o		-2.0		-2.7	
Concrete products							7.4 ^a		-1.1	
							2.9 ^a		-3.0	
Sand-lime brick							-2.5 ^d		6.7	
							-2.1 ^d		1.1	
Clay products							-5.3 ^d		4.6	
							-5.1 ^d		2.0	
Glass					6.1		3.6		4.5	
					2.7		1.2		-1.4	

<i>Industry</i>		<i>1869- 1879</i>	<i>1879- 1889</i>	<i>1889- 1899</i>	<i>1899- 1909</i>	<i>1909- 1919</i>	<i>1919- 1929</i>	<i>1929- 1937</i>
<i>Forest products</i>								
Lumber-mill products	OUTPUT				-0.2	-0.7	0.3	-4.0
	EMPLOYMENT				2.8	-1.3	-1.1	-3.2
Planing-mill products	OUTPUT						-4.2 ^a	-5.4
	EMPLOYMENT						-5.1 ^a	-3.7
Excelsior	OUTPUT						0.3 ^a	-4.3
	EMPLOYMENT						-1.3 ^a	-3.2
Turpentine and rosin	OUTPUT				-2.7	-1.7	2.8	-2.6
	EMPLOYMENT				-0.6	-3.4	3.7	-2.6
<i>Iron and steel products</i>								
Blast-furnace products	OUTPUT			5.1	6.0	1.8	3.6	-1.6
	EMPLOYMENT			3.0	-0.2	1.2	-5.3	-1.0
Steel-mill products	OUTPUT	8.6	9.2	8.4	6.3	3.9	4.7	-0.4
	EMPLOYMENT	7.1	3.6	4.7	2.7	4.5	0.5	2.5
Wire	OUTPUT					0.4	3.8	-1.3
	EMPLOYMENT					0.9	1.3	1.1
Wrought pipe	OUTPUT						6.8 ^a	-1.2
	EMPLOYMENT						1.2 ^a	2.7
Cast-iron pipe	OUTPUT					-6.6 ^d	8.6	-4.7
	EMPLOYMENT					0.2 ^d	4.5	-1.5
Firearms	OUTPUT						4.5 ^b	0.8
	EMPLOYMENT						1.6 ^b	0.0
<i>Nonferrous-metal products</i>								
Copper	OUTPUT				8.0	2.5	5.3	-2.7
	EMPLOYMENT				3.3	1.1	-1.7	0.0
Lead	OUTPUT				5.1	0.0	4.8	-6.6
	EMPLOYMENT				-1.2	-1.3	-2.9	-2.2
Zinc	OUTPUT				7.1	6.2	3.0	-1.9
	EMPLOYMENT				3.2	7.6	-1.8	-0.4
Secondary metals, non-precious	OUTPUT						6.4 ^a	2.7
	EMPLOYMENT						8.8 ^a	2.3
Collapsible tubes	OUTPUT						1.5 ^a	2.7
	EMPLOYMENT						-1.8 ^a	1.1
Nonferrous-metal products, not elsewhere classified	OUTPUT						9.1 ^a	-1.6
	EMPLOYMENT						5.1 ^a	0.6

TABLE 11 (concluded)

INDIVIDUAL MANUFACTURING INDUSTRIES

Physical Output and Wage-Earner Employment:
Average Annual Percentage Changes

Industry	1869-1879		1879-1889		1889-1899		1899-1909		1909-1919		1919-1929		1929-1937	
<i>Machinery</i>														
Phonographs	OUTPUT						13.4	20.0			-5.8			
	EMPLOYMENT						15.1	18.6			-6.7			
Typewriters	OUTPUT										5.1 ^b		1.8	
	EMPLOYMENT										3.4 ^b		2.9	
<i>Transportation equipment</i>														
Automobiles, incl. bodies and parts	OUTPUT						43.1	31.7			13.5		-1.3	
	EMPLOYMENT						42.3	16.3			2.6		0.8	
Carriages, wag- ons and sleighs	OUTPUT			2.0			0.1	-7.1			-17.0		-4.2	
	EMPLOYMENT			1.7			-0.9	-11.1			-15.8		-4.5	
Cars, railroad	OUTPUT						-0.5	4.1			-5.1		-0.9	
	EMPLOYMENT						2.3	1.7			-3.2		0.1	
Locomotives	OUTPUT			1.8			0.7	1.3			-11.0		-7.2	
	EMPLOYMENT			2.5			-2.4	6.0			-8.5		-2.5	
Ships and boats	OUTPUT						-2.7	22.2			-15.8		-2.7	
	EMPLOYMENT						-1.4	25.3			-17.8		1.5	
Motorcycles and bicycles	OUTPUT						-7.6	10.9			-5.6			
	EMPLOYMENT						-12.9	9.4			-8.8			
Carriages and sleds, children's	OUTPUT										2.0 ^a		-1.5	
	EMPLOYMENT										0.7 ^a		-3.7	
<i>Miscellaneous products</i>														
Organs	OUTPUT						-5.8 ^c	-3.0			0.8			
	EMPLOYMENT						-8.0 ^c	-2.0			2.1			
Pianos	OUTPUT						6.5 ^c	1.9			-6.1		-5.0	
	EMPLOYMENT						3.9 ^c	-1.1			-8.1		-6.8	
Buttons	OUTPUT										4.8 ^d		2.9	
	EMPLOYMENT										1.4 ^d		3.6	

Source: Appendix F.

^a 1925-1929.^b 1923-1929.^c 1904-1909.^d 1914-1919.^e 1899-1914.

^f The figures for rayon alone are available only for 1923-29 and 1929-37. The corresponding rates for output are 23.4 and 15.2; and for employment, 18.2 and 4.4.

The tendency toward retardation in growth of output is apparent even from a crude analysis of the direction of change in the growth rate of output between successive decades.¹⁰ Of the 271 possible comparisons between contiguous decades, almost two thirds reveal such declines. A similar preponderance in number of declines over number of increases (including zero changes among the latter) is found in all but one pair of contiguous decades considered singly, and for over two thirds of the 99 separate industries listed.¹¹ The rate at which output increased declined progressively in every decade in 9 of the industries for which we have data for four or more decades: rice, ice, cordage and twine, leather gloves, wood-distillation products, fertilizers, tanning and dye materials, zinc and automobiles. In the automobile industry output rose less rapidly during the second decade of the twentieth century than during the first, lost speed again during the third decade, and again during the fourth.

The preceding comparisons between contiguous decades not only indicate the presence of retardation in growth but serve to measure its continuity. In one respect, however, such comparisons tend to underestimate the actual extent to which retardation exists. For example, in the flour industry the rate of growth of output fell from the decade 1869-79 to the decade 1879-89, rose to 1889-99, fell to 1899-1909, rose to 1909-19, fell to 1919-29, and fell again to 1929-37. There were two rises and four declines. Yet both rises stopped at

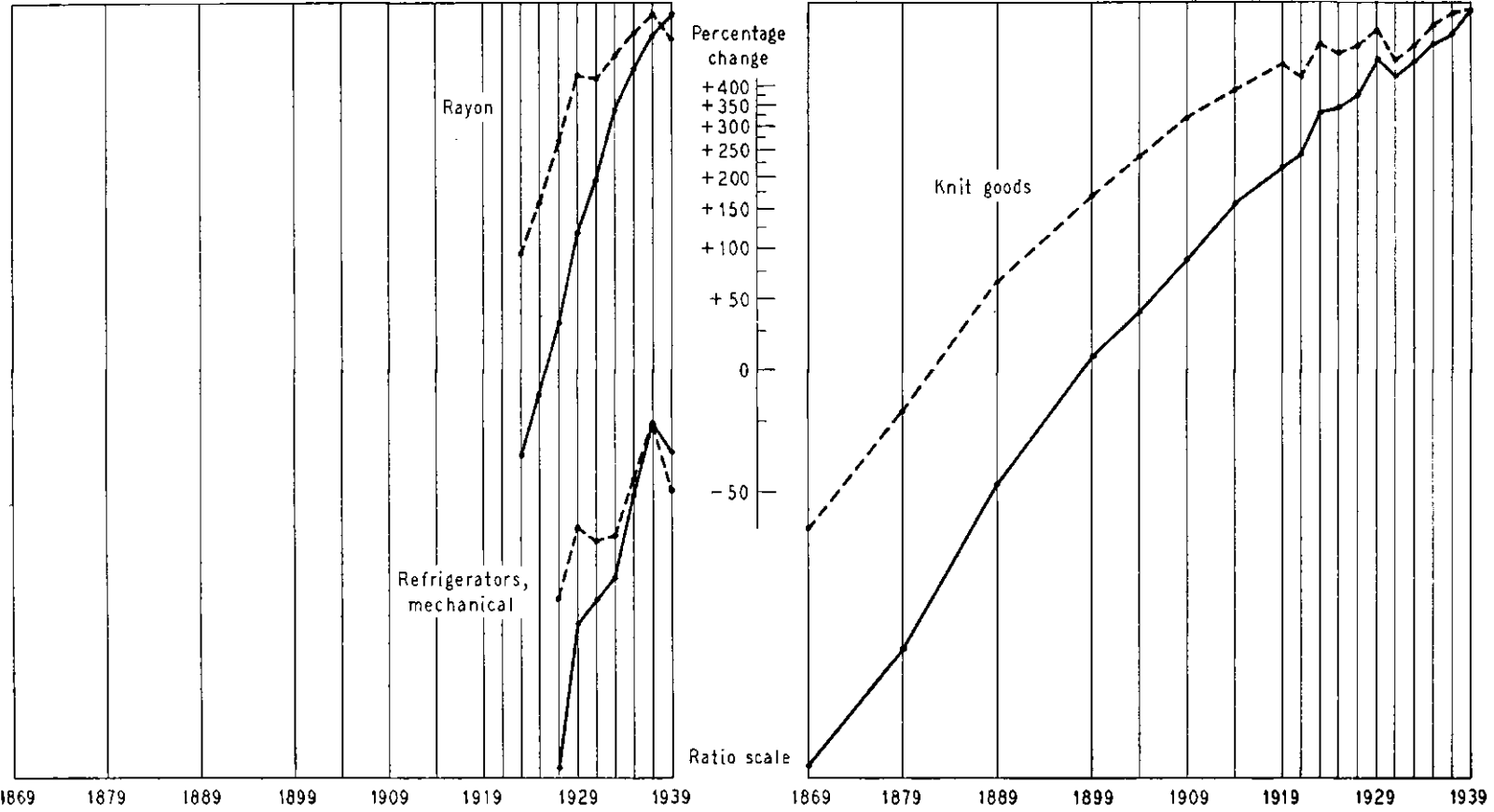
¹⁰ For other evidence of retardation in growth of output, somewhat differently presented, see Simon Kuznets, *Secular Movements in Production and Prices* (Houghton Mifflin, 1930), and Arthur F. Burns, *Production Trends in the United States since 1870* (National Bureau of Economic Research, 1934).

¹¹ Exclusion of the comparison of 1919-29 with 1929-37, because of the generally low rate of change in output between the latter pair of years, reduces the total number of comparisons to 177, 105 of which are negative. Exclusion of industries with but one comparison (usually 1919-29 with 1929-37) lowers the total number of industries to 75; in 48 of these there were more negative changes than positive and zero combined. (Combining zero changes with positive changes makes, of course, for a conservative conclusion concerning retardation.)

Chart 18

SELECTED MANUFACTURING INDUSTRIES

Indexes of Physical Output (————), and Wage Earners Employed (-----)

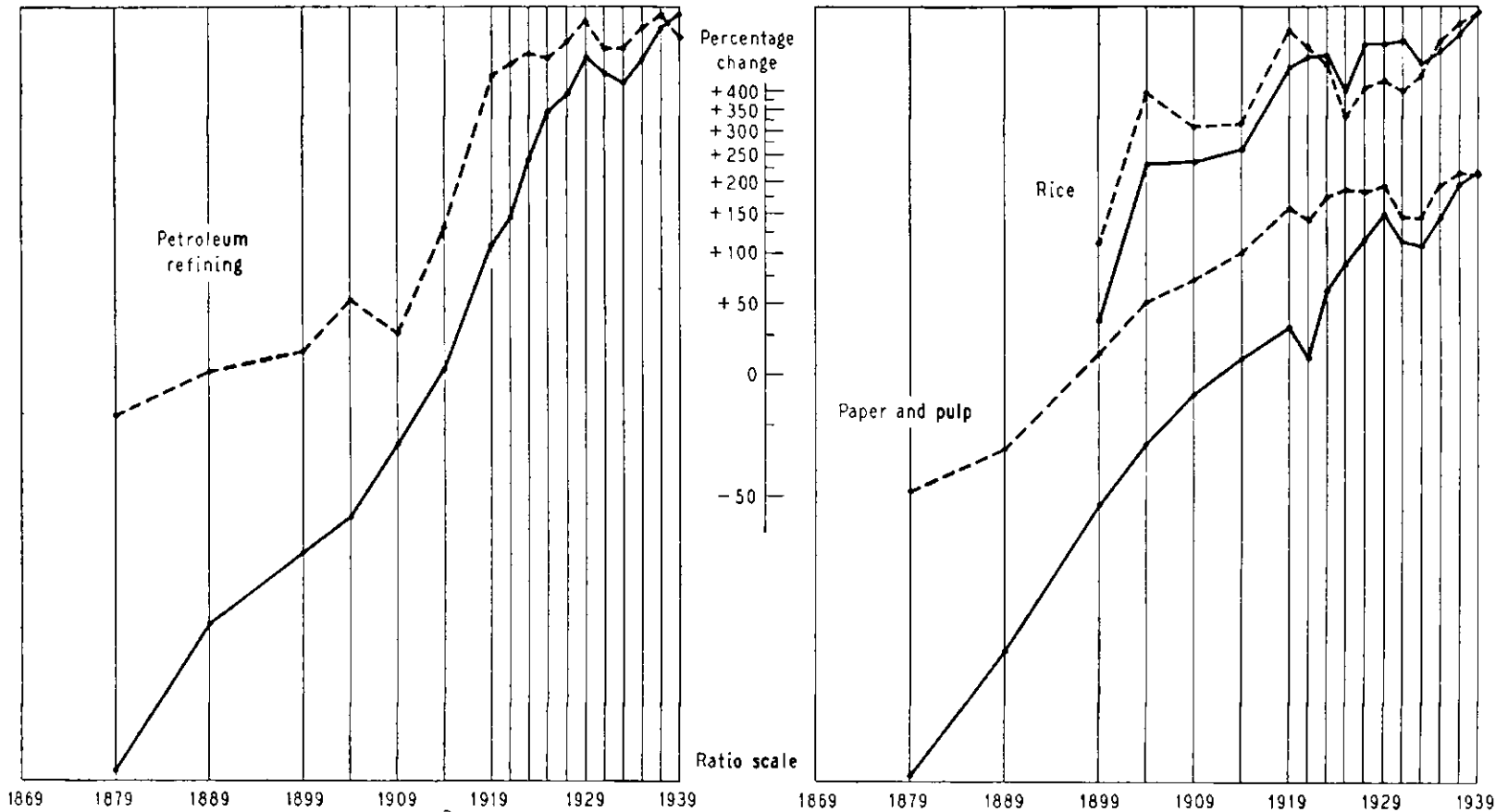


Based on Table F-1

Chart 18 (cont.)

SELECTED MANUFACTURING INDUSTRIES

Indexes of Physical Output (————), and Wage Earners Employed (-----)

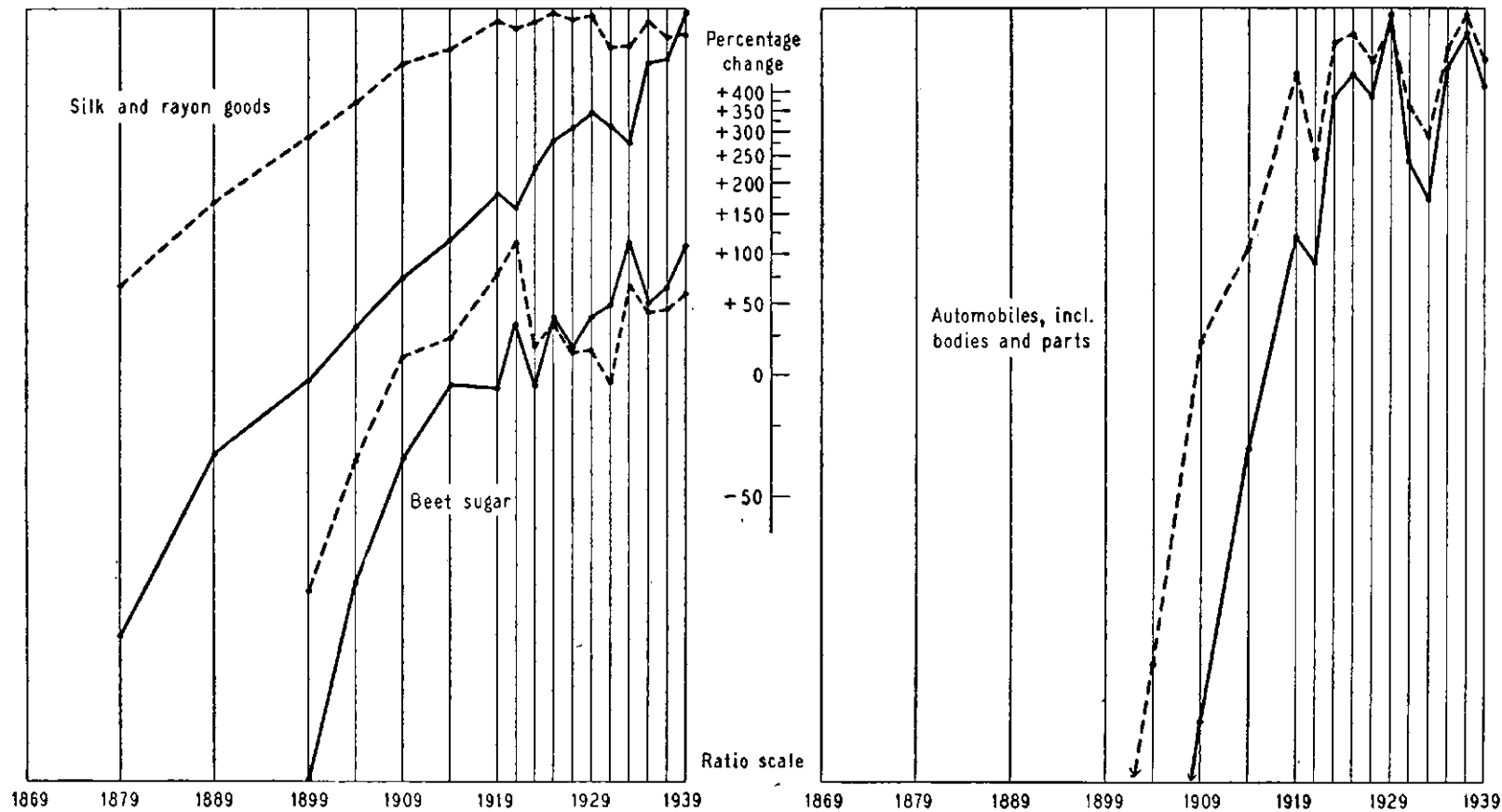


Based on Table F-1

Chart 18 (cont.)

SELECTED MANUFACTURING INDUSTRIES

Indexes of Physical Output (—), and Wage Earners Employed (-----)

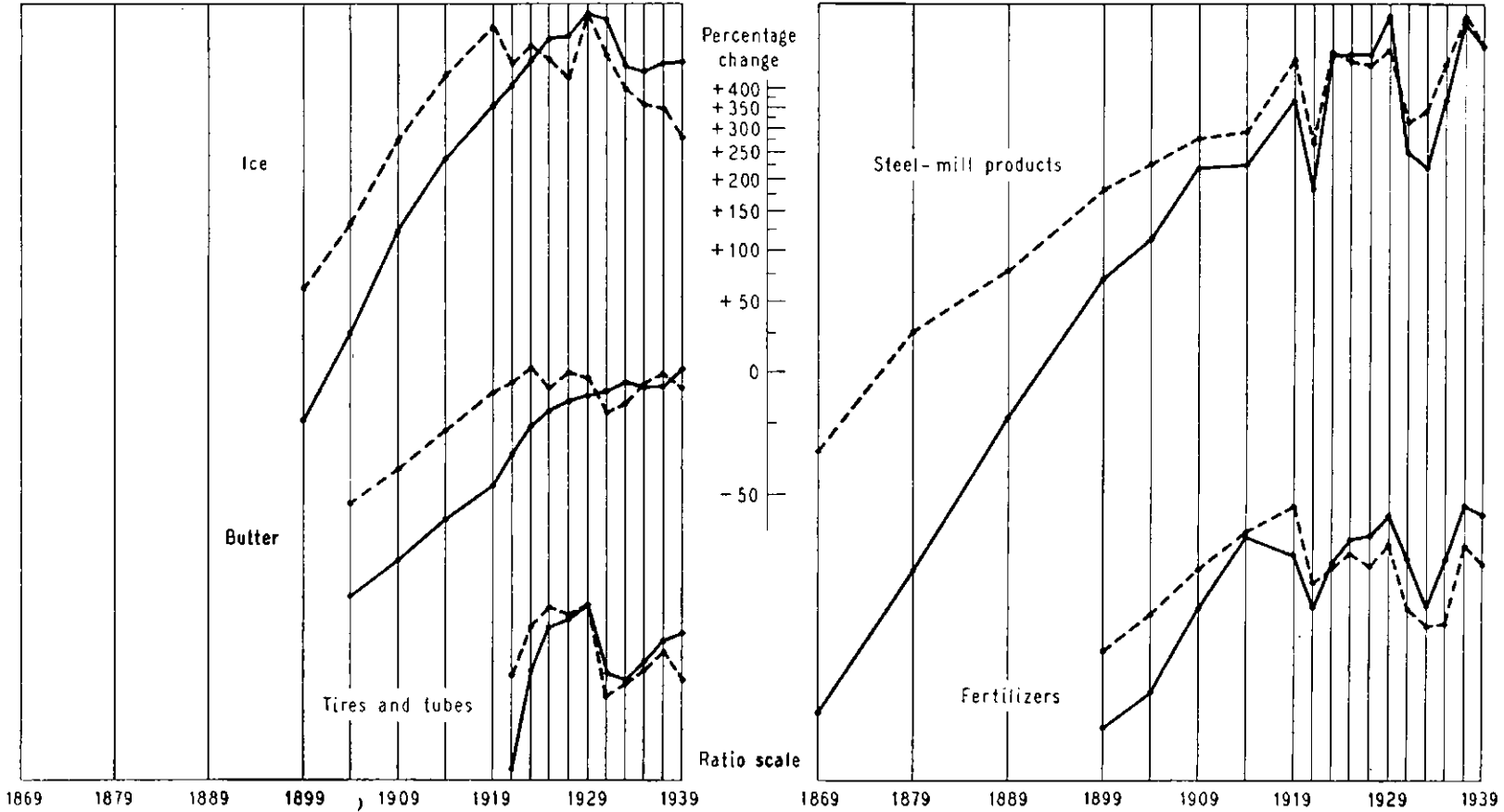


Based on Table F-1

Chart 18 (cont.)

SELECTED MANUFACTURING INDUSTRIES

Indexes of Physical Output (—), and Wage Earners Employed (-----)

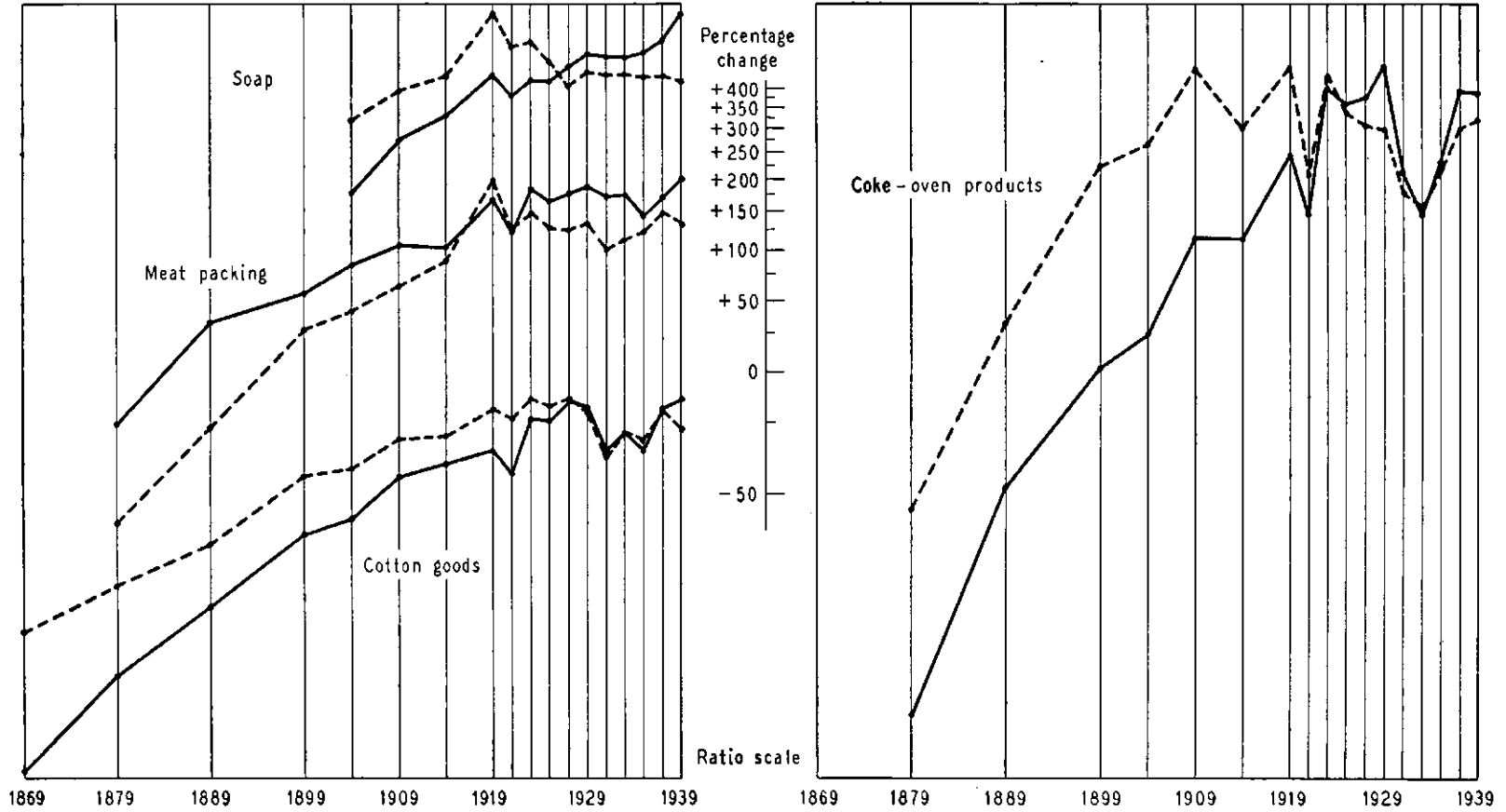


Based on Table F-1

Chart 18 (cont.)

SELECTED MANUFACTURING INDUSTRIES

Indexes of Physical Output (—), and Wage Earners Employed (-----)

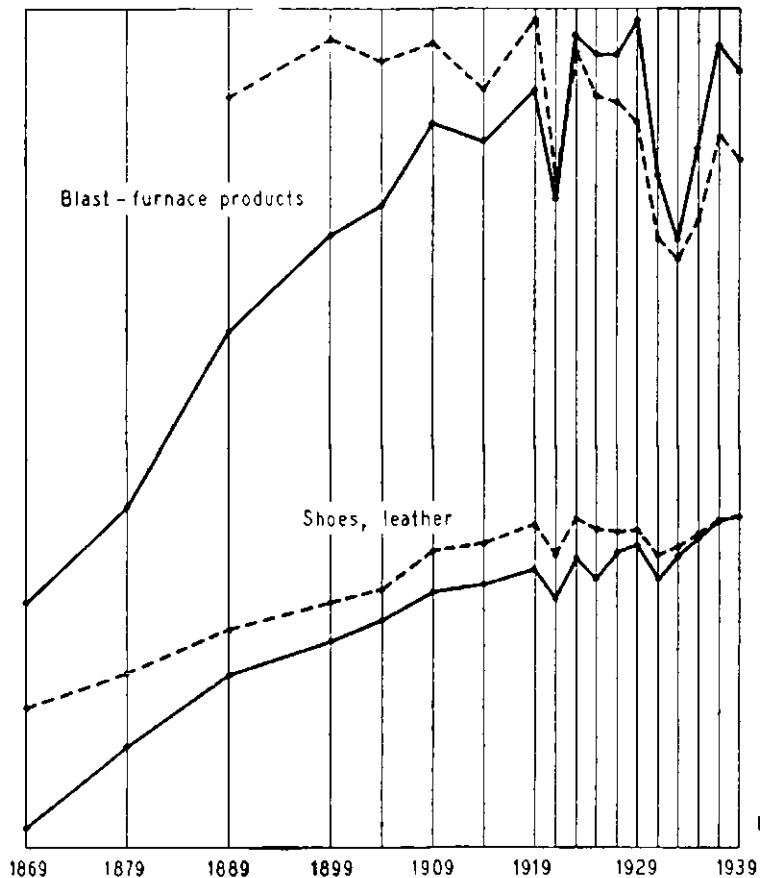


Based on Table F-1

Chart 18 (cont.)

SELECTED MANUFACTURING INDUSTRIES

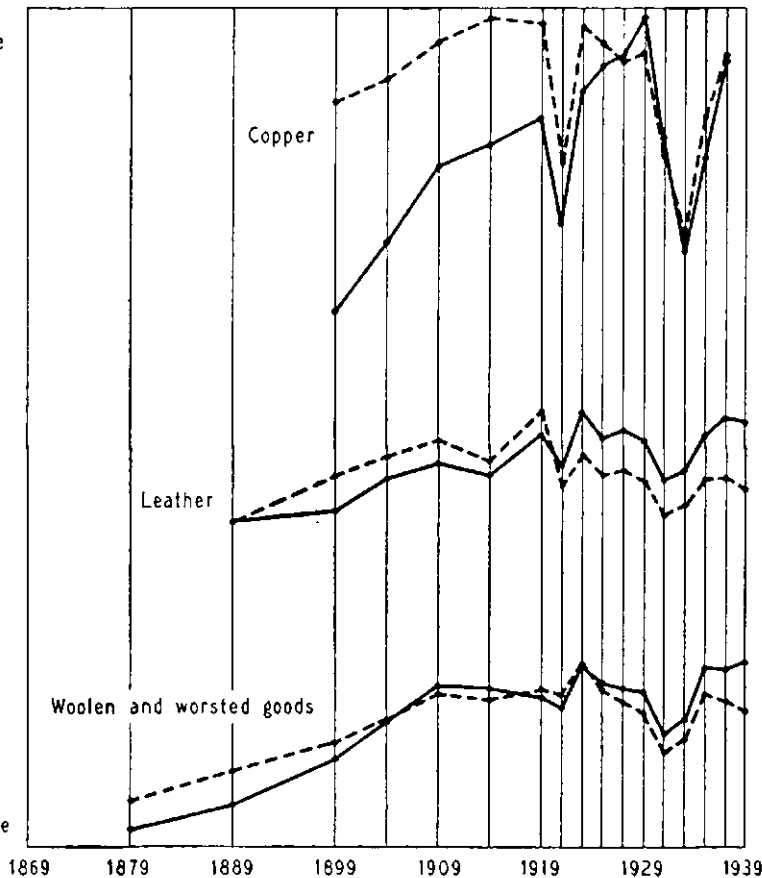
Indexes of Physical Output (——), and Wage Earners Employed (-----)



Percentage change

+400
+350
+300
+250
+200
+150
+100
+50
0
-50

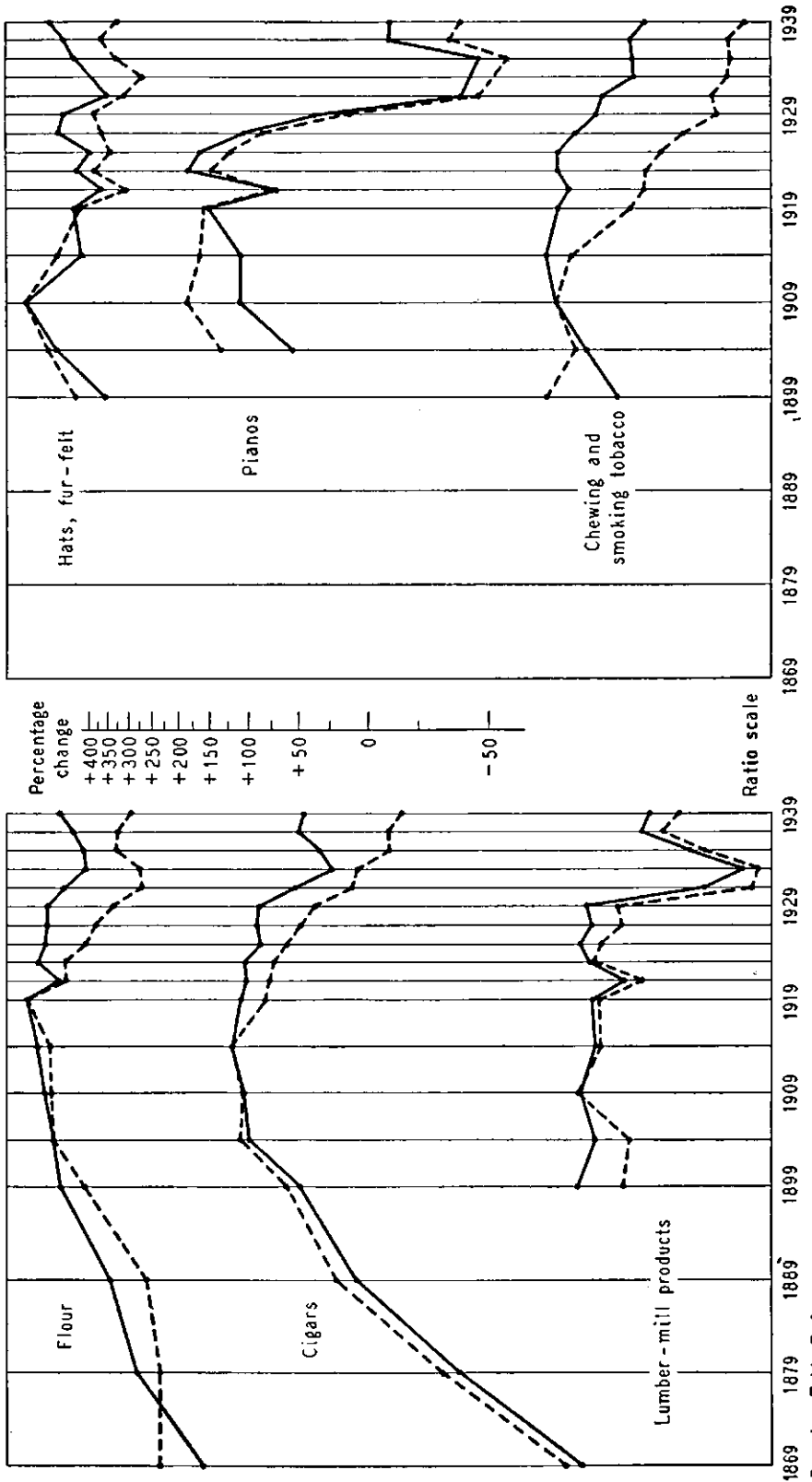
Ratio scale



Based on Table F-1

Chart 18 (cont.)
 SELECTED MANUFACTURING INDUSTRIES

Indexes of Physical Output (—), and Wage Earners Employed (-----)

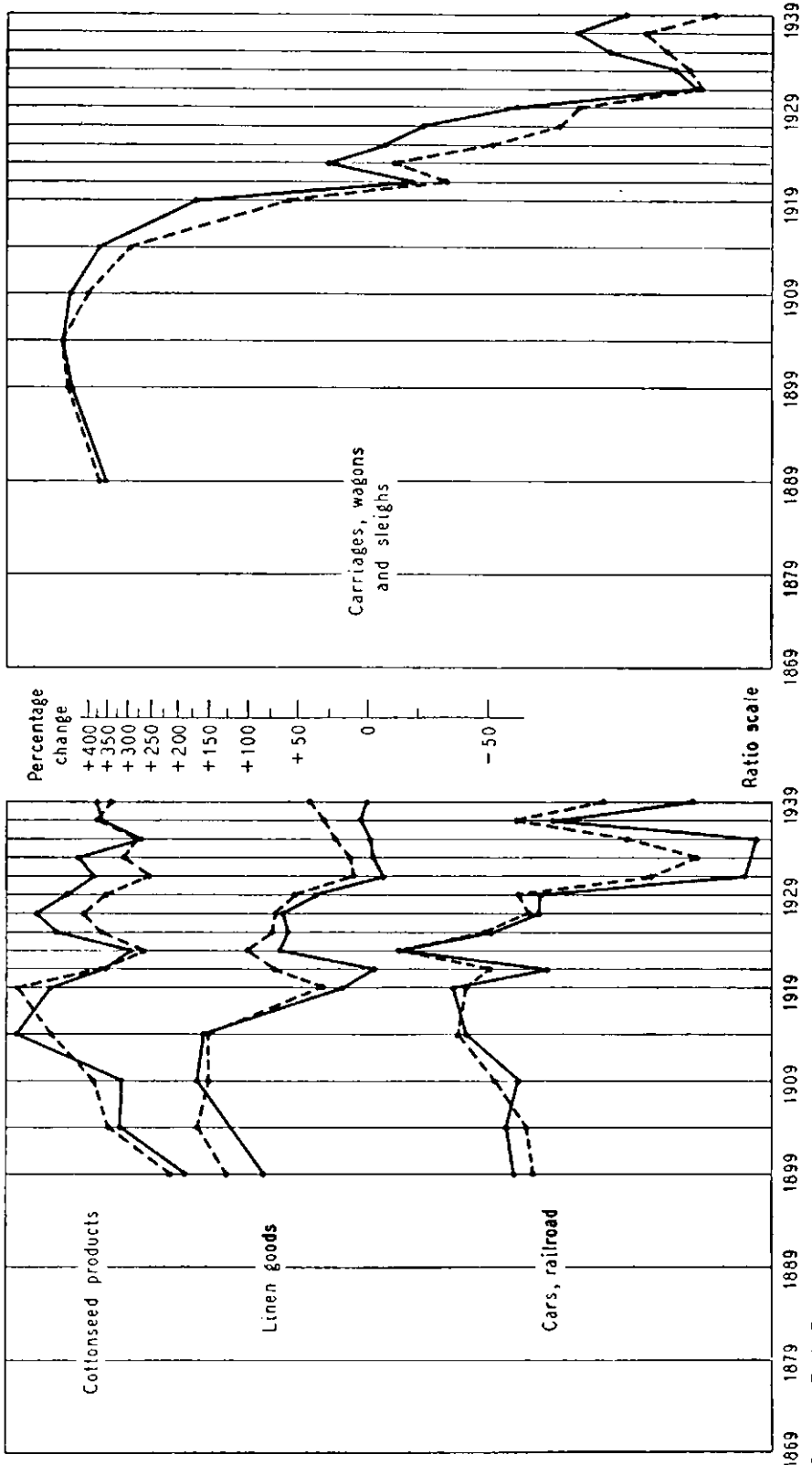


Based on Table F-1

Chart 18 (concl.)

SELECTED MANUFACTURING INDUSTRIES

Indexes of Physical Output (—), and Wage Earners Employed (-----)



Based on Table F-1

levels lower than the previous high points. If the heights of the succeeding levels are taken into account, as well as the direction of movement between them, a pronounced downward trend is discernible in the rate of growth of output.

That the phenomenon of retardation is widespread is indicated in Table 12; here the average rate, per decade, of change in the rate of growth is specified by the measure of retardation. Ninety-nine industries are included in the table. In over eight tenths of these output grew at a progressively slower rate. Exclusion of the period 1929-37 reduces both the number of industries and the proportion affected by retardation, yet over seven tenths of the 74 industries for which figures are available are still to be classed in that category. Further restriction to industries for which there are long series (that is, at least back to 1899) hardly modifies this picture. Some of the exceptional industries, it is interesting to note, were powerfully influenced by external events. Among these are three liquor industries, which, after serious curtailment of their production by the prohibition amendment, revived dramatically upon its repeal. Again, several industries producing construction materials—sand-lime brick, clay products (brick), lumber, and cast-iron pipe—benefited substantially from the great building boom of the 1920's. Petroleum refining is another industry characterized by acceleration in growth of output, in this case because of the development of the motorcar during the last three of the six decades covered by the series for this industry.

With these exceptions, then, the rate of change in manufacturing output has tended to decline with the passage of time. Rapid rates of increase in output have usually been followed by slower rates, and the latter by actual decreases. Put somewhat differently, the output of individual industries has tended to rise less and less rapidly from decade to decade, eventually becoming zero (at peak output) and then negative.

TABLE 12

SELECTED MANUFACTURING INDUSTRIES

Physical Output and Wage-Earner Employment:
Measures of Retardation in Growth

Industry	Period Covered by Series	Measure of Retardation, Full Period		Measure of Retardation, Period excl. 1929-37	
		Physical Out- put	Number of Wage Earners	Physical Out- put	Number of Wage Earners
<i>Percent per decade</i>					
<i>Foods</i>					
Meat packing	1879-1937	-1.0	-1.3	-0.9	-1.6
Oleomargarine	1925-1937	-5.2	-1.4		
Flour	1869-1937	-0.9	-0.5	-0.8	-0.7
Cereals	1925-1937	-11.4	1.6		
Rice	1899-1937	-3.0	-1.5	-4.0	-4.5
Bread and cake	1923-1937	-5.1	-1.6		
Biscuits and crackers	1923-1937	-2.7	-1.3		
Fish, canned	1904-1937	-0.8	0.0	-0.9	-1.2
Fruits and vegetables, canned	1899-1937	-0.1	0.7	0.4	0.7
Milk, canned	1904-1937	-3.4	-2.2	-3.8	-4.9
Butter	1904-1937	-0.9	-1.4	0.6	-1.5
Cheese	1904-1937	0.7	0.4	0.8	-0.9
Ice cream	1923-1937	-3.3	-1.8		
Beet sugar	1899-1937	-4.9	-4.0	-7.1	-8.3
Cane sugar, not elsewhere made	1909-1937	5.8	1.9	0.8	-12.7
Cane-sugar refining	1909-1937	-2.5	-3.3	-1.4	-9.0
Confectionery	1925-1937	3.8	-2.0		
Chocolate	1923-1937	-0.7	3.8		
Corn products	1909-1937	-3.0	-2.2	-0.3	-6.2
Ice	1899-1937	-4.4	-4.9	-3.0	-3.8
<i>Beverages</i>					
Liquors, malt	1899-1919	-10.7	-7.6	-10.7	-7.6
Liquors, distilled	1899-1937	26.2	7.6	-1.9	-2.4
Malt	1925-1937	6.8	12.6		
Liquors, vinous	1923-1937	39.5	22.4		
<i>Tobacco products</i>					
Cigarettes	1904-1937	-4.1	-4.0	-2.6	-6.2
Cigars	1869-1937	-1.7	-2.1	-1.7	-2.1
Chewing and smoking to- bacco	1899-1937	-2.1	-0.2	-3.1	-2.2
<i>Textile products</i>					
Cotton goods	1869-1937	-0.8	-0.6	-0.7	-0.5
Lace goods	1914-1937	1.0	2.5	-1.9	3.4

TABLE 12 (continued)

SELECTED MANUFACTURING INDUSTRIES

Physical Output and Wage-Earner Employment:
Measures of Retardation in Growth

Industry	Period Covered by Series	Measure of Retardation, Full Period		Measure of Retardation, Period excl. 1929-37	
		Physical Output	Number of Wage Earners	Physical Output	Number of Wage Earners
<i>Percent per decade</i>					
<i>Textile products (concluded)</i>					
Woolen and worsted goods	1879-1937	-0.3	-0.4	-0.5	-0.7
Silk and rayon goods	1879-1937	-1.0	-1.2	-1.2	-1.0
Knit goods	1869-1937	-0.8	-1.1	-0.4	-1.1
Carpets and rugs, wool	1899-1937	-0.4	0.0	1.1	1.0
Asphalted-felt-base floor covering	1923-1937	-4.8	-1.3		
Linoleum	1923-1937	-2.5	0.3		
Oilcloth	1899-1937	-3.3	-4.0	-0.7	-5.0
Cordage and twine	1899-1937	-1.0	-0.8	-0.6	-1.6
Jute goods	1899-1937	-0.6	-0.6	-3.6	-3.7
Linen goods	1899-1937	-1.2	0.0	-1.2	0.3
Hats, fur-felt	1899-1937	-1.1	-0.8	-2.1	-2.1
Hats, wool-felt	1879-1937	2.7	2.4	1.1	1.5
Artificial leather	1925-1937	2.4	-1.0		
Wool shoddy	1889-1929	0.1	-1.0	0.1	-1.0
<i>Leather products</i>					
Leather	1889-1937	-0.1	-1.0	-0.4	-1.9
Shoes, leather	1869-1937	-0.5	-0.3	-0.6	-0.4
Gloves, leather	1899-1937	-0.5	1.6	-0.4	1.2
<i>Rubber products</i>					
Shoes, rubber	1899-1937	-1.7	-3.1	-1.2	-2.1
Tires and tubes	1923-1937	-8.5	-5.4		
<i>Paper products</i>					
Paper and pulp	1879-1937	-0.9	-0.6	-0.6	-0.4
<i>Printing and publishing</i>					
Total	1899-1937	-1.9	-0.8	-0.6	-0.4
<i>Chemical products</i>					
Chemicals, industrial, incl. rayon and compressed gases ^a	1899-1937	0.1	-0.9	1.9	-0.4
Cottonseed products	1899-1937	-2.3	-2.1	-2.3	-4.7
Linseed products	1923-1937	-4.8	-0.9		
Carbon black	1914-1937	-6.2	-5.8	-1.8	-3.3

TABLE 12 (continued)

Industry	Period Covered by Series	Measure of Retardation, Full Period		Measure of Retardation, Period excl. 1929-37	
		Physical Output	Number of Wage Earners	Physical Output	Number of Wage Earners
<i>Percent per decade</i>					
<i>Chemical products (concluded)</i>					
Soap	1904-1937	-1.7	-1.9	-2.3	-3.4
Wood-distillation products	1899-1937	-2.0	-2.4	-1.8	-3.1
Charcoal	1923-1937	-5.8	7.4		
Explosives	1889-1937	-2.6	-2.3	-2.7	-3.5
Fertilizers	1899-1937	-1.9	-2.0	-2.2	-3.3
Paints and varnishes	1899-1937	-0.9	-1.0	0.6	-0.4
Salt	1869-1937	-1.0	-0.8	-0.9	-0.7
Tanning and dye materials	1899-1937	-2.3	-1.8	-2.6	-4.6
<i>Petroleum and coal products</i>					
Petroleum refining	1879-1937	-0.1	0.3	1.2	1.5
Coke-oven products	1879-1937	-2.3	-2.7	-1.9	-3.7
Fuel briquettes	1909-1937	-5.9	-2.8	6.0	2.4
<i>Stone, clay and glass products</i>					
Cement	1904-1937	-6.0	-3.1	-5.5	-2.9
Lime	1904-1937	-0.2	-0.9	0.1	-3.6
Concrete products	1925-1937	-7.9	-5.7		
Sand-lime brick	1914-1937	-1.3	-0.9	9.4	3.3
Clay products	1914-1937	0.2	0.4	10.5	7.5
Glass	1899-1937	0.2	-0.5	-0.8	-2.1
<i>Forest products</i>					
Lumber-mill products	1899-1937	-1.1	-1.8	0.3	-2.0
Planing-mill products	1925-1937	-1.3	1.5		
Excelsior	1925-1937	-4.6	-1.9		
Turpentine and rosin	1899-1937	0.5	0.1	2.8	2.1
<i>Iron and steel products</i>					
Blast-furnace products	1889-1937	-1.5	-1.3	-0.8	-2.3
Steel-mill products	1869-1937	-1.4	-0.7	-1.0	-0.9
Wire	1909-1937	-0.8	0.1	3.4	0.4
Wrought pipe	1925-1937	-7.5	1.5		
Cast-iron pipe	1914-1937	1.0	-0.8	16.3	4.3
Firearms	1923-1937	-3.5	-1.6		

TABLE 12 (concluded)
 SELECTED MANUFACTURING INDUSTRIES
 Physical Output and Wage-Earner Employment:
 Measures of Retardation in Growth

Industry	Period Covered by Series	Measure of Retardation, Full Period		Measure of Retardation, Period excl. 1929-37	
		Physical Output	Number of Wage Earners	Physical Output	Number of Wage Earners
<i>Percent per decade</i>					
<i>Nonferrous-metal products</i>					
Copper	1899-1937	-2.8	-1.3	-1.3	-2.4
Lead	1899-1937	-3.0	-0.5	-0.2	-0.9
Zinc	1899-1937	-2.9	-2.0	-2.0	-2.4
Secondary metals, non-precious	1925-1937	-3.5	9.8		
Collapsible tubes	1925-1937	1.2	3.0		
Nonferrous-metal products, not elsewhere classified	1925-1937	-9.8	-4.3		
<i>Machinery</i>					
Phonographs	1899-1929	-8.4	-9.5	-8.4	-9.5
Typewriters	1923-1937	-3.8	-0.5		
<i>Transportation equipment</i>					
Automobiles, incl. bodies and parts	1899-1937	-11.7	-11.3	-10.8	-15.3
Carriages, wagons and sleighs	1889-1937	-3.0	-2.9	-6.5	-6.5
Cars, railroad	1899-1937	-1.1	-1.2	-2.2	-2.7
Locomotives	1889-1937	-3.0	-1.6	-3.8	-2.4
Ships and boats	1899-1937	-3.8	-3.3	-6.3	-7.7
Motorcycles and bicycles	1899-1929	1.0	2.1	1.0	2.1
Carriages and sleds, children's	1925-1937	-3.3	-4.4		
<i>Miscellaneous products</i>					
Organs	1904-1929	3.4	5.4	3.4	5.4
Pianos	1904-1937	-4.7	-3.9	-6.8	-5.9
Buttons	1914-1937	-0.9	1.1	-6.5	-6.6

Source: Based on the rates of change in Table 11. The measure of retardation equals $100(b-1)$, b being given by the equation $1 + \frac{r}{100} = ab^t$, fitted to the rates of change by Glover's method; r = the percentage rate of change in output (or employment) in Table 11, and t = the number of rates in each row (i.e., the number of decades covered, counting periods of less than a decade as equal to a full one).

^a The measures of retardation for the rayon branch, covering the period 1923-1937, are -6.6 percent per decade for output and -11.7 percent per decade for employment.

The extensive data in Tables 11 and 12 thus confirm the findings of Kuznets and Burns.¹²

In many of the industries whose output was characterized by a decelerating rate of growth the degree of diminution was quite substantial. The rate of gain in output in one third of the industries listed in Tables 11 and 12 fell off by more than 3 percent per decade. At a 3 percent per decade rate of retardation, an industry's output would slow down in growth from around 10 percent per annum to zero in a period of only four decades.

As for the rate of growth in employment, the evidence in Table 11 shows that it too is subject to retardation. Just as output in most individual industries has tended to expand less and less rapidly with the passage of time, so the percentage change in number of workers employed has usually diminished from period to period. Reductions in hours of labor have modified this pattern, to be sure, and for this reason retardation of growth in number of workers, when measured by direction of change between rates in contigu-

¹² Both Dr. Kuznets' and Dr. Burns' findings relate mainly to the production of single commodities rather than to groups of related commodities. On the other hand, our series cover industries as defined by the Census, that is, they usually apply to groups of commodities. For example, Dr. Burns deals with wheat flour production, whereas we present figures for the entire flour industry, which produces not only wheat flour, but also cornmeal, buckwheat flour, some feed, and so on. The trends in these products have differed from one another; according to the Census the peak of wheat flour production came in 1919, of buckwheat flour in 1909, and of cornmeal in 1899 or earlier. Because of these differences it may be expected that our series for industries would be less extreme in their behavior than Dr. Burns' series for individual products. The Census industrial categories sometimes bring together establishments manufacturing diverse products, such as Portland and non-Portland cements, merely to lessen the total number of separate industries, and to that extent statistics based on the industrial categories yield results less illuminating than those based on individual products. However, many, if not most, of the Census industries do combine establishments producing commodities related through their process of manufacture (such as cottonseed oil and cottonseed cake and meal) and in such cases the trend of employment and output revealed by the Census data is somewhat more significant than the trend that would be shown for the separate products if data were available for them.

ous decades, is far less pronounced than in the case of output. But in terms of the measures in Table 12, the evidence of retardation in growth of employment is almost as substantial as for output. Of the 99 industries listed in Table 12, over seven tenths were characterized by retardation in growth of employment, and if the period 1929–37 is excluded, the proportion is even higher, eight tenths. Undoubtedly trends in manhours would show even more pronounced rates of retardation than trends in employment.

Although rates of retardation in employment are not identical with corresponding rates of retardation in output, they show a distinct resemblance. The data assembled in Table 12 reveal a substantial degree of correlation between pairs of columns. Industries whose output has grown at a rapidly declining rate—automobiles, tires and tubes, and carbon black (a basic material for rubber products)—are outstanding also for speedy decline in rate of growth in employment. Again, industries at the bottom of the list in one respect are usually at the bottom in the other. The liquor industries are worth noting in this connection.¹³

Similarity in degree of retardation in both output and employment does not mean, of course, that the graph of employment is superimposed exactly on that of output. Chart 18 does reveal a marked affinity between the lines for employment and output, but as we already know, peaks in employment frequently precede peaks in output; and at any given time the rate of growth in employment is usually slower than the corresponding rate for output. Both these facts are brought out in Table 11. As a rule (to which there are exceptions), the rate of growth of output is algebraically greater than the corresponding rate for employment. Both rates tend to fall with time, but the difference in levels

¹³ For all the industries in Table 12 the coefficient of rank correlation between the rates of retardation in output and those in employment for the full period is .65.

seems to persist. As the rates decline, they may turn negative, and in this transformation the rate for employment usually precedes that for output.

The time pattern of employment can be inferred, of course, from the time pattern of output and of employment per unit, and there is some value in tracing this connection. For example, in an industry in which output has grown at a rate that has declined progressively, and in which employment per unit has decreased at an approximately constant percentage rate, one should expect to find that the growth of employment has also been characterized by retardation. Indeed, the rate of retardation in employment would exactly equal the rate of retardation in output if the rate of decline in employment per unit were quite constant. Further, under the circumstances stated, the maximum level of employment would precede the maximum level of output by a determinate period. And finally, the rate of increase in employment at any specified time would be equal to a determinate fraction of the corresponding rate of increase in output.¹⁴

¹⁴ The algebraic expression of the reasoning in the text is as follows: Under the circumstances stated, output will be defined by the function

$$\log Q = a + bt + \frac{c}{2}t^2;$$

employment per unit of product, by

$$\log \frac{N}{Q} = A + Bt;$$

and employment, by

$$\log N = \log Q + \log \frac{N}{Q} = (a + A) + (b + B)t + \frac{c}{2}t^2;$$

in which $Q =$ output, $N =$ employment, $t =$ time, and the other symbols represent constants. The rate of growth in output is derived from the equation

$$\frac{d \log Q}{dt} = b + ct;$$

it is the antilog of $b + ct$. The rate of growth in employment is derived from the equation

$$\frac{d \log N}{dt} = (b + B) + ct;$$

INDUSTRIAL FLUX AND CHANGES IN EMPLOYMENT

Against this background of growth and decline in individual industries, during the period ending with the year 1939, it is well to re-examine certain conclusions brought out in the preceding chapter. Employment appears to move in the same direction as output, but contrary to employment per unit of product, during the early stages of an industry's career; during the middle stages its movement seems to correspond with employment per unit rather than with output; and during the late stages all three tend to follow the same direction. In young industries, whose output characteristically shoots up quickly, the enormous gains in production apparently tend to outweigh the decline in the labor-output ratio; as a consequence employment too expands, most often rather rapidly. During the mature phase of an industry's development output expands slowly, if at all, and the gain is usually more than counterbalanced by the declining trend in the labor-output ratio; as a result jobs decrease unless the length of the working week is reduced sufficiently to offset the decline. During the period between the peak in output and the peak

it is the antilog of $(b + B) + ct$. B , which is the log of the rate of decline in N/Q , is, of course, negative. The maximum in Q is reached when

$$b + ct = 0, \text{ or } t = \frac{-b}{c}.$$

The maximum in N is reached when

$$(b + B) + ct = 0, \text{ or } t = \frac{-(b + B)}{c}.$$

The difference between the dates of the two maxima is B/c .

If the rate of decline in the employment-output ratio is correlated with the rate of increase in output, as was suggested though not established in Chapter 3, the inference concerning employment becomes more complex though it is not seriously modified. Then, as compared with the preceding case, employment will reach a maximum earlier; will reach a lower maximum; will rise less rapidly to the maximum; will fall less rapidly from the maximum; and finally, will not be symmetrical about the vertical passing through the maximum.

in employment, if the two differ, there will naturally be a decline in employment while output is still rising. The length of this period will depend on the particular rate of decline in employment per unit in the industry. Often, of course, business cycles and random perturbations will cause the peaks of employment and output to coincide, as we have seen. But in the vicinity of these peaks there may still be differences in direction of movement as between employment and output. In old and waning industries, falling output offers no counterpoise to diminishing labor requirements per unit of product, and even substantial cuts in weekly hours of work fail to stem reductions in the number employed.

These conclusions, based on the period bounded mainly by 1899 and 1939, would have to be modified somewhat if it were found that the labor-output ratio not only shrinks but does so at a rate that changes regularly from stage to stage.¹⁵ But whether or not there does exist a typical pattern of development in employment per unit of product, there can be no question that there has been continuous flux in the industrial distribution of employment. In almost all prosperous years, and in many years of poor business as well, to judge from what has happened during the Census years 1899–1939, the employment offered by one or another industry has reached a maximum. Jobs grow in number in some branches

¹⁵ If unit labor requirements shrink at a declining rate, their sharpest drops must occur in precisely the stages at which output is expanding most rapidly; and since the rise of the latter overcompensates for the shrinkage in the former, presumably the number employed mounts most rapidly in the same period. In that case, also, the change in labor per unit would become less and less noticeable just when employment is expanding but slowly or actually receding, for in this period output is either lagging behind that of most other industries or definitely sagging. If deceleration of change in unit labor requirements could be proven, one would have to conclude, then, that an industry's labor force usually expands most rapidly when its reductions in labor per unit are most drastic, and least rapidly or not at all when it has ceased substantially to cut its unit labor requirements. All this is by way of conjecture, however. We cannot state, from the data gathered in this study, that the labor-output ratio has changed at other than a fairly constant rate during the life of an industry.

of industry while they decline in others, even though the aggregate for all industry may show scarcely a ripple.

Something of this industrial ebb and flow was perceptible in earlier tables of this chapter. A different view is provided by Table 13.¹⁶ In the first decade of the century there was a

TABLE 13

INCREASES AND DECREASES IN WAGE-EARNER
EMPLOYMENT IN MANUFACTURING
INDUSTRIES, SELECTED PERIODS

Period	Total Number of Separate Industries	Average Number of Wage Earners ^a	Increases in Employment		Decreases in Employment	
			Number of Industries with Increases	Sum of Job Increases	Number of Industries with Decreases	Sum of Job Decreases
1899-1909	266	5,370,685	225	1,773,601	41	80,320
1909-1919	290	7,350,597	221	2,443,313	69	372,490
1919-1929	307	8,382,720	144	994,693	163	1,051,019
1929-1937	289	8,472,662	150	834,525	139	629,122

Source: Based on an analysis of the data in Appendix B-1.

^a Average of numbers employed in the two years compared.

net decline in employment in 41 manufacturing industries, a loss amounting in all to some 80 thousand wage-earner jobs; but during the same period there was an increase in employment in 225 industries, amounting to 1.8 million jobs. In the decade 1909-19 decreases in employment occurred in 69 industries, a loss of close to 400 thousand jobs; and increases in 221 industries, a gain of almost 2.5 million jobs. In the next two periods job losses exceeded or came close to equaling job increases. Between 1919 and 1929 more than half our manufacturing industries registered net losses in employment; during these years over one million, or one in eight, jobs were eliminated, while about a million new ones

¹⁶ This table follows closely one published by Frederick C. Mills in *Economic Tendencies in the United States* (National Bureau of Economic Research, 1932), p. 420.

were created. In the last period covered, 1929-37, there were 600 thousand losses and 800 thousand increases.¹⁷

This incessant shifting of employment among industries bears upon certain aspects of the problem of technological labor displacement. The connections between advance in technology and the aggregate volume of employment and unemployment are, of course, exceedingly complex, and one could scarcely claim that the preceding discussion of one aspect of change, secular trends, in one sector of the economy, manufacturing, disentangles them. Nevertheless the findings, limited though they are, at least help to explain employment changes in individual industries, and to indicate the kinds of influence exerted upon these changes by technological developments.

Technological change, which is usually held to comprise also changes in efficiency and other factors connected only remotely if at all with technology proper, plays a part not only in the decline of employment in mature and decadent industries but in the emergence of new sources of employment as well. The founding of new industries, their solution of basic production problems and their subsequent rapid growth are largely matters of technological progress. And the sustenance of growth in mature industries, or the postponement of decline in older ones, has been due frequently to the technological advances made under the stress of competition for markets, materials, labor and capital. Even reductions in hours of labor, which lessen or offset the effect of factors making for reductions in employment, constitute one of the important fruits of general technological progress, distributed even to workers in laggard or stagnant industries. Technological development thus leads not only to loss of work but to new jobs and to long tenure.

The relationships involved even in a single industry are far

¹⁷ This summary takes no account of the violent changes in employment in the interval between the two terminal years.

from simple. When employment in an industry is contracting, and its technological level is rising at the same time, we cannot always state unequivocally that technological development is the factor responsible for the reduction in jobs. In the cigar industry, for example, production was 20 percent less in 1937 than in 1929, and aggregate manhours were 52 percent lower, but because of a shorter working week only 33 percent fewer workers were employed. Workers per unit fell almost 20 percent and manhours per unit 40 percent. Can we say that this reduction in unit labor requirements led to an equivalent labor displacement? Is it not possible that output, and with it employment, might have fallen still more had mechanization not been instituted and costs and prices cut? All this is not to deny that the trend of employment is downward in many industries and that a painful process of adjustment is continually going on. Yet *technological* unemployment in an industry, i.e., the fraction of unemployment that may be ascribed to a particular set of the several sets of factors making for unemployment, remains so complex a quantity that it can scarcely be estimated with existing statistics.

When employment and output are not falling, but rather rising, it is more readily apparent that declines in employment per unit do not necessarily mean labor displacement. Yet even in this case changes in the ratio of employment to production have been interpreted as measures of the displacement of labor. The volume of manufacturing output in 1929 was 64 percent greater than it had been in 1919, but the number of wage earners employed had not increased at all. It was 8.4 million in both 1919 and 1929. In these ten years, therefore, the number of workers engaged in producing a unit of output fell by almost 40 percent. It has sometimes been inferred from this evidence of stagnation of employment that post-war advances in technology and related developments prevented 5.4 million workers (i.e., 64 percent of 8.4) from

finding employment in manufacturing. But it is also relevant that the 64 percent advance in output could not have occurred if costs had not been cut; and that employment in other branches of industry, such as trade and service, expanded at the same time, contributing, incidentally, to the advance in factory output.

On the question of technological unemployment, viewed as a problem of the individual industry, one may make a few summary observations, though these do not rest entirely on the statistics considered here. First, the amount of "unemployment" in a specific industry is rather meaningless. There is constant shifting of labor among industries. Many workers, for example carpenters, are members of crafts or trades, rather than of industries. For this reason the total number of persons attached to a particular industry (including the unemployed) is not a significant one; and the difference between the number of persons attached and the number actually employed, i.e., the number unemployed, also is without meaning. It is preferable, therefore, to concentrate on *labor displacement*, i.e., the net decline in the number employed in a given industry during a specified time period.¹⁸ This leads

¹⁸ It must be stressed that we are dealing with but one element in labor turnover. Shifts of employment between regions and occupations are also significant, as is the movement of workers from one establishment to another. Thus, a change in occupation even within the same plant, often attributable to technological development, requires adjustment and imposes a burden on the persons affected. Nor is industrial turnover necessarily more important than the other types. As statements in the Census volumes attest, establishments frequently shift from one industry to another (i.e., change the nature of their main product) without a drastic change in personnel.

Furthermore, we are measuring *net* changes. Employment in an industry may show no net change whatever or may change but slightly, yet every worker in it may have been discharged and replaced. The considerable rate of turnover that may be involved in this sort of shift is illustrated by the course of events in a large cigar company when its operations were mechanized. The 626 hand workers employed by the company in 1931 (more than half of whom were men) had been replaced by 1936 by 13 hand workers on part time, 202 machine operators (mostly women) and 20 machinists. Few of the machine operators were retrained hand workers. (Daniel Creamer and Gladys V. Swackhamer, *Cigar Makers—After the Lay-Off*, National Research Project, Philadelphia, 1937, pp. 23-24.)

us to our second comment. The labor displacement associated with any event or complex of events in an industry cannot be measured by study of that industry alone. For one thing, there are such secondary effects as the displacement of labor in other industries in the community. The shutdown of a large local industry affects retail trade and other local activity. "Ghost towns" stand as tragic monuments to this sort of industrial collapse. Perhaps more important are the secondary effects of changes in a particular industry upon competing or complementary industries. The displacement of workers by machines may be accompanied by increased employment in the mechanical trades. Decline in carriage manufacture was associated with growth in motor-vehicle production. Technological displacement of labor thus often has its counterpart in technological "expansion of labor," as Carroll Wright has called it. In the third place, neither technology nor any other single factor can, as a rule, be set apart as *the* factor making for a given change in employment. Except in the rare cases when technological development is clearly the predominant element, its effect cannot be determined.

Finally, there is a hard kernel of truth in the contention that technological changes—and all the other developments characteristic of a dynamic economy—frequently create serious needs for adjustment. But it is true too that the separation of workers from their jobs has not always meant forced or prolonged unemployment, for growing industries have often attracted labor from other sectors of the economy by offering higher wages and better working conditions.

Chapter 6

Manufacturing in the National Economy

ALTHOUGH we have progressed only a few steps toward an understanding of the developments in manufacturing employment and production during the twentieth century, we have had to hack our way through a rather thick jungle of facts and figures. At this final point we shall review our journey and conclude by noting how trends in the field of manufacturing are related to the general economic development of the United States.

A SUMMARY OF CHANGES IN AMERICAN FACTORIES

Manufacturing employees in 1937, the last peak year of business preceding the present war, numbered ten million, as compared with five million in 1899. Factory jobs therefore doubled in the four decades between these two years.

The rise in number of factory workers after 1899, impressive though it was, fell far short of the almost fourfold increase in factory output during the same period. The number of workers employed in factories to turn out a unit of manufactured product thus declined by 50 percent during the four decades. And this cut probably understates the actual decline in employment per unit if only because of improvements in the quality of manufactured products, for which no allowance is made in our output index. Unit labor requirements fell more sharply than even such a refined figure, if we had it, would imply; for the decrease in employment of factory

workers per unit of product was accompanied by a very considerable drop in weekly hours of labor. A full-time week shrank from an average of about 60 hours per person in 1899 to about 40 hours in 1937. Since the number of workers needed per unit of product was cut in half, and hours were reduced by a third, there was a drop of two thirds in aggregate manhours per unit. In short, by 1937 only about one third as many manhours of factory work went into the fabrication of a given quantity of goods as 38 years earlier.

The factors making for reductions in labor per unit of product have not had the same impact on all manufacturing industries. For this reason the average for manufacturing in the aggregate conceals wide differences among industries. In some there were only minor decreases or even rises in the labor-output ratio; in others the declines were precipitate.

In eight of the 51 industries for which our information covers the period 1899-1937, employment per unit of product was cut by seven tenths or more. Heading the list is automobile manufacture (with a decline of nine tenths), followed by industries as diverse as beet sugar, silk and rayon goods, industrial chemicals, and blast-furnace products. At the bottom of the list are eight industries in which the employment-output ratio rose: three in the field of transportation equipment (railroad cars, locomotives and ships), and five others (turpentine and rosin, lumber-mill products, meat packing, linen goods and wool-felt hats).

The indexes of manhours per unit, too, vary from industry to industry with respect to rate of change, although they declined in all except two of the industries covered by separate indexes. The exceptions are locomotive manufacture and shipbuilding. These are among the eight industries in which employees per unit of output rose; the other six join the industries in which labor per unit of product was cut when their labor input is measured in terms of manhours instead of men.

No doubt the exceptional position of the few industries that did not succeed in reducing labor per unit of output appreciably is to be attributed in some degree to our inability to take statistical account of advances in the quality of their products. Perhaps the more important consideration, however, is suggested by the interesting fact that those industries which lagged in cutting down on the labor needed to turn out a unit of product either failed to expand their output between 1899 and 1937 or actually curtailed it. On the other hand, the industries at the head of the list usually expanded output faster than the average. Indeed, it was the industries with particularly large increases in *both* employment and output between 1899 and 1937 which tended to have exceptionally large declines in employment per unit, whereas those with under-average increases in both tended to reduce employment per unit less sharply than the average. Jobs per unit of product fell most precipitately in the automobile industry, in which we find the largest expansions both in total employment and in output. Again, in industrial chemicals employment increased eightfold and output multiplied twenty-five times, with a consequent decline of almost three quarters in labor per unit. In lumber mills, on the other hand, employment per unit went up by a fifth; at the same time the number of workers decreased in the same proportion and the volume of product fell off by a third.

We may conclude, then, that when an industry's output has grown rapidly, even a substantial decrease in the number of workers employed per unit has not usually meant fewer jobs in that industry. If output has expanded only moderately, however, a decline in the ratio of men employed to units produced has commonly coincided with rather slow growth in the number of jobs, and sometimes has actually resulted in a reduced volume of employment. Yet an increase in workers employed per unit has not necessarily been accompanied by increase in the labor force in the few industries

that ran counter to the general trend, for these were usually the ones whose output shrank at the same time.

Exceptionally large declines in labor per unit have been characteristic of rapidly growing industries. These industries have other interesting features in common as well. They have tended to effect particularly large reductions not only in labor per unit but also in wage costs per unit of product, in unit value added (that is, wage and overhead costs, including profits), and in selling price. In automobile manufacturing we find a striking combination of all these tendencies: here output and manhours of employment were increased between 1909 and 1937 by percentages larger than those in any other industry covered here (5,000 and 300, respectively); and in this same industry unit labor requirements, unit wage costs, unit value added, and average selling price were cut by the largest percentages (92, 70, 75 and 40, respectively). Petroleum refining, chemicals, beet sugar, and canned foods also are to be singled out for these relationships. Conversely, the industries that fell behind in reducing unit labor requirements and in expanding output and employment were slow to cut unit costs and prices. Among the laggards we find the industries manufacturing cotton goods, woolen and worsted goods, carpets and rugs, lime, and lumber.

The inverse relation we have noted between employment and output on the one hand and the employment-output ratio on the other holds for changes over specific periods, 1899-1937 or 1909-1937. Obviously all industries were not in the same phase of development during these years—some were coming into being, some were reaching their prime, some were already on the way out. The relationships for 1899-1937 or 1909-1937 therefore represent averages for industries at various stages of their careers. This observation leads us to the question: How are employment, output, and the labor-output ratio related during each of the successive stages through which an industry passes?

The growth of an industry, in terms of output, proceeds at a rate that diminishes more or less steadily from decade to decade, until, when peak output is attained, it becomes zero, and finally negative. The course of retardation may be illustrated by the cigar industry. Between 1869 and 1879 the output of cigars rose by 7.5 percent per annum, and between 1879 and 1889, by 6.1 percent. During each of the next two decades cigar manufacture increased annually by 3.3 percent, but between 1909 and 1919 the rate was only 0.1 percent. In the two following decades it fell: by 1.2 percent per year between 1919 and 1929, and by 2.7 percent in 1929-37. In an industry with an initial spurt as meteoric as that of automobile production one discovers an extremely rapid rate of retardation: the output of automobiles rose at an annual rate of 43 percent during the first decade of the present century, 32 percent in the second decade, and 13 in the third; then a decline set in, and production dropped at the rate of 1.3 percent per annum between 1929 and 1937.

Employment, too, grows at a decelerating rate. Just as output in most industries has tended to expand less and less rapidly with the passage of time, so the percentage increase in employment has usually diminished. Reductions in hours of labor have modified this pattern, but have not radically altered its general outline.

Retardation of growth in both output and the number employed by an industry does not mean, of course, that the movement of employment is exactly the same, at any one time, as that of output. Because of widespread and more or less persistent declines in employment per unit of product, aggregate employment in any one period usually grows more slowly than output; and maximum peaks in the former frequently precede maximum peaks in the latter. Among 72 industries which reached peaks in both employment and output prior to 1939, the high point in employment followed the peak in output in only 11. In 23, mainly because of cyclical

and random fluctuations impressed on both series, the two dates coincide. In the other 38 industries, over half of the sample, employment reached a peak and began to recede while output was still expanding; and in as many as 15 of these, output reached its peak more than a decade later than employment. There is evidence, moreover, that the highest peak in *manhours* leads the highest peak in output in a proportion of industries greater than 38 out of 72, and that the average lead of the manhour peak over the output peak is longer than the average lead of the employment peak over the output peak.

If we may judge by the statistics analyzed in this report, during the early stages of a manufacturing industry's career employment goes upward with output while employment per unit shrinks; during the middle stages the number of workers employed also tends to drift downward, although output is still advancing; and during the late stages all three tend to drop. In young industries, whose output characteristically shoots up quickly, the enormous gains in production usually more than counterbalance the declining trend in the labor-output ratio; as a consequence, employment too expands rather rapidly. During the mature phase of an industry's development output expands slowly, if at all; now the gain in volume of product is not great enough to offset the declining trend in the labor-output ratio, and as a result jobs decrease unless the working week is cut sufficiently to compensate for the lessening need of labor per unit. In old and waning industries, falling output offers no counterweight to diminishing unit labor requirements, so that even substantial cuts in the hours of work per week fail to halt reductions in the number of workers employed.

When we look at manufacturing in the aggregate, we see that change in total factory employment is the net result of the shift of workers into new industries, the rapid multiplication of jobs in the young industries that survive in the initial

struggle for breathing space, the moderate growth (but from a higher level) of industries close to maturity, the stagnation in older industries, the decline in waning industries, and finally the disappearance of employment in defunct industries. Technological changes contribute to all these developments, for they are basic not only to the ebb of employment in mature and decadent industries but also to the emergence and exploitation of new fields of employment. Technological evolution is thus a factor in the hiring of workers as well as in their firing.

Capital investment, too, if it can be considered apart from developments in technology, has played a dual role in the opening up of employment opportunities and in their industrial distribution. On the one hand, an industry's output (and the employment it offers) has seldom expanded unless capital has flowed into it; whereas industries with shrinking output and employment have not commonly increased their aggregate assets at the same time. There have been exceptions, of course. Since an influx of capital is only one of the means by which an industry's output is augmented, some industries may have grown, during some periods, with little or no increase, or even a decrease, in their capital assets; and it is conceivable that capital assets, by displacing other factors of production, have swelled even in a few declining industries. Nevertheless, what we know of industrial history bears out the broad observation made here. Between 1904 and 1937 the largest increases in both jobs and output occurred in the major groups of manufacturing industries whose fixed assets, in terms of net book values, grew most rapidly. Automobiles, petroleum refining, electrical machinery, chemical and rubber products stand out in this respect. And among the groups with relatively slight increases in output and employment, notably tobacco, textiles, leather, and forest products, are the industries with less-than-average increments to capital assets.

It is equally true, however, that an inflow of capital has

usually been accompanied by sharp cuts in labor requirements per unit. Inevitably, then, when output fails to expand sufficiently to balance the decline in unit labor, new capital investment is associated with fewer jobs. Here also the change in the employment offered by an industry is seen to correspond in direction with change in capital investment at certain stages of an industry's growth. Though adequate statistical information is lacking, it seems likely that in the early stages capital investment is accompanied by an increase in jobs; that in the mature period it coincides with static or declining employment, and that in the later stages disinvestment of capital parallels displacement of labor and dwindling output.

MANUFACTURING PRODUCTIVITY AND INDUSTRIAL DEVELOPMENT

The great reduction since 1899 in the factory labor utilized per unit of output (one half in terms of workers, two thirds in terms of manhours), and the corresponding advance in output per worker or per manhour, provide us with a rough indication of the growth of manufacturing productivity. These changes cannot, of course, be regarded as exact measures of the gain in the power and efficiency of manufacturing industry, for shifts in the ratio between output and labor input may have come about through the substitution of other production factors for workers, or of one type of labor for another. For example, if costs are incurred in the operation and maintenance of the cigar machines which displaced cigar makers, or in the purchase of the electric power which superseded the factory production of power, the measurable reduction in labor per unit must overstate the net gain in productivity. On the other hand, the substitution of unskilled for skilled labor (say, cigar-machine operators for hand workers) may signify an economy that is not reflected in the measures

of labor input available to us. (Of course, if the skill of the displaced workers is thereby rendered obsolete, as it often is, the gain is merely a gross gain, in the accounting sense, from the viewpoint of society at large; for in casting up its accounts the nation must give full consideration to the negative consequences of any industrial development.) Similarly, capital-saving innovations lead to advances that can hardly be gauged by any productivity ratio we are able to compute. Yet even liberal allowance for biases of this sort would not invalidate the conclusion that productivity has soared upward rather generally throughout manufacturing enterprise.

This enhancement of factory efficiency cannot be credited entirely to our manufacturing industry. Nor, indeed, because manufacturing constitutes merely one sector of our economy, can its productivity be fully understood or explained when viewed in isolation. The career of any single industry, great or small, is a thread woven into a complex pattern, to which it contributes its share of color, texture, and design, and from which it derives most of its meaning.

There is ample evidence that the labor-output ratio in manufacturing is affected by the kind and quality of the materials secured from nonmanufacturing industry. It is widely known, for instance, that selection of seed and technological advances have raised the sugar content of beets, so that there has been a gain in the sugar yield obtained by manufacturers per ton of beets treated. And in another field, the introduction of the flotation process, which led to the concentration of an increasing fraction of copper ores by the mining industry, has lessened the effort expended in the factory to derive a given quantity of copper in the smelting process. Similarly, such forms of nonmanufacturing endeavor as engineering and independent research have made their contributions to manufacturing. They have been the original source of many ideas concerning materials, products, processes, as well as organization and management, and have

helped also to transmit ideas from one industry to another. For all ideas do not originate in the industries utilizing them. They spring up in different areas of the industrial cosmos and merge in a common pool drawn upon by all types of enterprise.

Perhaps the stellar role in the contribution of nonmanufacturing industries to factory productivity has been played by transportation, and in particular by the railroad system, which has opened up many new sources of raw materials. Thus lumber manufacturers have extended their operations to virgin forests, thereby at least postponing increases in their costs. Again, highly concentrated localization of factories, with the fine division of labor and other advantages it implies, depends upon cheap and efficient transportation not only from sources of supply to factory but also among specialist plants. The immense expansion of the factory system would have been inconceivable without the extension of the railway system.

The growth of the economy at large has augmented the scale of operations and raised the level of productivity in manufacturing perhaps even more rapidly than in other fields of industry, for fabricated goods have acquired a favored place in consumers' budgets as incomes have risen. It is true, of course, that in some instances an expansion of the scale of operations may press upon limited natural resources, thus causing the employment of more, rather than less, labor per unit of product. Occasionally such a tendency is noted in mining, and, if demand leads to the exploitation of mines yielding low grades of ore, the result may even be an adverse effect upon manufacturing productivity. But the evidence gathered in this study indicates that growth of factory output has usually been associated with more, rather than less, output per worker employed.

The relation of manufacturing to the entire economy has always been a reciprocal one. Changes in one industry stimu-

late changes in others, through imitation, competition and cooperation. Many new devices and materials have resulted from a collaboration between producing industries on the one hand, and consuming industries on the other. Steel companies have helped to develop new materials for many of their smaller customers and for some of their large ones as well—notably the railroads. Less direct, perhaps, but even more obvious in its results is the sort of cooperation that yields improvements both in engines and in types of fuel and lubricants. Specifically, it is interesting to observe the high degree of correlation between trends in octane numbers of gasoline and in compression ratios of automobile engines. And then, of course, there are the specialist “assistant industries”—accountants, advertising agencies, engineers, commercial laboratories, efficiency advisers, and so on—which not only work out new techniques but also act as transmission belts for those developed elsewhere.

Just as nonmanufacturing industries have contributed to the expansion of manufacturing, so the latter has served to stimulate industry in other segments of the economy. Manufacturing has enhanced the productivity of nonmanufacturing industry both by taking over some of the tasks formerly done outside the factory and by supplying better and cheaper tools and materials for nonmanufacturing use. The substitution of the factory-made tractor for the farm-bred horse set free the farm labor that formerly was devoted to rearing, feeding, and caring for draught animals. And this is only one of a multitude of examples to which the reader can easily add from his own store of information and experience.

Growth in the efficiency of any single industry or group of industries—manufacturing or nonmanufacturing—is thus intimately related to developments elsewhere in the economy. Advance in manufacturing productivity is part of the evolution of the entire industrial system. For this reason we must learn to look not only within but beyond factory walls for an

understanding of the rise of manufacturing industries, and come to regard the increase in output per unit of labor in manufacturing as merely one observation on the change in the productivity of the entire economy.

FACTORY EMPLOYMENT AND OUTPUT AND THE NATIONAL ECONOMY

Like the growth of factory productivity, the trends that have characterized employment and output in manufacturing industry are aspects of the development of the economy at large. Factory output itself rose more rapidly than the total national product; the national income, adjusted for changes in prices, went up about 130 percent from 1899 to 1937, while the output of fabricated goods almost quadrupled. Factory output thus advanced about 50 or 60 percent more than the total product. But such a relative increase should not have been unexpected during this stage of our development. The rise in national income per capita brought with it a greater demand for processed commodities. It made possible the transfer of domestic chores like baking, canning, cooking, and sewing from the home to the factory, and it lessened the burden of many other tasks which factory-made goods (washing machines, vacuum cleaners, and other devices) could now accomplish more easily and efficiently. Aside from the relative increase in the volume of final consumer commodities passing through factories, these enterprises undertook a greater share of the production of other commodities. Such processes as butter- and cheese-making and animal slaughter were shifted from farm to factory, and the work of the farmer was eased by the increased fabrication of fertilizers, agricultural machinery, tractors and fuel. Factories turned to producing more and more of the "horse" power consumed in farm operations. A similar development characterized the relations between factories and nonagricultural industries such as mining, where mechanical excavators and loaders

took over much of the labor formerly needed at the pit. Factory output grew also because manufactured products came to occupy a larger place among our exports.

Just as factory output rose with the national income, between 1899 and 1937, so factory employment increased with the total number of jobs held by the gainfully occupied population. Once again we find that the trends did not run exactly parallel. Factory employment rose more rapidly than total employment and thus reflected a rise in the fraction of our available human resources devoted to manufacturing operations. But the disparity between the two trends in employment was less marked over the entire period 1899–1937 than that between the two output trends during the same period. The explanation is to be found in the more rapid increase in output per worker in factories than in the economy as a whole, a fact which was undoubtedly associated with the more rapid rise in factory output than in the total national product.

The changes in the relation between manufacturing and the entire economy did not take place at a uniform rate during the four decades beginning with 1899. Factory output climbed rapidly throughout the first three decades, but changed only fractionally between 1929 and 1937; and the increase in factory output, relative to the national product, came almost entirely during the first two decades. Factory employment rose only during the first two decades, both absolutely and in relation to total employment. During the 1920's and 1930's it remained unchanged, except for cyclical fluctuations, and in relation to total employment it actually declined during the 1920's.

During the 1920's, therefore, the gain in factory output was accomplished entirely by an increase in output per factory worker. In this period the newcomers to our working population apparently were not needed in manufacturing and could be diverted to nonmanufacturing operations, espe-

cially trade and service. Even in these occupations, it is possible that they contributed in some part to the increase in factory productivity and thus to the rise in factory output, for, as we have seen, factory productivity reflects many more changes than those occurring exclusively within factories.

Between 1929 and 1937, the maintenance of the level of factory output was accomplished by an increase in output per manhour, since the number of workers remained unchanged as a result of the sharp cut in hours of labor. In this period employment in nonmanufacturing industries also failed to grow, so that the annual increase in the number of our working population served merely to swell the ranks of the unemployed.

When viewed against the background of retardation in the growth of employment in individual manufacturing industries, the failure of total factory employment to rise during the 1920's and the decline in manhours of employment during the 1930's seem to indicate that manufacturing is approaching, or has already reached, maturity. There is some evidence, indeed, that the ratio of factory personnel to the total number of persons gainfully occupied has suffered retardation in recent decades. But the evidence is not conclusive: the ratio rose 12 percent from 1870 to 1880; 6 percent from 1880 to 1890; 8 percent from 1890 to 1900; 2 percent from 1900 to 1910; and 19 percent from 1910 to 1920; from 1920 to 1930 it fell 13 percent, but in 1930-37 it rose again, though only by about 2 percent.¹ The figures reveal a tendency to decline with the passage of time, but the variation about the downward trend is rather considerable. For output, adequate data are not available for the years prior to 1899. While the information covering the last four decades is not inconsistent with the presence of retardation in factory out-

¹ The figures for 1870-1930 are derived from Daniel Carson's analysis of the Census of Occupations (*Labor Supply and Employment*, unpublished manuscript of the National Research Project); and those for 1930-37 from Department of Commerce estimates.

put, it, too, can hardly be considered as proof of such a tendency.

On the statistical side, therefore, one may well doubt whether the growth of factory employment and output has consistently decreased in speed in relation to the rate of developments in the remainder of the economy, and thus whether the rates of change since 1919 and particularly from 1929 to 1937 are part of a clearly-defined trend. Yet even if retardation were to be considered accurately descriptive of the past relative growth of our factories, it is questionable that it could be interpreted as a sign of the approaching maturity of manufacturing. There is, of course, the complication raised by the present war, during which manufacturing has already expanded enormously. But aside from this "deviation," one is confronted by the inherent difficulty of characterizing as mature any major division of an economy, especially one as heterogeneous as manufacturing. Only a homogeneous industry can be treated as a single entity, so that an inference concerning its future may be hazarded from its past trend. But factories produce commodities at various stages of completion (pig iron, steel sheets, machine tools, and automobiles); and articles satisfying diverse wants (foods, textiles, construction materials, capital equipment, and durable consumers' goods). It is true that the pace of the shift of production from the household to the factory may slacken and ultimately cease, if it has not already done so; and full mechanization of farm and mine may finally be accomplished. In that event these forces, which in the past have stimulated rapid growth in our factories, may no longer operate. Yet there also exist potential factors that may cause manufacturing to grow. Among these are further developments of new processed materials, such as plastics; the shift of work from the construction site to the factory if extensive prefabrication of building materials becomes practicable; the full-fledged mechanization of trade and the service industries;

and the development of various new consumer goods. These possibilities, if realized, may cause a resurgence of manufacturing.

Qualifications concerning predictions as to the future of factory output apply equally to forecasts of the trend in factory employment. Whether the failure of factory employment to rise during the 1920's and 1930's portends a corresponding horizontal trend (or even an actual recession) after the present war boom has ended it is impossible to predict. There are snares in simple reasoning. And as is true of factory output, the future course of factory employment cannot be determined merely by a consideration of the variables related directly to manufacturing.

Nor can the significance of past trends in factory employment be appraised if attention is confined to factories alone. Stable or declining numbers of factory workers are not of themselves tragic omens. If employment in the rest of the economy is rising, as it was up to 1929, declining factory employment may mean either a diversion of energy from one type of production to another, or an advantageous reduction in the amount of labor required to fabricate a given amount of product. In that case, not only the growth but also the stagnation of factory employment falls into perspective as an aspect of our general economic advance. And if employment in all types of industry fails to rise, as during the 1930's, the roots of the problem posed by a declining number of factory workers reach far outside factory walls, and the solution of that problem must be sought in study of an area broader than manufacturing alone.

Appendix A

Note on the Measurement of Factory Employment

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THE data used here to determine the number of workers employed in manufacturing industries have been taken from the Census of Manufactures. Although these statistics are the most detailed and complete available, their study raises some troublesome questions concerning such matters as Census coverage, classification of personnel, and character of the employment averages. Several problems associated with Census material, particularly those which bear upon determination of output, were considered at some length in Appendix A of *The Output of Manufacturing Industries, 1899-1937*.¹ In the present note attention is concentrated upon the Census data on employment.

By a manufacturing industry's employment in a given year we mean the annual average number of persons, including wage earners, salaried workers, corporate officials, proprietors and firm members, who contributed to the value added by the industry in that year to the materials passing through its establishments. Neither this definition nor its application in the collection of statistics is as simple as it may seem at first glance. It is necessary to discuss what is meant by manufacturing, by employment, and by average number.

In every manufacturing industry there are a number of operations which are not usually regarded as manufacturing processes. Some maintenance work and certain tasks connected with extension of plant facilities are frequently performed by employees of the factory. Then there are distribution activities, like selling and servicing, which are not always divorced from factory operations. Indeed in some industries mining operations and lumbering are performed in factory establishments as part of the process

¹ National Bureau of Economic Research, 1940.

of fabrication. For the cement industry and certain others the Bureau of the Census has recognized the intimate relationship between the mining and the manufacturing aspects of the enterprise and the consequent difficulty of segregating the employees who are engaged primarily in quarrying; for this reason it has consistently asked manufacturers in these industries to report mining employees in the schedules they return to the Census of Manufactures, the source of our employment data. A similar request is sent to owners of logging camps, which are treated as part of the sawmill industry. Yet it is true not only in these industries but also in others that when workers engaged in "non-factory operations" are not segregated by reporting manufacturers they are perforce counted in the Census of Manufactures as factory employees. Manufacturing is thus in effect defined somewhat more broadly than it might otherwise be. This fact does not of itself create any serious difficulties, since the product of most of the persons reported on factory payrolls as engaged in "nonfactory" activity is adequately represented in the Census data on the value added by manufacturing.² But *changes* in the scope of the Census of Manufactures, caused by alterations in the degree to which nonfactory personnel is reported, do create difficulties; for they not only affect the indexes of factory employment but impair the comparability of the employment indexes with those of output.³ It is probable that such changes occur, for the schedules sent out in the Census have not always been so ex-

² Therefore the number of workers reported is the number that did contribute to the reported value added. For example, the manufacturing industries which do some mining or lumbering presumably report the cost of materials before extraction. Value added, the difference between cost of material and gross value of product, is therefore greater than it would be if mining or lumbering were segregated and the cost of materials were computed to include the wages of employees engaged in extraction.

The only exception is the work done by the small group of factory employees engaged in new construction and other forms of extension of plant facilities.

³ The comparability of employment with value added is hardly affected by the inclusion or exclusion of nonfactory personnel, since both items are equally conditioned by the manner in which these persons are counted. But the gross value of product (to be distinguished from the value added) is the same on either basis; for this reason, variation from Census to Census in the degree to which nonfactory employees are reported will cause changes in employment per dollar of gross value of product (and also per unit of gross physical output, on which our indexes of output are based).

implicitly worded as to obviate the possibility of variation in reply, nor have they remained unaltered from one Census to another. Some information on the number of nonfactory employees in factories has been collected in the latest three Censuses (Appendix B, Table B-4), and we have made use of it in preparing our indexes of employment (Appendix F). What we learn from this information, supplemented by a study of the schedules themselves, leads us to the conclusion that on the whole variation in the implicit Census definition of factory employment has given rise to no serious ambiguities in the data. However, for certain industries, especially those in which there is a large proportion of nonfactory employees, the incomparabilities in the employment statistics between successive Censuses are sometimes likely to be important.

As we have already noted, employees in distribution and similar activities, who can be distinguished from those engaged in factory operations, are omitted from the Census of Manufactures. It may be that such activities have become increasingly important in manufacturing during the last forty years; and to the extent that this is so indexes based on the Census data understate the growth of employment in manufacturing industries, at least if employment were to be defined more broadly than in the Census. But this is hardly a qualification of the Census data. To extend the definition of any industry to include activities which have at any time split off and attained independence would mean, in effect, to throw overboard all industrial classification: manufacturing itself would then lose its identity.

We prefer, wherever possible, to avoid confining our measure of employment to wage earners alone (Appendix B, Table B-1). Clerical work and the work of supervision and management constitute employment, and since they contribute to the value added by manufacturing, such occupations come within factory employment. To treat clerical workers, for example, as if they were in a nonmanufacturing industry—a "service" industry—is to fly in the face of the facts. It is true that compensation paid workers other than wage earners is not always a direct cost and is not easily allocable to separate items of production; but since we are concerned with the entire output and employment in an

industry this objection is hardly relevant. Unfortunately, the available Census statistics on non-wage-earner employment in manufacturing are incomplete (Appendix Tables B-2 and B-3). For all industries combined a reasonably accurate series on total employment in almost every Census year 1899-1939 can be estimated (Table B-5), but for individual industries this is more difficult and energy-consuming. We have therefore had to confine the major part of our discussion to wage earners alone, noting as well as we can, however, the degree to which this series differs from the measure of total employment in the years for which the latter is available; in most cases the difference is slight.⁴

The average number of persons employed by an industry during a given year is derived in the following manner: the number of persons listed on each payroll of the year is summed up, and the aggregate thus obtained is then divided by the number of payrolls. The resulting average is an artificial number, for it corresponds to no specific group of individuals. But it is a more satisfactory measure of employment than a number which does specify a count of separate and distinct individuals because it is less affected by the rate of labor turnover and the extent of idle time. Given a certain amount of work done during a year, the number of separate persons employed in that work will be larger if the rate of labor turnover is high than if it is low, and smaller if each person is employed continuously than if each is kept idle for some part of the period covered. A proper measure of employment should stand clear of these effects, and we must admit that the average number defined above is not entirely free of them. The extent to which this average number is affected depends on the length of the payroll period. If the payroll period were infinitesimal in length, the average number employed in any plant would be entirely independent of the amount of labor turnover and idle time. In this case the average number would be smaller than the number of separate and distinct individuals who worked in that plant during the year; or put differently, it would be equal to this number only if each of the individuals worked in every payroll period in which there was work, i.e., if

⁴ The methods of handling the difficulties encountered in measuring total employment are described in the introduction to Appendix F.

there were no turnover and no variation in the degree or date of part-time work. Here we have the clue to the meaning of the average: it is the number of persons that would have been on the payroll if the work actually done had been performed by workers who all enjoyed full and continuous employment. It is, in other words, the *equivalent full-time* number of workers.⁵

Our concept of employment, then, implies a measure based on data for 52 payroll periods per year. In fact, however, the Census measures do not exactly correspond to this measure. The average number of wage earners is derived by the Census from 12 monthly figures, each relating to the week which includes the 15th of the month or the working day closest to that date.⁶ The difference does not appear to be serious. For workers other than wage earners the Census gives only the number employed on some one day, usually December 15th. But since the number of salaried workers, corporate officials and proprietors does not fluctuate seasonally with as great an amplitude as the number of wage earners, no serious error arises on this score. Because of cyclical fluctuations it is probable that a December figure is less than the annual average during recession and greater during revival; but this cyclical bias need not worry us since we are interested mainly in trends.

It will be noted that the average combines work and workers of diverse grades and talents, making no allowance for differences in quality or efficiency of labor among various classes of workers

⁵ As a matter of fact, the calculated average number differs somewhat from the full-time figure because it does not allow for idle time or turnover *within* the week. To pass from the calculated average to the equivalent full-time figure one would have to multiply the former by the average number of hours actually worked per week per worker and divide by the number of hours in the full-time week. The average number of hours used for this purpose should allow for turnover as well as for part-time work within the payroll period. Available hours data do make such an allowance, since they are computed by dividing the aggregate number of manhours of work done during a week by the number on the week's payroll. (If the amount of overtime exceeds the amount of undertime, the equivalent "full-time" number will be greater than the equivalent "full-number-of-weeks" number.)

⁶ The number of workers reported in the Censuses before 1899 is the average number employed during the time each establishment was in operation, and not the average employed during the full year. In pushing the indexes of employment farther back than 1899, in the case of several industries, we have had to take this change of definition into account and make various adjustments to avoid or at least lessen incomparability of the figures for 1889 with those for 1899.

or among the same workers at various times. That is, the weights implicit in the computation are identical. That wide differences do exist in quality and skill is a matter of common experience;⁷ and presumably the difficulties encountered and the methods utilized in dealing with them would be analogous to those involved in the computation of index numbers of physical output and of prices. But we can do no more than mention the problem, since very little in the way of statistical material is available. Simple aggregation of numbers is the only practicable solution. Changes in quality and skill of labor and in effort exerted are therefore relevant to the interpretation of these summations.

Unemployed workers are excluded from our aggregates. For some comparisons with output it may be illuminating to combine unemployed with employed workers, particularly if one is concerned with the entire economy, and with a concept of productivity which contrasts output with *available* labor resources. But measures of unemployment in separate industries are ambiguous even in theory; and our chief interest here is in the relation between actual employment and output in limited parts of the economic system.

⁷ For some interesting statistical data see W. D. Evans, "Individual Productivity Differences," *Monthly Labor Review*, February 1940.

Appendix B

Number of Persons in Manufacturing Industries

Appendix B

Number of Persons in Manufacturing Industries

INTRODUCTORY NOTE

THIS appendix brings together the basic data on number of persons engaged in manufacturing industries during the Census years 1899–1939. The statistics are presented in the following tables:

- B-1 Number of Wage Earners in Manufacturing Industries: Individual Industries, Groups of Industries, and Total Manufacturing.
- B-2 Number of Salaried Workers in Manufacturing Industries: Groups of Industries and Total Manufacturing.
- B-3 Number of Proprietors and Firm Members in Manufacturing Industries: Groups of Industries and Total Manufacturing.
- B-4 Number of Nonfactory Personnel in Manufacturing Industries: Groups of Industries and Total Manufacturing.
- B-5 Aggregate Number of Personnel in Manufacturing Industries: Total Manufacturing.

The explanatory note accompanying each table should be consulted before the figures themselves are utilized.

Explanatory Note to Table B-1: Number of Wage Earners in Manufacturing Industries

This appendix table contains the basic data on the average number of wage earners employed in American factories in each Census year from 1899 to 1939 inclusive. The character of the average number calculated by the Census is discussed in Appendix A. The distinction between wage earners and salaried employees (given in Appendix Table B-2) does not rest on the manner in which compensation is paid. It is based, according to the Bureau of the Census, "primarily on the character of work done rather than on the unit of time which is the basis of compensation.

Wage earners are not confined to those who receive day wages, although most wage earners are paid on this basis. It will doubtless be found, for instance, that engineers and firemen in mills and pressmen in newspaper offices are often employed by the week or the month, but they should be classed as wage earners rather than as salaried employees. Timekeepers, messenger boys, etc., in printing plants, and the like, whose work is closely related to that of persons who would ordinarily be called clerks, stenographers, and salesmen, may be classed as salaried employees."¹

Of the three sections of the table presented here, the first shows in detail the average number of wage earners employed by each manufacturing industry. The industries are arranged in groups which proceed in the order previously established for major groups of manufacturing industries. Within the groups, the order of the individual industries is designed to bring closely related industries together for convenience in presentation. A second section assembles the group totals and shows the grand total for all manufacturing industries combined. The third section reconciles the grand total arrived at in the present study with the grand total given in each Census volume.² This reconciliation is necessary because the composition of total manufacturing in this study differs somewhat from that of the Census, as do also the composition and order of our major groups.

In order to obtain accurate and comparable data, we have had to take figures from many different Census volumes. Furthermore, we have sometimes combined series given in detail in the Census reports, and for this reason the reader may occasionally find it difficult to locate in the Census volumes certain figures presented by us. The industry titles used here are short titles; complete Census titles will be found in the index to *The Output of Manufacturing Industries, 1899-1937*.³

¹ Census of Distribution, Manufactures, and Mines and Quarries, 1929—Instructions for Preparing Distribution, Manufactures, and Mines and Quarries Reports—Cities Having 10,000 or More Inhabitants, Bureau of the Census (Washington, 1930), p. 36.

² The 1899 and 1904 Census totals were taken from the 1909 Census report.

³ Since publication of the volume cited we have made a few changes in the short titles. For example, *tobacco products, other* is now called *chewing and smoking tobacco*, and *chemicals, not elsewhere classified* is now called *chemicals, industrial*. None of the changes in title should cause the reader trouble in identifying the industries affected.

Footnotes explain pertinent changes in classification and coverage. Breaks or discontinuities in series have been indicated by footnote symbols at the point where the discontinuity occurs; and symbols are repeated in a series if breaks occur at more than one point. Whenever possible the continuity of a series has been preserved, at least in part, by the provision of two figures for the year in which a change in composition took place, one figure comparable with earlier years and the other comparable with later years.

The industrial classification in the 1939 Census was set up to conform to the standard classification system recommended by the Division of Statistical Standards of the Bureau of the Budget. For this reason it differs considerably from the classification followed in earlier Censuses. However, in all cases comparable 1937 figures were provided in the 1939 Census report and are given here. Because of their great number and the ready availability of information in the 1939 Census report, no attempt is made here to describe in detail the changes between 1937 and 1939.

The footnotes which give details concerning the various changes in the definition of certain industries are necessarily condensed. For example, footnote j, p. 183, reads: "Between 1909 and 1914 powdered milk and sugar of milk were transferred from *chemicals, industrial*, to *milk, canned*." In more precise terms, the statement means that up to and including 1909 establishments whose chief product was powdered milk or sugar of milk were classified under *chemicals, industrial*, whereas in 1914 and later years they were classified under *milk, canned*.

We use *n.e.c.* as the abbreviation for *not elsewhere classified*, *n.e.m.* for *not elsewhere made*, and *n.e.d.* for *not elsewhere done*. Italicized figures represent duplications (such as totals) of other figures in the same column, though not necessarily on the same page. Group totals are not italicized. The titles of industries are italicized in footnotes. The printed totals do not always agree exactly with the sum of the component items because decimals carried in the original calculations have been rounded off.

TABLE B-1

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

FOODS	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Industry</i>																
Meat packing*	68.9	74.6	88.2	98.9	161.0	161.0	117.0	132.8	120.4	119.1	122.5	106.7	113.2	116.6	127.5	120.5
Sausage, n.e.m.	0.88	1.3	1.9	2.6	3.5	3.4	3.9	4.6	4.9	5.0	5.9	6.2	7.8	9.2	10.2	
															12.5	12.3
Oleomargarine, n.e.m.	1.1	0.52	0.61	0.92	2.9	2.9	2.0	1.5	1.6	1.5	1.5	1.0	0.84	1.2	1.2	0.98
Shortenings			b	1.8	2.4	2.4	1.1	1.7	2.0 ^c	2.7	3.0	3.7	3.7	4.8	4.9	4.7
Flour	32.2	39.1	39.5	39.7	45.5	45.3	35.4	35.2	32.0 ^d	30.0	27.0	22.8	23.2	26.5	26.4	24.8
Cereals			b	5.2	7.6	7.6	5.7	6.4	6.2	6.0	6.5	7.0	7.1	7.9	8.1	7.8
Feeds	} 8.2	11.3 ^e	1.8	2.5 ^b	4.4	4.4	3.3	3.4	4.5 ^d	7.6	10.2	8.4	8.8	11.6	14.4	15.4
Food, n.e.c.			13.2	17.2 ^d	6.9	11.4	11.3	8.9	10.7	11.6	10.3 ^f	10.6	8.9	10.7	14.1	16.8	15.5
														14.6	15.5	
Rice	0.65	1.5	1.2	1.3	2.1	2.1	1.9	1.8	1.3	1.5	1.6	1.5	1.6	2.0	2.2	2.3
Macaroni			b	3.5	4.5	4.5	3.9	4.1	4.6	4.6	5.1	4.8	5.5	6.0	6.5	6.0
Biscuits and crackers	} 60.2	81.3	100.2	25.0	34.3	34.1	31.5	35.1	32.4	33.0	33.9	28.4	27.2	29.2	28.8	29.2
Bread and cake				99.0	107.3	106.4	117.0	127.5	128.0	139.0	167.0	154.8	155.2	189.2	210.6	201.5
Fish, canned	12.6 ^g	8.4	9.9	11.2	12.4	12.4	7.9	9.1	10.5	12.6	13.6	8.6	10.0	13.3	18.2	17.6
														18.7	17.6	
Fruits and vegetables, canned	44.4 ^h	48.5 ^b	50.0	62.9	77.5	76.3	51.7	72.5	85.9	80.9	98.9	80.2	84.3	116.3	137.1	116.8
Vinegar and cider	1.6	1.5	1.5	1.2	2.0	1.9	1.5	1.3	1.2	1.1	0.98	0.85	0.84	1.0	0.97	1.1
Butter	} 12.8	} 9.5	11.6	14.1	17.6	17.6	18.5	20.3	17.8	20.1	19.1	15.7	16.5	18.4	19.4	18.0
Cheese				2.7	2.7	2.9	4.0	4.0	3.5	4.3	3.4	3.5	3.4	3.0	3.1 ⁱ	4.3	4.5	5.0
Milk, canned		3.4	4.2 ^j	6.0	13.7	13.7	9.5	8.3	7.1	7.4	7.1	6.1	6.3	8.5	9.0	9.7
Ice cream			k	10.4	19.2	19.0	20.2	23.1	23.0	21.9	22.4	17.8	14.4	17.3	18.7	15.7
Beet sugar ^l	2.0	4.0	7.2	8.0	11.8	11.8	13.6	7.6	8.9	7.4	7.5	6.2	10.7	9.2	9.4	10.4
Cane sugar, n.e.m. ^l	} 14.1	13.5 ^e	4.1	3.6	6.1	6.1	2.7	2.8	2.1	0.97	2.3	2.0	2.4	2.9	4.2	4.2
Cane-sugar refining			9.4	11.3	18.2	18.2	15.5	15.3	14.5	14.0	13.9	11.9	11.5	13.8	14.0	14.1

FOODS (concluded)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More											
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939	
<i>Industry</i>																	
Chewing gum	} 26.9	36.2	44.6	{ 2.0	{ 3.2	3.2	2.0	2.1	2.2	2.5	2.3	2.1	2.3	2.3	2.4	2.6	
Confectionery				{ 51.6	{ 76.5	76.0	61.0	63.5	63.6 ^m	63.2	63.5	51.3	50.6	52.1 ^m	53.7	49.7	
Chocolate	1.3	2.1	2.8	4.2	9.1	9.1	6.7	6.9	7.1 ^m	6.4	6.2	5.7	6.5	8.3 ^m	7.4	6.5	
Corn products	5.9	4.7	4.8	4.5	7.8	7.8	6.1	6.5	6.5	7.0	6.7	6.7	7.6	7.3	7.0	6.8	
Flavorings	1.6	2.2	2.3	2.4	3.6	3.6	3.5	3.6	3.9	5.0	5.0 ⁿ	5.2 ^o	2.3	2.9	4.2	3.6	
Baking powder	1.9	2.4	2.2	2.3	3.3	3.3	3.6	3.5	2.9	3.0	3.0	2.9	2.7	2.7	2.4	2.3	
Ice ^p	6.9	10.1	16.1	23.0	30.2	29.9	24.1	26.9	24.9	22.1	32.2	25.2	21.3	19.0	18.7	15.9	
TOTAL	304.2	358.9	420.1	498.6	703.1	699.1	583.1	642.2	635.0	639.5	702.9	605.7	618.0	718.3	788.8	788.6	741.0

^a For 1899-1919 *meat packing* includes *lard*, not made in *meat packing establishments*. After 1919 *lard* was not treated as a separate industry.

^b Prior to 1914 *cereals*, *macaroni*, and *shortenings* were combined with *food, n.e.c.*

^c Between 1925 and 1927 vegetable cooking oils were transferred from *oils, n.e.c.*, and other classifications to *shortenings*.

^d Between 1925 and 1927 grain ground for prepared feeds was transferred from *flour to feeds*. The comparability of the figures for the latter industry appears to have been seriously affected by this shift.

^e Between 1904 and 1909 some establishments compounding sirups were transferred from *cane-sugar refining to food, n.e.c.*

^f Between 1927 and 1929 canned poultry products were transferred from *food, n.e.c.*, to *poultry products*. The latter we do not consider to be a manufacturing industry.

^g The 1899 figure for *fish, canned*, appears to be seriously erroneous because of the inclusion of some of the fishermen engaged in catching the fish or of some of the laborers engaged on contract work.

^h Packing and shipping houses that handled dried fruits completely processed on fruit farms were included in *canned fruits and vegetables* in 1904 only.

ⁱ The 1933 Census of this industry is considered by the Bureau of the Census to be somewhat incomplete.

^j Between 1909 and 1914 powdered milk and sugar of milk were transferred from *chemicals, industrial to milk, canned*.

^k Prior to 1914 *ice cream* was not considered a manufacturing industry and was not canvassed.

^l Figures for 1931-39 for *beet sugar* and *cane sugar, n.e.m.*, were requested by the U. S. Bureau of the Census for the seasons beginning in the respective Census years, and for earlier Census years for the seasons ending in those years. Thus the figure given for 1931 applies to the season 1931-32, whereas the figure for 1921 refers to the season 1920-21. In 1925, 1927 and 1929, however, most of the establishments in *cane sugar, n.e.m.*, and a few of the establishments in *beet sugar*, reported for the seasons 1925-26, 1927-28 and 1929-30, instead of 1924-25, 1926-27 and 1928-29.

^m Chocolate departments operated by confectionery manufacturers are classified under *chocolate*. In 1935 and prior to 1927 some confectionery manufacturers failed to make separate returns for their chocolate departments, which were consequently included in the statistics on *confectionery*. Only 5 establishments failed to make separate reports in 1935.

ⁿ Between 1929 and 1931 *dairymen's supplies* was abandoned as a separate classification, and the products were divided among *flavorings* and other classifications.

^o Between 1931 and 1933 malt extracts and sirups were transferred from *flavorings to liquors, malt*.

^p Incomparabilities mar the series for *ice* because of the erroneous inclusion, in varying degree, of some wage earners employed in delivery service.

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

BEVERAGES	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More											
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939	
<i>Industry</i>																	
Beverages, non-alcoholic																	
Excl. near beer	8.8	10.9	13.1	15.5	17.4	16.5	14.7										
Incl. near beer								29.3	27.4	27.0	28.3	23.9	15.1	16.8	28.0	21.3	
Liquors, malt																	
Incl. near beer	39.5	48.1	54.6	62.1	34.3	34.3	18.6										
Excl. near beer												•	23.5 ^b	39.2	47.0	36.1	
Malt	2.0	2.1	1.8	2.0	1.4	1.4	0.62	0.49	0.57	0.50	0.59	0.54	0.85 ^b	1.4	1.6	1.5	
Liquors, vinous	1.2	1.9	1.9	2.3	1.0	0.98	0.42	0.52	0.26	0.15	0.19	0.096	1.3	2.3	3.0	2.1	
Liquors, distilled	3.7	5.4	6.4	6.3	1.4	1.4	1.1	1.1	1.4	1.2	1.5	1.0	2.5 ^{c,d}				
													7.7	8.2	6.2	4.1	
TOTAL	55.1	68.3	77.8	88.2	55.4	54.5	35.4	31.3	29.6	28.8	30.5	25.5	43.2	42.4	67.9	85.9	65.0

^a Between 1931 and 1933 malt extracts and sirups were transferred from *flavorings* to *liquors, malt*.

^b Between 1933 and 1935 malthouses were transferred from *liquors, malt*, to *malt*.

^c The 1933 Census of this industry is considered by the Bureau of the Census to be somewhat incomplete.

^d Between 1933 and 1935 ethyl alcohol was transferred from *liquors, distilled*, to *chemicals, industrial*. Overlapping figures are provided for 1933 by the Bureau of the Census.

TOBACCO PRODUCTS	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
	<i>Industry</i>															
Cigarettes ^a	} 103.4	{	4.5	8.3	11.8	22.9	} 117.1	{	21.6	21.1	20.1	22.5	24.4	26.1	27.4	
Cigars ^a			130.9	131.3	141.0	115.8			114.1	111.9	108.8	94.6	84.2	68.2	66.9 ^b	56.0	55.9	50.9
Chewing and smoking tobacco	29.2	24.0	27.2	26.0	18.3	18.3	16.6	16.3	15.0	13.1	10.8	11.4	10.2	10.1	10.1	9.2
TOTAL	132.5	159.4	166.8	178.9	157.1	155.0	150.0	146.3	132.1	129.3	116.1	99.8	99.7	90.5	92.2	87.5

^a For the years 1909, 1914 and 1919 the Census gives figures for a small industry, *cigars and cigarettes*. The average number of wage earners in this industry was distributed between the industries *cigars* and *cigarettes* in proportion to the average number of wage earners in the two industries. The average number of wage earners in the *cigars and cigarettes* industry in 1921 and 1923 was com-

puted by the Census with the average number of wage earners in *cigarettes* to avoid disclosure of the figures for individual establishments.

^b In 1933 the coverage of *cigars* was incomplete. On the basis of U.S. Bureau of Internal Revenue data the coverage may be estimated as about 81.5 percent; the wage-earner figure for this year has been raised accordingly.

TEXTILE PRODUCTS	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
	<i>Industry</i>															
Cotton goods	297.9	310.5	371.2 ^a	379.4	431.0	430.9 ^b	412.1	471.5	445.2	467.6	424.9	330.0	379.4 ^{c,d}	369.1	422.3	396.0
Cotton small wares	4.9	5.4	7.7 ^a	6.6	9.4	9.4	7.4 ^t	16.4	16.2	15.0	15.3	12.8	13.2 ^{e,k}	13.5 ^b	12.6	13.3
Lace goods			▲	7.4	6.5	6.5	6.4	7.3	7.0	6.5	6.9	6.0	5.9	7.9	8.1	7.3
Woolen and worsted goods ^l															159.0	149.2
Wool scouring	0.72	0.78 ⁱ	1.1	1.1	2.2	2.2	1.5	1.5	1.1	1.4	1.3	1.4	1.4	1.5	1.3	1
Woolen goods	68.9	72.7	52.2	49.2	63.0	62.9	56.4	72.4	67.1	61.8	58.5	42.9	48.5 ^{d,k}	69.1 ^l	67.3	1
Worsted goods	57.0	69.3	111.0	109.5	103.8	103.8	105.9	122.1	98.2	92.6	88.5	76.7	78.7 ^d	93.2	} 90.8	1
Haircloth	} 3.1	} 2.9	0.54	0.60	0.42	0.42	0.30	0.50	0.36	0.38	0.45	0.40	0.60	0.59		
Upholstering materials, n.e.c.			2.6	2.5	1.6	1.5	0.74	1.2	1.2	1.1	1.4	0.90	0.68 ^d	3.2	4.6	4.5
Wool pulling	0.48	0.68	0.63	0.71	0.70	0.70	0.55	0.70	0.57	0.52	0.60	0.64	0.68	0.87	0.79	0.84
Silk and rayon goods	65.4	79.6	99.0 ^m	108.2	126.8	126.7	121.4	125.2	132.5	127.6	130.5	109.2	110.3 ^o	125.9 ^b	116.8	119.8
															117.9	

For footnotes see pp. 188-89.

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

TEXTILE PRODUCTS (continued)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More													
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939			
<i>Industry</i>																			
Dyeing and finishing	29.8	35.6	44.0	48.5	56.0	55.9	51.5	63.4	70.7	73.9	79.3	67.6	66.3 ^{a, n}	74.7 ^o	77.5	66.9			
Hosiery, knit	}	83.7	104.1	129.3 ^m	150.5	172.5	161.9	97.0	103.9	112.8	129.5	112.4	117.9 ⁿ	138.0	150.5	159.1			
Underwear, knit								48.6	48.3	46.2	41.5	32.0	35.9	34.9	39.9	47.2	38.5		
Outerwear, knit								41.5	28.0	24.7	29.0	26.1	26.9	35.5	29.3	30.8	28.1		
Cloth, knit								7.2	6.4	6.6	8.5	7.5	9.0	11.4	11.4	10.9			
Carpets and rugs, rag ^p	1.3	1.7	2.0	2.1	2.0	1.9	1.6	2.0	1.9	1.6	1.5	1.0	0.68	0.99 ^l	0.43	^a			
Mats and matting	1.2	0.62	0.94	0.87	1.1	1.1	0.63	0.99	0.90	0.42	0.47	0.31	0.22	0.69	0.79	^a			
Carpets, rugs and mats, except wool														^a	2.8	3.1			
Carpets and rugs, wool	28.4	33.2	33.3 ^r	31.3	22.9	22.9	22.9	35.2	33.9	32.8	32.6	22.9	21.3	27.6 ^l	30.8	25.6			
Asphalted-felt-base floor covering	}	2.7	3.4	4.2	4.4	5.4	5.4	0.82	1.7	2.5	2.4	2.3	1.9	2.3	2.7	3.3			
Linoleum								4.9	6.3	4.9	5.4	5.5	2.9	2.8	3.7	4.8			
Cordage and twine	13.1	14.6	14.6	15.8	17.6	17.6	14.6	16.4	15.4	15.1	14.5	11.1	11.1	12.3	14.0	12.1			
Jute goods	4.5	6.1	6.7 ^t	8.0	7.1	7.1	5.7	6.0	6.3	5.4	4.9	3.8	4.2	4.6	6.5	3.6			
Linen goods	3.3	3.8	3.6	3.6	1.9	1.9	2.5	2.9	2.6	2.5	2.2	1.6	1.6	1.8	1.9	1.7			
Clothing, men's, work	}	120.9	137.2	191.2	173.7	175.3	174.6	165.2	36.6	32.8	40.6 ^a	38.2	33.1 ^t	55.3	61.1 ^u	70.4			
Clothing, men's, n.e.c.									158.2	141.5	146.1	149.9	122.0 ^v	119.3					
Clothing, men's, buttonholes ^v									0.94	0.90	0.83	0.67	0.48	0.45	0.33	0.33	0.33	0.41	0.29	0.22	0.24	154.6^{w}	158.2
Cloth sponging and refinishing	0.53	0.80	0.98	0.90	1.2	1.2	1.1	1.2	0.93	0.74	0.90	0.58	0.68		155.7	161.7			

TEXTILE PRODUCTS (continued)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Industry</i>																
Furnishings, men's, n.e.c.					18.9	18.9	15.9	19.0	21.1 ^v	25.2	26.6	24.0 [*]	16.7	18.8	22.2 [*] 23.7	20.4
Gloves, textile, n.e.m.	13.2	16.4 [*]	15.9	22.5	99.0	9.0	5.8	8.9	7.8 ^{aa} 9.7	10.3	9.3	7.1	8.6	8.0	12.7	12.3
Shirts	36.6	36.5	48.5	52.0	39.6	39.2	45.4	51.7	49.9	57.2	59.8	57.8 [*]	53.8	59.9	67.6	70.5
Collars, men's	17.1	10.8	12.4	10.1	11.1	11.1	9.3	10.4	7.2	3.3	3.0	2.0	1.2	0.83		
Clothing, women's, n.e.c.	83.7	115.7	153.7	168.9	165.6	165.0	144.9	133.2	126.5	154.5 ^{bb}	187.5	173.9	159.8 ^{cc}	220.6	242.9 [*] 243.5	281.3
Corsets	12.3	11.0	17.6	20.5	18.4	18.4	17.1	16.1	14.5	13.8	13.7	14.0	14.0	15.6	16.4	18.8
Embroideries										9.0	6.6	5.6	4.7	5.7	6.7	8.5
Millinery										33.3	32.2	26.6	22.6 ^{cc}	22.8	21.6 [*]	24.3
Trimmings, n.e.m.	16.9	27.5 [*]	39.2	45.3	50.8	50.4	53.7	54.2	53.6	9.5 ^{bb}	7.9	6.2	5.1	6.1 ^b	8.5 7.9	9.3
Handkerchiefs									^v	6.7	6.0	4.8	4.7	4.9	5.0	4.8
Elastic woven goods, n.e.m.		[*]	10.1	9.6	10.9	10.9	9.5 ^t	3.5	3.8	4.1	4.3	3.3	2.6	2.7 ^b	2.9	2.6
Hats, cloth	12.5	6.6	6.2	7.3	7.5	7.5	6.5	7.3	6.6	6.3	5.8	3.5	4.1	3.8	3.5 [*]	3.4
Hats, straw, men's		5.6	8.8	9.5	7.3	7.3	5.9	6.8	5.9 ^{dd}	3.3	3.4	2.8	3.1	2.9	3.0	2.7
Hats, fur-felt	18.9	22.0	25.1	21.3	18.5	18.5	13.9	16.7	15.2	15.9	16.5	14.1	12.5	14.7	15.9	14.7
Hats, wool-felt	2.1	1.5	2.0	1.2	1.4	1.4	1.4	2.0	1.9	2.1	2.0	1.5	1.6	3.0	4.0	4.4
Hat and cap materials	1.4	2.4	2.4	1.8	3.0	3.0	1.7	2.3	2.1	2.8	2.6	1.9	1.9	2.5	2.4	2.7
Fur goods	7.8	9.4	11.9	9.0	13.6	13.5	12.1	14.4	16.6	16.6 [*]	15.8	12.4	8.2	12.5	13.0 [*]	13.1
Furs, dressed	0.84	1.1	1.2	1.5	5.1	5.1	4.4	5.2	5.1	5.5	5.2	5.2	5.4	6.4	6.3	5.1
Artificial leather	2.0	1.8	7.4 ^{cc} 0.44	0.80	2.0	2.0	1.4	2.5	2.7	2.7	2.6	1.9	2.0	2.3	3.9	4.0
Oilcloth	0.51	0.53	0.98	1.2	1.1	1.1	0.95	1.2	1.2	1.1	1.4	1.2	1.3	1.4		
Awnings	3.3	3.4	4.2	5.1	6.0	5.9	5.1	6.0	6.2	6.5	7.2	5.4	4.5 ^{ff}	4.0 ^{ff}	4.7	3.9
Bags, textile, n.e.m.	3.9	5.7	8.0	9.4	10.8	10.7	10.3	11.5	11.4	11.2	11.8	12.0	10.5	10.9	12.1	12.0
Belting, woven, n.e.m.	0.25	0.69	1.2	0.95	2.5	2.5	1.1 ^f	0.34	0.25	0.34	0.26	0.19	0.17			
Housefurnishings, n.e.c.	5.2	4.8 ^{hh}	4.9 ⁱⁱ	6.9	7.9	7.8	7.5	8.7	9.3	11.7	15.8	14.2	14.7 ^{oo}	15.9 ^{h,o} 26.0 ^{xx}	23.9	33.4
Horse blankets	0.58	1.1	1.6	1.7	0.77	0.76	0.70	0.84	0.69	0.66	0.58	0.39	0.54			

For footnotes see pp. 188-89.

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

TEXTILE PRODUCTS (concluded)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More											
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939	
<i>Industry</i>																	
Felt goods	2.7	3.3	3.5	4.0	5.2	5.2	4.2	5.7	5.1	5.5	5.5	4.4	5.0 ^k	3.6	3.7	3.3	
Flags and banners	0.51	0.37	0.93	1.5	1.1	1.0	0.99	0.88	1.0	1.0	0.94	0.78	0.57	} ^v 1.7 ^v	2.1	**	
Regalia	1.6	2.5	2.6	2.0	2.2	2.2	2.1	2.0	1.7	1.8	1.4	0.92	0.42		0.47	0.50	•
Nets and seines	0.75	0.82	0.95	1.1	0.86	0.86	0.70	0.88	0.88	0.87	0.90	0.57	0.42	} 6.0 ^{ll}	0.47	0.50	•
Wool shoddy	1.9	2.1	2.0 ^{jj} 1.9	2.1	2.6	2.6	1.2	2.1	2.2	1.7	1.8	1.1	1.5		5.6	5.4	4.8
Waste	1.3	1.7	2.0 ^{jj} 2.1	3.1	2.8	2.8	1.9 ^{kk}	2.7	3.0	3.5	3.9	3.2	3.0				
TOTAL	1,036.7	1,179.1	1,457.1 1,466.3	1,525.8	1,635.6	1,632.3	1,532.0	1,741.7	1,654.3 1,655.6	1,719.7	1,732.0	1,441.1	1,491.0	1,707.5	1,834.6 1,838.5	1,839.9	

^a Prior to 1914 *lace goods* was included in *cotton small wares* and *cotton goods*.

^b Between 1919 and 1921 establishments engaged primarily in the manufacture of aircraft parts, other than engines and tires, were transferred from *cotton goods* and other industries to *aircraft*.

^c Between 1933 and 1935 dyeing and finishing departments of textile mills making cotton, rayon, and silk goods were transferred to dyeing and finishing; and cotton-and-silk-mixed fabrics and cotton-and-rayon-mixed fabrics having a cotton warp, even though the material of chief value was silk or rayon, were transferred from *silk and rayon goods* to *cotton goods* and to *cotton small wares*. The Bureau of the Census states that the combined figures for the latter two industries for 1935 are "roughly, but not exactly" comparable with the figures for 1933 and prior years and that the 1935 figures for *silk and rayon goods* are not comparable with the figures for earlier years.

^d Between 1933 and 1935 cotton batting, wadding, and mattress felts were transferred from *cotton goods* to *upholstering materials, n.e.c.*; and batts, padding, and card rolls were transferred from *woolen goods* and *worsted goods* to *upholstering materials, n.e.c.* The comparability of the figures for *upholstering materials, n.e.c.*, appears to have been seriously affected by these shifts.

^e Between 1909 and 1914, 8 establishments manufacturing jute carpets were transferred from *carpets and rugs, wool*, to *jute goods*.

^f Between 1927 and 1929 sheep-lined clothing was transferred from *fur goods to clothing, men's, work*.

^g Between 1931 and 1933 children's play suits, windbreakers, lumberjacks and oiled waterproof outer garments were transferred from *clothing, men's, n.e.c.*, to *clothing, men's, work*; sheep-lined and blanket-lined coats were transferred from *clothing, men's, work*, to *clothing, men's, n.e.c.*; workshirts (including flannel shirts) were transferred from *shirts to clothing, men's work*; and men's nightwear was transferred from *furnishings, men's, n.e.c.*, to *shirts*.

^h For 1935 and 1937 the statistics for *clothing, men's work*, are not comparable because of a change in the constitution of the industry.

ⁱ Because *clothing, men's, buttonholes*, contains a large proportion of small establishments, the degree to which it is covered in the Census probably varies from year to year.

^j Between 1935 and 1937 uniforms were transferred from *flags and banners to clothing, men's, n.e.c.* In 1935, moreover, some establishments in *flags and banners* reported their merchandising activities with their manufacturing activities.

• *Nets and seines* are included with *cotton goods* in 1939. We have provided overlapping figures for 1937 for *cotton goods*.

The larger 1937 figure for *cotton goods* also reflects a revision arising from the reclassification of some establishments to accord with the 1939 classification.

† Between 1921 and 1923 belting manufactured in textile mills and elastic webbing manufactured in textile mills were transferred to *cotton small wares*, the former from *belting, woven, n.e.m.*, and the latter from *elastic woven goods, n.e.m.* The comparability of the figures for *cotton small wares* appears to have been seriously affected by the shift.

‡ Between 1933 and 1935 *cotton small wares* was expanded to include some mixed fabrics with a cotton warp. According to the Bureau of the Census, the figures are still comparable.

§ Between 1935 and 1937 some establishments were transferred from *cotton small wares* to each of the following industries: *fabricated textile products, n.e.c.* (combination of *housefurnishings, n.e.c.*, *belting, woven, n.e.m.*, and *horse blankets, silk and rayon goods, elastic woven goods, n.e.m.*, and *trimmings, n.e.m.*)

¶ For 1939 *wool scouring, woolen goods and worsted goods* (including *haircloth*) are available only in combination. The Bureau of the Census has provided a comparable 1937 figure. The combination for 1937 differs slightly from the sum of the 1937 figures for the industries named because of the reclassification of some establishments to accord with the 1939 classifications.

‡ Prior to 1909 contract work alone was included in *wool scouring*, whereas some of the establishments included in later Censuses reported also work done on purchased skins and wool.

* Between 1933 and 1935, woven felts were transferred from *felt goods* to *woolen goods*.

† Between 1935 and 1937 some establishments in *carpets and rugs, rag*, were transferred to *carpets and rugs, wool*, and some establishments in the latter industry were transferred to *woolen goods*.

‡ Between 1909 and 1914 some knitting mills using silk as the sole material were transferred from *silk and rayon goods* to *knit goods*.

§ Between 1933 and 1935 dyeing and finishing of hosiery knitted by others were transferred from *dyeing and finishing to hosiery, knit*.

¶ Between 1935 and 1937 some establishments in *dyeing and finishing* were transferred to *fabricated textile products, n.e.c.* (combination of *housefurnishings, n.e.c.*, *belting, woven, n.e.m.*, and *horse blankets*).

‡ Because *carpets and rugs, rag*, contains a large proportion of small establishments, the degree to which it is covered in the Census probably varies from year to year.

§ In 1939 a new industry, *carpets, rugs and mats, except wool*, was constituted from *carpets and rugs, rag*, and *mats and matting*, and parts of several other industries. Comparable figures for 1937 are provided by the Bureau of the Census.

¶ Prior to 1909 *suspenders, garters* and elastic woven goods were classified with *furnishings, men's, n.e.c.*, *rubber goods, other*, and *millinery*. In 1909 they were grouped under a new classification, *elastic woven goods, n.e.m.*

‡ After 1925 *millinery and lace goods, n.e.c.*, was abandoned as a separate classification and divided among *embroideries, millinery*, and *trimmings, n.e.m.* Ladies' handkerchiefs (formerly part of *millinery and lace goods, n.e.c.*) were classified with men's handkerchiefs (formerly in *furnishings, men's, n.e.c.*) under the title *handkerchiefs*.

§ The 1937 Census of this industry is reported by the Bureau of the Census to be incomplete.

¶ Between 1923 and 1925 certain establishments manufacturing gloves and mittens of cloth and leather combined were transferred from *gloves, leather*, to *gloves, textile, n.e.m.* Overlapping figures for 1925 are provided by the Bureau of the Census.

‡ Between 1927 and 1929 women's scarfs and other neckwear were transferred from *trimmings, n.e.m.*, to *clothing, women's, n.e.c.*

§ The 1933 Census of this industry is considered by the Bureau of the Census to be somewhat incomplete.

¶ Between 1925 and 1927 women's and children's straw hats, other than harvest hats, were transferred from *hats, straw, men's*, to *millinery*.

‡ Prior to 1909 *excelsior* was combined with *artificial leather*. Overlapping figures for 1909 are available for *artificial leather*.

§ Between 1933 and 1935 more than 300 establishments whose values of products were reported as between \$5,000 and \$20,000 were eliminated from *awnings* by the Census of Manufactures. More than 100 such establishments were not eliminated in 1933-35, however, because in some previous Censuses they had reported values of products above \$20,000. In 1937 these establishments also were eliminated.

¶ *Flags and banners* and *regalia* are included with *belting, woven, n.e.m.*, *house furnishings, n.e.c.*, and *fabricated textile products, n.e.c.*, in 1939.

‡ Between 1904 and 1909 establishments manufacturing signs and advertising novelties were transferred from *housefurnishings, n.e.c.*, and other classifications, to a new classification, *signs*.

§ Prior to 1914 *aluminum manufactures* was included in *housefurnishings, n.e.c.*, and other industries.

¶ Between 1909 and 1914 a few establishments making cotton or mattress shoddy and a few small establishments engaged in the cutting of flocks were transferred from *wool shoddy* to *waste*.

‡ Oakum was combined with *all other industries* in 1921 and with *waste* in other Census years.

§ After 1935 establishments reporting wiping rags as their primary product, formerly classified under *waste*, were not canvassed by the Bureau of the Census.

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

LEATHER PRODUCTS	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More											
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939	
<i>Industry</i>																	
Leather	52.1	57.2	62.2	55.9	72.5	72.5	49.0	59.7	52.3	52.9	49.9	42.0	44.2	50.9	50.7	47.3	
Shoes, leather	141.8	149.9	185.1	191.6	211.0	211.0	183.5	225.2	207.0	203.1	205.6	181.4	190.9	202.1	215.4	218.0	
Shoe cut stock, n.e.m.	6.2	5.9	6.7	7.8	9.7	9.7	7.0	8.0	8.0	8.6	9.5	8.6	6.5	} 18.3	} 18.8	} 18.8	
Shoe findings, n.e.m.	3.2	4.4	6.5	6.7	8.9	8.9	5.9	7.9	8.6	10.0	10.4	9.1	10.3				
Belting, leather	1.7	2.1	3.0	3.0	2.8	2.8	2.3	3.2	2.6	2.2	2.6	1.6	1.7	2.4	2.8	2.3	
Gloves, leather	14.2	10.6	11.4	10.7	10.7	10.7	7.9	10.0 ^a	8.4	} 9.1	} 9.2	} 7.9	} 8.1	} 9.8	} 11.6	} 10.0	
								7.7	7.7								
Leather goods, n.e.c.	6.3	7.8 ^b	7.7	7.1	8.9	8.9	8.6	7.9	6.7	7.2	6.0	5.2	4.5	6.0	} 20.9	} 20.1	
Pocketbooks	1.7	2.3	1.5	1.5	2.9	2.9	2.7	5.5	6.8	8.6	10.4	8.7	8.1	11.4			
Luggage	7.0	9.1	11.1	9.9	11.5	11.4	8.7	11.4	10.3	10.3	11.4	6.2	5.1	6.7	8.7	8.3	
Saddlery and harness	14.4	15.0	14.6	13.0	10.4	10.0	4.5	6.6	4.6	4.0	3.3	} 2.0	} 2.5	} 3.2	} 3.0	} 2.8	
Whips ^c	1.3	1.6	1.5	1.2	0.72	0.71	0.29	0.20	0.10	0.09	0.06						
TOTAL	249.7	266.0	311.3	308.2	350.1	349.4	280.4	345.6	315.4	316.1	318.5	272.8	282.0	310.8	332.0	327.7	
									314.1						328.6		

^a Between 1923 and 1925 some establishments manufacturing gloves and mittens of cloth and leather combined were transferred from *gloves, leather*, to *gloves, textile, n.e.m.* Overlapping figures for 1925 are provided by the Bureau of the Census.

^b Between 1904 and 1909 establishments manufacturing signs and advertising

novelties were transferred from *leather goods, n.e.c.*, and other classifications to a new classification, *signs*.

^c Because this industry contains a large proportion of small establishments, the degree to which it is covered in the Census probably varies from year to year.

RUBBER PRODUCTS	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More											
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939	
<i>Industry</i>																	
Shoes, rubber	14.4	19.0	17.6	18.7	32.9	32.9	23.9	29.4	25.0	26.8	25.7	15.9	18.1	17.2	18.4	14.9	
Tires and tubes	} 22.2	} 24.9 ^a	} 31.7 ^b	} 55.3	} 125.7	} 125.7	} 55.5	} 74.0	} 81.6	} 78.3	} 83.3	} 49.2	} 53.0	} 57.1	} 63.3	} 54.1	
Rubber goods, other																	23.9	34.5	34.5^{a,d}	36.9	40.2	34.2	35.2	40.3	48.2	51.8
TOTAL	36.6	43.9	49.3	74.0	158.5	158.5	103.3	137.9	141.1	142.0	149.1	99.3	106.3	114.7	129.8	120.7	
									141.9								

^a Prior to 1909 *rubber goods, other*, included some suspenders, garters, and elastic woven goods. Between 1904 and 1909 these three products were brought together in a new classification in the textile group, *elastic woven goods, n.e.m.*

^b Between 1909 and 1914 rubber combs and hairpins were transferred from *combs, n.e.c.*, to *rubber goods, other*.

^c Between 1925 and 1927 rubber cement was transferred from *manila, n.e.c.* to *rubber goods, other*. Overlapping figures for 1925 are provided by the Bureau of the Census.

^d Between 1925 and 1927 rubber toy ballons were transferred from *toys and games, n.e.c.* to *rubber goods, other*. Overlapping figures for 1925 are provided by the Bureau of the Census.

PAPER PRODUCTS	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More												
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939		
<i>Industry</i>																		
Paper	}	49.6	66.0	76.0	88.5	113.8	113.8	105.3	120.7 ^a	123.8	}	98.6	103.3	87.7	87.2	103.3	110.8	110.6
Pulp		24.8	24.7	20.2	20.1	23.6	27.0	26.9										
Bags, paper, n.e.m.		2.0	2.5	3.2	3.5	4.2	4.2	3.7	4.7	5.6		6.5	7.0	6.8	7.7 ^b	9.1	10.4	11.1
Boxes, paper, n.e.c.		27.7	32.1	39.5	45.3	55.9	55.8	46.2	56.9	57.1		56.4	55.7	46.7	47.2	55.3	65.2	69.2
Cardboard, n.e.m.		0.63	0.59	0.92	1.2	1.4	1.4	1.2	1.2	0.98	0.66	0.61	0.52	0.49	0.63	0.88	°	°
Card cutting and designing		0.32	0.70	0.52	0.52	1.1	1.1	0.76	1.2	1.1	2.0	2.3	2.0	1.8	3.0	3.3	°	°
Envelopes		3.0	4.3	5.3	7.0	8.1	8.1	7.9	9.2	9.1	9.7	10.4	8.9	8.0	9.0	9.5	8.7	8.7
Labels and tags		0.75	1.3	2.3	2.6	5.2	5.2	4.2	5.0	5.4	6.1	4.5	^d					
Paper goods, n.e.c.		6.1	9.8	13.0	13.5	14.1	14.1	11.5	14.7	13.4	14.8	20.2	17.9 ^c	20.4	20.7	27.4	32.9	33.6 ^c
Stationery goods, n.e.c.		3.0	4.3 ^f	6.2	7.7	11.3	11.2	11.3	13.3 ^g	11.4	9.0	11.1	8.6 ^c	5.7	3.5	^b	35.2	33.6 ^c
Wall paper		4.2	3.9	4.0	4.7	4.3	4.3	4.0	5.4	5.1	4.8	4.7	3.7	3.2	4.3	4.5	4.1	4.1
TOTAL		97.3	125.5	151.0	174.5	219.4	219.2	196.0	232.3	232.9	233.4	244.5	203.2	202.2	199.8	235.7	264.5	264.0

^a Between 1923 and 1925 some establishments were transferred from *roofing to paper and pulp*.

^b Between 1933 and 1935 *stationery goods, n.e.c.*, was abandoned as a classification and the products were divided among *bags, paper, n.e.m.*, and other classifications.

^c *Cardboard, n.e.m.*, and *cardcutting and designing* are included in *paper goods, n.e.c.* in 1939. Overlapping figures for 1937 are provided by the Bureau of the Census.

^d Between 1929 and 1931 *labels and tags* was abandoned as a classification and the products were divided among *printing and publishing, book and job; lithographing; engraving, other; and miscellaneous articles*.

^e Between 1931 and 1933 papeteries were transferred from *stationery goods, n.e.c.*, to other industries, principally *paper goods, n.e.c.* Overlapping figures for 1931 are provided by the Bureau of the Census.

^f Between 1904 and 1909 establishments manufacturing signs and advertising novelties were transferred from *stationery goods, n.e.c.*, and other classifications to a new industry, *signs*.

^g Between 1923 and 1925 manifolding machinery was transferred from *stationery goods, n.e.c.*, to *foundry and machine-shop products, n.e.c.*

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

PRINTING AND PUBLISHING	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More											
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939	
<i>Industry</i>																	
Printing and publishing, book and job	68.4	88.8	109.6	114.2	123.4	121.7	121.9	130.8	134.6	142.3	150.6 ^a	135.3	} 104.7 ^b	126.7	141.4		
Printing and publishing, music	0.78	0.58	0.74	0.87	0.90	0.90	0.90	0.92	0.96	0.99	0.81	0.66			144.0	132.6	
Printing and publishing, periodical	94.6	96.9	108.7	114.4	120.4	115.1	107.5	115.6	117.0	119.4	129.7	119.5	109.1	118.7	135.2	118.7	
Bookbinding and blank-book making	16.0	17.7	19.9	21.7	20.4	20.1	17.5	20.7	20.8	21.9	24.8	21.2	16.9	20.5	25.3	25.8	
Engravers' materials	0.076	0.049	0.13	0.11	0.17	0.17	0.18	0.22	0.18	0.18	0.31	0.28	0.22	°			
Engraving, steel and copper	3.3	3.6	5.3	6.9	7.0	7.0	7.2	7.5	7.3	8.5	10.1	} 7.0	5.0	5.3	7.8		
Engraving, wood ^d	0.34	0.34	0.32	0.30	0.24	0.22	0.13	0.14	0.12	0.13	0.14				7.2	5.4	
Engraving, other ^d	0.96	1.6	1.3	1.5	1.9	1.8	1.3	1.9	1.8	1.8	2.2 ^a	1.5	1.1	2.2	2.1	1.4	
Lithographing	13.0	12.6	15.1	15.2	15.6	15.6	14.0	16.3	17.0	16.3	19.0 ^a	16.2	14.6	17.7	24.1	26.0	
														22.5			
Photo-engraving, n.e.d.	2.7	3.9	5.3	6.2	6.8	6.7	7.0	8.5	9.9	11.0	12.4	10.1	7.9	9.4	12.4	11.8	
														77.9			
Printing materials, n.e.c.	0.56	0.36	0.54	0.42	0.72	0.72	0.82	0.56	0.89	0.88	1.0	0.78	} 0.89	°			
Type founding	1.4	1.4	1.5	1.1	0.81	0.80	0.61	0.61	0.54	0.52	0.47	0.41					
Stereotyping, n.e.d.	2.4	2.7	2.8	3.5	3.7	3.7	3.6	4.1	4.3	4.5	6.5	4.9	3.7	4.4	4.8	4.4	
TOTAL	204.6	230.5	271.3	286.3	302.0	294.5	282.5	308.0	315.3	328.6	358.0	317.8	264.1	304.8	353.1	326.0	
													263.0				

^a Between 1929 and 1931 *labels and tags* was abandoned as a separate classification and its products were divided among *printing and publishing, book and job; lithographing; engraving, other; and miscellaneous articles.*

^b Between 1933 and 1935 *stationery goods, n.e.c.*, was abandoned as a separate classification and the products were divided among *printing and publishing, book and job; printing and publishing, music; and other classifications.*

^c After 1933 *printing materials, n.e.c.; type founding; and engravers' materials* were transferred to *foundry and machine-shop products, n.e.c.*

^d Because this industry contains a large proportion of small establishments, the degree to which it is covered in the Census probably varies from year to year.

CHEMICAL PRODUCTS	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More											NUMBER OF WAGE EARNERS
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939	
<i>Industry</i>																	
Chemicals, industrial ^a						52.3	62.2 ^g	48.5	53.2 ^h	65.8	79.0	76.0	69.6				
Gases, compressed	17.5	22.3	26.0 ^b	35.4 ^a	76.9	76.9 ^d	49.1	62.9 ^a	57.9 ^f	3.2	3.4	2.8	2.8	3.8	4.7	4.0	
Rayon								14.4 ^a	19.1	26.3	39.1	38.7	44.3	50.6	55.1	48.3	
Druggists' preparations	5.7	7.4	9.5	9.3	15.6	15.5	10.8	9.0	9.7	10.1	10.7	9.5	21.7	25.6	28.4	27.4	
Patent medicines	11.6	11.0	11.0	13.3	17.4	17.1	13.8	17.4	14.8	15.1	16.4	13.5			29.6	27.4	
Toilet preparations	1.8	2.1	2.4	2.9	5.4	5.3	5.8	7.8	8.7	10.5	13.1	10.7 ⁱ	9.0	9.7	10.2	10.4	
Drug grinding	0.64	0.98	0.92	1.1	1.3	1.3	0.84	0.75	0.62	0.66	0.68	0.66	0.63	0.59	0.70		
Cottonseed products ^k	11.0	15.5	17.1	21.8	26.8	26.8	16.2	12.7	16.2	18.4	15.8	12.3	14.2	13.2	16.6	15.2	
Linseed products	1.3	1.3	1.5	1.5	2.2	2.2	2.1	2.6	2.7	2.7	2.7	1.8	1.6	2.4	2.6	2.1	
Oils, essential	0.17	0.13	0.29	0.25	0.32	0.30	0.30	0.17	0.18	0.17	0.26	0.13	0.18	0.17	0.20	0.26	
Ammunition	5.2	7.4	8.7	11.5	22.8	22.8	8.4	10.5	7.8	7.6	7.2	5.9	5.8	7.2	8.4	5.4	
Fireworks	1.6	1.5	1.4	1.3	1.2	1.2	1.2	1.2	1.4	1.6	1.8	1.4	0.92		6.5	5.4	
Blackings	1.2	1.2	1.4	1.8	2.5	2.4	1.7	2.2	1.9	1.7	1.6	1.5	1.6	1.5	1.5	5.1	
Cleaning preparations	0.51	0.56	0.98	1.2	2.0	1.9	1.7	2.4	2.2	2.4	2.7	2.4	2.8	2.8	3.3		
Bluing	0.22	0.21	0.31	0.25	0.36	0.36	0.23	0.19	0.18	0.16	0.10	0.095	0.077	0.058	0.067	0.055	
Carbon black	0.085	0.20	0.23	0.34	0.68	0.68	0.83	1.3	1.5	1.6	1.9	1.0	1.4	1.8	2.2	1.6	
Candles		0.82	0.54	0.39	0.54	0.54	0.61	0.75	0.63	0.71	0.78	0.71	0.67	0.71	0.72	0.84	
Soap	9.5	11.0	13.0	14.2	20.4	20.4	16.6	17.0	51.4	13.4	14.4	14.2	14.3	13.9	14.0	13.6	
Charcoal ^l	1.8	0.92	0.63	0.23	0.21	0.19	0.27	0.10	0.16	0.10	0.058	0.037	0.018	0.030	0.048		
Hardwood-distillation products								1.5	2.9	2.9	2.9	2.8	1.6	1.3	1.9	2.1	
Softwood-distillation products	1.6	2.3	2.7	2.8	4.9	4.9		0.34	1.1	1.2	1.5	1.8	1.0	1.4	1.9	2.4	
Explosives	4.5	5.8	6.3	6.3	9.2	9.2	4.5	6.4	5.7	5.8	5.6	4.7	4.2	4.6	5.4	7.2	
Fertilizers	11.6	14.2	18.3	22.8	26.3	26.3	16.9	18.6	19.6	18.6	20.9	14.6	13.1	17.5	20.9	18.7	
Glue and gelatin	1.6	2.9	3.3	3.1	4.3	4.3	2.9	3.7	3.3	3.2	3.0	2.6	2.0	3.3	3.5	3.0	

For footnotes see next page.

NUMBER OF WAGE EARNERS

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

CHEMICAL PRODUCTS (concluded)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Industry</i>																
Grease and tallow	2.0	3.6	4.4	5.1	6.6	6.6	4.4	5.2	5.3	5.1	5.5	4.1	4.0	4.8	5.2	5.2
Ink, printing	0.50	0.71	1.1	1.4	2.0	2.0	1.7	2.0	2.2	2.3	2.4	2.2	2.1	2.4	2.8	2.6
Ink, writing	0.28	0.43	0.50	0.51	0.70	0.69	0.50	0.58	0.52	0.49	0.42	0.35	0.36	0.38	0.37	0.25
Mucilage	0.46	0.47	0.54	0.70	0.80	0.79	0.76	0.66	0.70 ^m 0.56	0.50	0.41	0.28	0.21	0.27	0.30	0.28
Paints and varnishes	9.7	11.6	14.2	16.1	21.5	21.5	18.0	22.8	25.5	28.1	29.2	22.5	22.9	27.7	31.7	28.2
Salt	4.8	4.7	4.9	5.1	6.5	6.5	6.0	6.8	6.3	6.0	5.5	4.7	5.0	5.0	4.6	3.7
Tanning and dye materials	1.6	2.7	2.4	2.8 ^o	4.3	4.3	3.0	3.2	2.5	2.4	2.4	2.0	2.1	2.7	2.8	2.7
TOTAL	108.6	134.0	154.5	183.4	283.8	283.1	190.9	237.2	236.7 236.6	245.6	275.0	226.5	233.9	272.0	309.7 305.9	279.9

^a Blast-furnace products and chemicals, industrial, each include part of ferro-alloys, which was listed as a separate industry in 1919.

^b Between 1909 and 1914 powdered milk and sugar of milk were transferred from chemicals, industrial, to milk, canned.

^c Between 1914 and 1919 artificial dyestuffs and mineral colors and dyes were transferred from tanning and dye materials to chemicals, industrial.

^d Between 1919 and 1921 some establishments were transferred from secondary metals, nonprecious, to chemicals, industrial.

^e Between 1923 and 1925 rayon and allied products were transferred from chemicals, industrial, to a new classification, rayon. The rayon data for 1923 were secured from a special tabulation made by the Bureau of the Census for the Bureau of Foreign and Domestic Commerce from the original returns for 1923; see the *Commerce Year Book, 1932*, Vol. I, p. 423. To obtain the 1923 figure for chemicals, industrial, we subtracted the figure for rayon from the figure given for 1923.

^f Between 1925 and 1927 compressed and liquefied gases were transferred from chemicals, industrial, and Pintsch gas plants from gas, manufactured, to a new classification, gases, compressed.

^g Between 1929 and 1931 molded plastics were transferred from chemicals, industrial, and other industries to pulp goods.

^h Between 1933 and 1935 ethyl alcohol was transferred from liquors, distilled to chemicals, industrial.

ⁱ Between 1931 and 1933 druggists' preparations and patent medicines were combined into a single industry, drugs and medicines. At the same time some establishments were shifted from the latter industry to toilet preparations and vice versa.

^j In 1939 drug grinding and foundry supplies were included in the combination of druggists' preparations and patent medicines. Comparable 1937 figures are provided for the latter.

^k Data on cottonseed products for 1925 and prior years relate to the 12-month period ending July 31 following the year specified, although in the early Census returns some firms may have reported for the calendar year. The figures for 1927-37 relate to the 12-month period ending July 31 of the year indicated, but may also include a few reports prepared on a calendar-year basis.

^l Because this industry contains a large proportion of small establishments, the degree to which it is covered in the Census probably varies from year to year.

^m Between 1925 and 1927 rubber cement was transferred from mucilage to rubber goods, other. Overlapping figures are provided for 1925 by the Bureau of the Census.

PETROLEUM AND COAL PRODUCTS	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
	<i>Industry</i>															
Petroleum refining	12.2	16.8	13.9	25.4	58.9	58.9	63.2	66.7	65.3	71.2	80.6	68.8	69.0	77.4	83.2	72.8
Lubricants, n.e.m.	0.13	0.12	0.18	0.48	0.47	0.47	0.42	0.60	0.61	0.57 ^a	2.6	2.1	1.8 ^a	1.9 ^a	2.2	2.1
Oils, n.e.c.	1.5	1.3	1.8	2.0	5.9	5.9	3.5	4.3	3.6 ^b	3.4 ^a	1.2	0.96	0.93	1.8	2.5	4.1
Coke-oven products	17.0	19.0	29.3	21.1	29.3	29.3	16.1	28.4	23.2	21.1	20.6	14.4	13.1	16.7	20.6	21.7
Fuel briquettes		•	0.088	0.14	0.17	0.17	0.37	0.36	0.25	0.27	0.43	0.30	0.30	0.34	0.46	0.41
TOTAL	30.8	37.2	45.1	49.1	94.8	94.8	83.6	100.3	93.0	96.6	105.4	86.6	85.1	98.1	108.9	101.2
			45.2	49.1	94.8										109.6	101.2

^a Between 1927 and 1929 lubricating oils were transferred from *oils, n.e.c.*, to *lubricants, n.e.m.* The comparability of the figures for both industries appears to have been seriously affected by this change. The 1935 figure for *lubricants, n.e.m.* does not cover lubricating oils and is therefore not exactly comparable with preceding or following figures.

^b Between 1925 and 1927 vegetable cooking oils were transferred from *oils, n.e.c.*, and other industries to *shortenings*.

^c In 1904 no establishments were reported as engaged primarily in the manufacture of products classified under *fuel briquettes*; in 1899 this industry was included with *all other industries*.

STONE, CLAY AND GLASS PRODUCTS	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
	<i>Industry</i>															
Asbestos products			•	0.96	3.7	3.6	2.0	6.1	6.1	6.3	8.1	6.0	6.1	9.6 ^b	13.0	10.0
Steam and other packing	1.1	2.7	3.6 ^a	4.2	6.1	6.1	4.9	5.1	6.1	5.9	7.3	4.7	4.6 ^c	4.8	5.9	5.9
Roofing	7.6	8.8 ^d	2.5 ^a	4.1	8.9	8.9	6.9	7.7 ^a	8.3	7.3	6.0	4.1	4.4	6.5	7.4	8.0
Cement						25.5	26.2	35.1	38.4	36.3	33.4	24.3	15.8	20.7	26.4	23.8
Lime						11.3	10.3	12.3	12.1	10.9	8.6	6.7	6.0	7.5	9.8	9.5
Wall plaster and board						5.1	4.9 ^f									
							7.0	9.3	11.0	10.0	7.5	5.9	4.4 ^c			
													4.7	8.0	11.6	13.0

For footnotes see page 197.

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

STONE, CLAY AND GLASS PRODUCTS (concluded)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More													
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939			
<i>Industry</i>																			
Concrete products ^g	} 41.7	2.5	10.0	10.3	8.4	7.4	7.0	10.8	14.7	17.8	16.5	9.3	4.4	8.4	12.8	17.4			
Marble and granite		51.1 ⁴	65.6	55.0	32.8	32.3	30.3	40.1	36.6	40.5	37.8	27.7	16.5	15.2	20.8	18.5			
Emery wheels	0.55	0.80	1.9	2.4	5.6	5.6	2.8	3.6	3.4	3.3	3.9	} 4.6	4.9	6.8	9.7	7.7			
Hones	0.19	0.22	0.15	0.17	0.21	0.21	0.095	0.17	0.16	0.19 ^b	0.17								
Sandpaper	0.27	0.30	0.61	0.68	0.77	0.77	0.68	1.2	1.2	0.92	1.2								
Pulp goods	0.69	0.70	0.78	1.7	3.0	3.0	4.7 ^f	2.6	3.6	3.0	3.0	3.6	2.4 ^j	5.7	6.8	12.7	16.7	15.0	15.8
Sand-lime brick			k	0.56	0.50	0.50	0.37	0.58	0.80	0.79	0.57	0.32	0.084	0.23	0.41	0.35			
China firing and decorating, n.e.d. ^s	0.30	0.22	0.33	0.30	0.24	0.23	0.32	0.36	0.33	0.37	0.32	0.22	0.15	0.28	0.31	0.42			
Pottery	43.7	52.4	56.2 ¹	26.7	27.9	27.9	28.5	36.8	36.5	36.7	35.4	27.0	23.6	28.8	33.1	32.7			
Clay products, n.e.c.	62.0	66.0	76.5 ^{4, 1}	100.2	76.9	76.3	68.8	102.7 ^m	103.0	102.8	101.0	93.3	} 51.1	31.9	44.6	65.2	61.5		
Crucibles	0.67	0.28	0.34	0.30	0.85	0.85	0.41	0.52 ^m	0.27	0.28	0.26	0.32							
Graphite	0.14	0.22	0.16	0.25	0.50	0.49	0.15	0.24	0.23	0.29	0.49	0.18	0.17	0.26 ⁿ	0.056	0.055			
Minerals and earths	2.1	2.2	2.0	4.7	14.4	14.4	6.9	8.7	8.8	8.3 ^o	1.7	1.1	1.9	4.3	4.5	5.9			
Statuary and art goods	p	1.5	1.7	2.0	1.5	1.4	1.6	1.8	2.0	2.0	2.1	1.3	0.69	0.72	0.86	0.98			
Glass	52.8	64.0	68.9	74.5	77.5	77.5	54.7	73.3	69.4	65.8	67.5	49.9	49.8	67.1	79.1	69.8			
Glass products, n.e.m.	4.9	8.4	9.4	8.1	6.5	6.4	4.7	5.2	4.9	4.5	6.0	} 7.2	6.5	10.7	12.7	10.0			
Mirrors	2.6	2.6	3.0	3.2	2.6	2.6	2.4	3.5	4.2	4.3	4.8								
TOTAL	240.4	295.9	349.1	345.9	320.9	318.5	269.7	368.6	371.2	366.7	346.5	234.0	237.3	188.8	257.2	330.3	328.6	311.4	

^a Prior to 1914 *asbestos products* was included with *steam and other packing and roofing*.

^b Between 1935 and 1937 some establishments were transferred from *cotton small wares* to *asbestos products* and other classifications.

^c Between 1933 and 1935 mineral wool was transferred from *steam and other packing to wall plaster and board*. Overlapping figures for 1933 are provided by the Bureau of the Census.

^d Between 1904 and 1909 roofing slate was transferred from *roofing* to *marble and granite*.

^e Between 1923 and 1925 some establishments were transferred from *roofing* to *paper and pulp*.

^f Between 1921 and 1923 wall board, other than gypsum wall board, was transferred from *pulp goods* to *wall plaster and board*. Overlapping figures for 1921 are provided.

^g Because this industry contains a large proportion of small establishments, the degree to which it is covered in the Census probably varies from year to year.

^h After 1927 *hones* was limited to establishments which did not quarry the stone but purchased it in the rough and prepared it for the market.

ⁱ Between 1929 and 1931 there was a change in the classification of an important manufacturer of abrasives. The Bureau of the Census believes that this change renders the statistics for the 3 abrasives industries for 1931 incomparable with those for prior years.

^j Between 1929 and 1931 molded plastics were transferred principally from *electrical machinery*, but also from *miscellaneous articles, chemicals, n.e.c., machine-tool accessories, n.e.c.,* and *phonographs*, to *pulp goods*. Overlapping figures for 1931 are given for *pulp goods*.

^k Prior to 1914 *sand-lime brick* was included with *clay products, n.e.c.*

^l Between 1909 and 1914 terra cotta and fire clay products were transferred from *pottery* to *clay products, n.e.c.* The comparability of the figures for both industries appears to have been seriously affected by this change.

^m Between 1923 and 1925 clay crucibles were transferred from *crucibles* to *clay products, n.e.c.* Overlapping figures for 1923 are provided by the Bureau of the Census.

ⁿ Between 1935 and 1937 some establishments were transferred from *graphite* to other industries. The comparability of the figures for *graphite* appears to have been seriously affected by the shift.

^o After 1927 establishments performing manufacturing operations alone were included in *minerals and earths*; in prior years mining establishments also were included. The change appears to have had a serious effect upon the comparability of the figures.

^p Between 1899 and 1904 establishments engaged in manufacturing statuary and art goods were transferred from *plastering and stuccowork* (a classification abandoned by the Bureau of the Census in 1904) and *miscellaneous articles* to a new classification, *statuary and art goods*.

FOREST PRODUCTS	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Industry</i>																
Lumber-mill products, n.e.c. ^a	413.3	404.6	547.2	479.8	480.9	469.3 ^b	364.2	495.9	467.1	413.9	419.1	196.6	189.4	255.2	323.9	297.8
Planing-mill products, n.e.m.				96.2	87.0	86.4 ^b	78.0	103.0	111.3	96.6	90.1 ^o	54.5 ^d				
	73.5	97.7	112.4									54.6	35.4	48.3	66.8	
Window and door screens				3.2	2.2	2.1	2.1	3.7	3.8	3.7	4.0	2.6	1.6	1.9	2.8	2.8

For footnotes see page 199.

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

FOREST PRODUCTS (concluded)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Industry</i>																
Wood turned and shaped, n.e.c.	14.8	21.3	20.9	18.0	17.1	16.9 ^b	14.6	17.0 ^a	14.9	15.9	18.7 ^{a,t}	17.0	15.5	21.5	23.1	22.0
Baskets	4.2	5.1	4.7	4.6	4.5	4.5	4.8	5.8	6.8	9.3	9.4	8.4	8.4	9.0	9.3	9.4
Boxes, wooden, cigar	4.6	6.3	6.1	5.8	5.2	5.2	4.7	5.1	4.8	4.6	4.4	3.8	3.4	3.2	3.3	3.1
Boxes, wooden, other	22.0	30.3	35.4	38.5	42.4	42.3	32.6	39.2	34.8	30.8	30.6	22.9	21.8	23.1	26.0	25.4
Cooperage	22.1	21.1	19.5	17.1	13.2	13.1	9.9	12.0	11.5	11.5	10.7	8.2	8.5	9.9	9.6	7.2
Furniture	89.0	113.5	127.1	130.4	140.3	140.0	124.4	168.2	181.0	186.3 ^k 788.7	193.4	127.6	105.5 ^b	130.8	170.1	159.2
Billiard tables	0.45	0.80	1.5	1.5	2.1	2.1	0.92	0.88	1.0	1.2	1.4	0.59	0.41	0.31	0.53	ⁱ
Mirror and picture frames	6.0	6.6	6.0	4.8	4.7	4.7	3.8	4.5	4.2	4.5	4.4	3.1	2.4	2.7	3.4	3.2
Caskets and coffins	6.8	8.5	9.3	9.5	11.9	11.9	10.0	11.6	11.5 ^j	11.7	13.0	11.9	12.2	13.8	13.7	12.4
Cork products	2.3	2.9	3.1	3.5	3.5	3.5	2.8	3.5	3.3	3.2	3.8	3.0	2.8	3.0	3.6	2.9
Excelsior		^k	1.0	1.2	1.2	1.2	1.1	1.3	1.3	1.3	1.2	0.93	0.81	0.83	0.96	0.92
Lasts	1.1	1.2	1.7	2.1	2.9	2.9	2.6	2.3	2.0	1.7	1.8	1.5	1.4	1.5	1.4	1.5
Matches	2.0	3.2	3.6	3.8	3.7	3.7	4.5	4.7	4.6	3.9	3.8	3.4	4.7	5.1	5.3	5.4
Turpentine and rosin ^l	41.9	33.4	39.5	34.8	28.1	27.9	27.4	34.3	29.4	37.9	40.2	28.3	30.9	31.3	32.4	1.0
															7.5	
Wood preserving	0.48	0.74	2.4	2.8	4.0	4.0	4.2	6.5	8.4	12.3	13.1	9.7	7.0	9.0	12.4	11.2
TOTAL	704.6	757.2	940.6													
			941.6	857.6	855.0	841.7	692.6	919.5	902.0	850.1						
										852.0	863.0	504.0				
												504.1	452.0	570.3	708.5	
															677.1	633.6

* Sawmills are unaffected by the restriction, prevailing since 1919, of the Bureau of the Census inquiries to establishments reporting products valued at \$5,000 or more. For Census purposes a mill which saws less than 200,000 feet of lumber or 1,000,000 lath or 2,000,000 shingles is treated as an establishment with products valued at less than \$5,000.

^b Between 1919 and 1921 establishments engaged primarily in the manufacture of aircraft parts, other than engines and tires, were transferred from *lumber-mill products, n.e.c., planing-mill products, n.e.m., wood turned and shaped, n.e.c., and cotton goods to aircraft.*

^c Between 1929 and 1931 *dairymen's supplies* was abandoned as a separate classification, and the products were divided among *planing-mill products, n.e.m., wood turned and shaped, n.e.c.,* and other classifications.

^d Between 1931 and 1933 horsedrawn lunch wagons were transferred from *carriages, wagons and sleighs to planing-mill products, n.e.m.* Overlapping figures for 1931 are given.

^e Between 1923 and 1925 *rules* was abandoned as a separate industry, and the products were divided among *wood turned and shaped, n.e.c.,* and other industries.

^f Between 1929 and 1931 *carriage and wagon materials* was abandoned as a separate classification, and turned wood products, such as hubs, felloes and spokes, were transferred to *wood turned and shaped, n.e.c.*

^g Between 1927 and 1929 sewing machine cases, cabinets and tables were transferred from *sewing machines to furniture.* Overlapping figures for 1927 are provided by the Census.

^h Between 1933 and 1935 the composition of *dental goods and equipment* was changed to include, among other items, dental chairs and cabinets formerly classed with *furniture.*

ⁱ In 1939 *billiard tables* were included in *sporting goods, n.e.c.,* one of the "miscellaneous products" industries.

^j Between 1925 and 1927 metal burial vaults were transferred from *safes and vaults to caskets and coffins.*

^k Prior to 1909 *excelsior* was combined with *artificial eather.*

^l The higher 1937 figure for *turpentine and rosin* includes all employees, those who were engaged in the production and gathering of crude gum as well as employees at the still. The lower 1937 figure and the 1939 figure apply only to the latter.

The percentage of coverage of total production fell below 100 after 1929. For 1931 the percentage of coverage is not given; in 1933 it was 85, and in 1935 it was 87. The figures for these two years have been raised accordingly. In 1937 estimates were made by the Bureau of the Census for producers who failed to report.

For the period 1921-31 the statistics for *turpentine and rosin* relate to the crop year ending March 31. Thus the data for 1921 refer to the crop year 1921-22. In preceding years, however, and again in 1933, 1935, and 1937, the canvasses were made to cover the calendar year, in order to bring the statistics into line with those for other industries. The statistics for the calendar year differ only slightly from those for the crop year.

IRON AND STEEL PRODUCTS	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Industry</i>																
Blast-furnace products*	39.2	35.1	38.4	29.4	43.3	43.3	18.7	36.7 ^b	29.2 ^b	28.0	25.0	13.6	12.1	15.2	23.1	19.5
Steel-mill products	183.2	207.6	240.1	248.7	375.1	375.1	235.5	388.2	370.7	361.3	394.6	264.6	276.8	359.6	479.3	399.0
Bolts and nuts, n.e.m.	7.7	8.1	11.3	10.7	18.0	18.0	10.1	16.0	13.9	13.6	16.2	10.5	8.5	12.5	16.8	14.3
Forgings, n.e.m.	4.9	5.9	8.5	11.3	29.1	29.1	16.9	27.7	20.5	15.6	20.9	10.0	8.0	12.3	18.3	15.4
Galvanizing, n.e.d.	0.54	1.3	1.4	1.6	1.7	1.7	0.68	0.88	0.80	0.95	1.1	1.0	0.76	1.2	1.1	1.2
Nails and spikes, n.e.m.	4.5	3.7	2.8	2.6	3.4	3.4	2.4	2.8	2.2	2.1	2.0	1.6	1.7	2.2	2.4	2.5
Springs, steel, n.e.m.	2.1	2.5	3.2	3.7	9.0	9.0	5.4	8.6	5.9 ^e	5.8	5.8	2.9 ^d	2.1	3.1	3.9	2.9

For footnotes see page 201.

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

IRON AND STEEL PRODUCTS (concluded)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Industry</i>																
Structural metal work, n.e.m.	24.9	34.3	40.2	47.2	44.0	43.9	32.9	51.6	48.3	52.4	54.9	37.5	21.4	27.2	38.8	35.5
Wire, n.e.m.	1.6	4.7	18.1	17.6	19.7	19.7	14.8	21.3	18.5	19.9*	22.5	14.5	14.7	21.6	24.6	22.0
Wirework, n.e.c.	9.1	13.4	12.3	12.1	15.2	15.1	11.5	16.8	19.3	21.7	22.4	17.2	17.6	25.2	33.5	30.4
Wrought pipe, n.e.m.	5.5	5.4	6.8	8.8	10.4	10.4	8.7	10.6	10.9	11.1	11.4	8.0	6.6	10.7	14.1	8.4
Cast-iron pipe		†	12.2	12.6	12.6	12.6	12.5	21.6	23.0	22.9	19.7	16.1	9.5	13.5	17.6	16.5
Doors, metal	0.12	0.70	1.6	2.0	2.1	2.1	1.8	2.4	6.8	8.0	9.6	6.8	3.6	4.5	8.4	7.7
Heating apparatus	9.3	11.7	23.4	26.4	36.7	36.7	30.8	44.1	43.3	42.9	39.6	29.0	22.3	27.1	89.3	76.4
Stoves and ranges	2.5	3.7 ^g														
		33.4	37.1	37.3	43.4	43.4	32.5	49.8	46.5	45.2	46.6 ^h	32.6	30.2	41.7		
Plumbers' supplies, n.e.c.	8.0	10.8	19.3	18.5	13.6	13.6	16.7 ^l	27.2	33.3	29.2	28.0	19.7	15.9	20.1	25.2	24.6
Screw-machine products	3.5	3.5	5.1	8.1	15.2	15.1	8.7	13.2	14.1	13.7	19.9	12.0	10.2	15.0	21.3	16.9
Cutlery, n.e.c.	12.0	14.5	17.0	16.6	19.9	19.8	14.3	16.7	16.4	15.8	15.0	12.5	10.8	13.7	16.8	15.4
Files	3.2	3.3	4.2	4.3	5.8	5.8	3.6	4.6	4.2	3.9	4.0	3.0	2.6	2.9	3.7	3.2
Saws	3.2	4.6	4.8	4.6	5.5	5.5	3.8	5.4	4.7	4.2	4.1	3.0	2.5	3.4	4.4	4.1
Tools, other	7.6	11.6	16.0	16.9	35.6	35.2	19.5	29.1 ⁱ	25.3	25.2 ^k	19.3	10.8	9.6	12.6	17.6	15.3
										76.4						
Firearms	4.5	6.2	6.0	7.1	11.3	11.3	4.7	6.2	4.5	6.1	6.8	4.3	3.4	4.9	6.8	5.0
Hardware, n.e.c.	29.4	35.1	41.8	43.7	46.2	46.1	35.2	52.2	52.3	47.8	52.3	36.1	32.6	41.5	53.0	35.6
															43.3	
Safes and vaults	2.0	3.5	3.3	3.0	2.9	2.9	3.5	3.5	3.9 ^l	3.4	3.0	2.0	0.93	0.81	1.1	1.2
Tin cans and tinware, n.e.c.	^m	16.9	19.8	22.6	34.4	34.4	22.7	30.5	29.9	29.7 ⁿ	31.5 ^h	25.3	23.3	27.5 ^u	33.1	31.8
TOTAL	368.7	431.1														
		477.7														
			582.6													
			594.8	617.2	853.9	853.2	568.0	887.8	848.5	830.5	876.3	594.7				
										821.8		594.3	547.6	720.1	954.4	
														944.7	805.0	

^a *Blast-furnace products and chemicals, n.e.c.*, each include part of *ferro-alloys*, listed as a separate industry in 1919.

^b The 1925 figure for *blast-furnace products* is not comparable with those for other years because some plants failed to include in their 1925 reports the number of wage earners employed in relining blast furnaces.

^c Between 1925 and 1927 motor-vehicle spring bumpers were transferred from *springs, steel, n.e.m.* to *automobile bodies and parts*.

^d After 1931 establishments engaged in the repairing and replacing of motor vehicle springs, formerly classified under *springs, steel, n.e.m.*, were not canvassed by the Bureau of the Census. Overlapping figures for 1931 are provided by the Bureau of the Census.

^e Between 1927 and 1929 certain large establishments engaged primarily in rolling nonferrous metal and manufacturing nonferrous wire were transferred from *wire, n.e.m.* to *nonferrous-metal products, n.e.c.*

^f Prior to 1909 *cast-iron pipe* was combined with *foundry and machine-shop products, n.e.c.*

^g After 1899 stoves and hot-air furnaces were transferred from *foundry and machine-shop products, n.e.c.* to *stoves and ranges*. Overlapping figures are provided for 1904.

^h Between 1929 and 1931 *dairymen's supplies* was abandoned as a separate classification, and the products were divided among *stoves and ranges, tin cans and tinware, n.e.c.*, and other classifications.

ⁱ Between 1921 and 1923 enameled bathtubs, sinks, etc. were transferred from *stamped and enameled ware* to *plumbers' supplies, n.e.c.*

^j Between 1923 and 1925 *rules* was abandoned as a separate classification, and the products were divided among *tools, other*, and other classifications.

^k Between 1927 and 1929 a new classification, *machine-tool accessories, n.e.c.* was established. Establishments thus classified were formerly classified with *tools, other*, and other industries. For *tools, other*, overlapping figures for 1927 are provided by the Bureau of the Census.

^l Between 1925 and 1927 metal burial vaults were transferred from *safes and vaults to caskets and coffins*.

^m In 1899 *tin cans and tinware, n.e.c.*, was combined with *sheet-metal work, n.e.c.*

ⁿ Between 1927 and 1929 stamped tinware was transferred from *tin cans and tinware, n.e.c.*, to *stamped and enameled ware*. In 1937 it was retransferred to *tin cans and tinware, n.e.c.*

NONFERROUS-METAL PRODUCTS	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Industry</i>																
Primary nonferrous metals																
Copper	11.3	12.8 ^b	15.6	17.7	17.3	17.3	8.3	16.8	15.6	13.9	14.5	8.6	5.6	10.4	14.5	•
Lead	8.3	7.6 ^b	7.4	7.4	6.4	6.4	4.5	6.2	6.1	5.4	4.8	2.6	2.1	3.2	4.0	•
Zinc	4.9	6.5	6.7	9.6	13.8	13.8	5.8	11.9	11.3	11.2	11.6	7.3	6.9	8.8	11.3	•
Secondary metals, non-precious	0.98	1.7	2.1	2.6	4.2	4.2 ^o	1.6	1.8	2.9	2.8	4.1	2.6	2.9	3.8	5.0	3.6
Secondary metals, precious	0.22	0.28	0.46	0.46	0.64	0.64	0.78	0.90	1.3	0.80	0.93	0.80	0.74	1.0	1.1	1.1
Aluminum manufactures			d	4.6 ^o	11.4	11.4	9.6	16.3	14.4	14.8	21.2	13.8	13.6	19.3	23.7	23.5

For footnotes see page 203.

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

NONFERROUS- METAL PRODUCTS (concluded)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More													
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939			
	<i>Industry</i>																		
Collapsible tubes	}	0.58	0.77	0.68	1.0	1.9	1.9	2.2	3.3	{	1.9	2.0	1.8	1.7	1.8	2.0	2.0	1.9	
Tin and other foils		2.1	1.9	2.7	2.6	3.0	2.9	2.5	3.4	3.3	1.7	1.7	1.7	1.2	1.3	1.8 ^f	1.7	1.3	
Electroplating ^g		0.064	0.18	0.20	0.26	0.78	0.78	0.58	0.76	0.84	0.83	0.74	0.57	0.59	0.81	1.0	1.0	1.0	
Fire extinguishers		1.2	1.4	1.4	1.1	0.95	0.94	1.1	0.92	1.1	1.1	1.2	0.86	0.61	0.56	0.62	0.56	0.56	
Gold leaf and foil		11.2	12.6	18.9	18.0	18.2	18.1	15.9	22.9	22.3	21.0	23.6	14.8	10.5	16.7	21.7	20.5	20.5	
Lighting equipment		2.7	4.0	4.6 ^h	5.3	9.3	9.3	6.5	6.8	5.8	5.6	6.2	5.4	6.4	10.1	9.6	10.4	10.4	
Needles and pins		29.0	34.9	42.7	42.4 ^o	78.5	78.5	42.3	67.3	65.1	65.9 ^l	79.1	48.9	47.8	62.9	83.0	73.3	73.3	
Nonferrous-metal products, n.e.c.		6.4	6.3	8.0	8.7	9.5	9.5	9.5	12.1	11.3	11.8	10.7	}	11.1	9.2	10.2	11.4	12.1	
Plated ware		5.8	8.6	8.6	7.1	6.5	6.5	5.3	5.0	5.6	5.0	5.0		5.0	5.0	5.0	5.0	5.0	5.0
Silverware		28.3	39.5 ^j																
Sheet-metal work, n.e.c.			22.6	28.4	28.7	27.6	27.0	25.2	28.9 ^k	25.0	24.5 ^k	28.6 ^l	19.4	13.1	17.4	23.0	18.7	18.7	
Stamped and enameled ware		17.8	23.5	27.5 ^d	30.3	35.2	35.2	24.8 ^m	36.6	31.3	30.9 ⁿ	40.0	28.4	32.3	50.0 ⁿ	61.1	54.3	54.3	
Clocks		6.0	7.2	8.0	6.8	8.3	8.2	6.5	9.4	7.9	9.9	10.4	}	16.2	12.8	18.0	23.2	17.9	
Watch and clock materials		0.33	0.38	0.64	0.67	0.58	0.58	0.39	0.40	0.50	0.42	0.31		0.31	0.31	0.31	0.31	0.31	0.31
Watches		6.9	10.7	10.7	12.4	15.9	15.9	12.2	11.6	13.9	12.2	10.7		10.7	10.7	10.7	10.7	10.7	10.7
Watchcases		3.9	4.2	4.6	3.5	3.9	3.9	3.7	4.3	3.5	3.4	3.4	1.7	1.2	2.0	2.5	2.4	2.4	
Jewelry	}	20.5	22.1	30.3	28.3	30.9	30.7	23.5	26.4	23.8	24.1	27.9	16.7	13.1	17.1	20.4	22.2	22.2	
Jewelers' findings														1.9	1.8	2.7	2.5	2.8	2.8
TOTAL		168.4	207.1	230.3	239.5	304.8	303.7	212.7	293.8	276.6	272.7	314.7	208.6	188.3	265.0	331.4	335.3	303.6	

^a *Copper, lead and zinc* are given only in combination in 1939. This combination, entitled *primary nonferrous metals*, includes the production of aluminum, formerly classified under *chemicals, industrial*. A comparable 1937 figure is provided by the Bureau of the Census.

^b In 1909 the copper and lead departments of an important copper and lead smelting and refining establishment were reported together under *copper*, whereas in 1904 the lead department was included with *lead*.

^c Between 1919 and 1921 certain establishments were transferred from *secondary metals, nonprecious*, to *chemicals, n.e.c.*

^d Prior to 1914 *aluminum manufactures* was included among *miscellaneous articles, housefurnishings, n.e.c.*, and *stamped and enameled ware*.

^e Between 1914 and 1919 aluminum castings were transferred from *nonferrous-metal products, n.e.c.*, to *aluminum manufactures*. The comparability of the figures for the latter industry appears to have been considerably affected by this change.

^f Between 1935 and 1937 several establishments were transferred from *tin and other foils* to other industries.

^g Because this industry contains a large proportion of small establishments, the degree to which it is covered in the Census probably varies from year to year.

^h Between 1909 and 1914 metal hairpins were transferred from *combs, n.e.c.*, to *needles and pins*.

ⁱ Between 1927 and 1929 certain large establishments engaged primarily in rolling nonferrous metal and manufacturing nonferrous wire were transferred from *wire, n.e.m.* to *nonferrous-metal products, n.e.c.*

^j In 1899 *tin cans and tinware, n.e.c.*, was combined with *sheet-metal work, n.e.c.*

^k Sheet-metal shops in which some manufacturing was carried on in connection with building construction or repair contracts were not canvassed for 1925 and 1927, unless the value of the manufactured products exceeded \$20,000. Previously such shops were canvassed if the value of their manufactured products amounted to \$5,000 or more. After 1927 all sheet-metal shops were covered with respect to work done in the shop; outside work was not included.

^l After 1929 *dairymen's supplies* was abandoned as a separate classification, and the products were divided among *sheet-metal work, n.e.c.*, and other classifications.

^m Between 1921 and 1923 enameled bathtubs, sinks, etc., were transferred from *stamped and enameled ware* to *plumbers' supplies*.

ⁿ Between 1927 and 1929 stamped tinware was transferred from *tin cans and tinware, n.e.c.*, to *stamped and enameled ware*. Between 1935 and 1937 it was retransferred to *tin cans and tinware, n.e.c.*

MACHINERY	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Industry</i>																
Foundry and machine-shop products, n.e.c. ^a	331.2	378.3 ^b 346.6	401.5 ^c 389.2	398.9 ^d 363.1	573.2 ^e 483.6	482.5	321.8	449.5 ^f	404.1 ^g 398.9	404.2 ^h	455.0 ⁱ	284.9 287.5	219.5 ^{k, l, m} 220.0	316.2 ⁿ 373.6	433.0 478.3	342.1
Agricultural implements	46.6	47.4	50.6	48.5	54.4	54.3	30.4	31.0	28.7	33.3	41.7	17.5	11.1 ^o 19.3	52.9	77.5 80.2	59.1

For footnotes see pp. 205-06.

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

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MACHINERY (continued)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Industry</i>																
Office and store machines, n.e.c.														^p	44.8	36.2
Business machines	2.1	4.1	7.5	9.0	16.5	16.5	9.8	15.0	13.3	14.4	16.8 ^a	12.2	10.9 ^m 12.4	18.5	23.6	^p
Typewriters	} 4.3	6.2	9.6	11.1	15.7	15.6	13.4	15.0	15.0	{ 15.6	16.9 ^a	10.9	9.6	15.4	21.4	^p
Carbon paper																	1.1	1.3	1.2	1.2	1.4	1.6	1.7
Electrical machinery	42.1	60.5 ^r	87.3	118.1	212.4	212.3	161.2	234.9	239.9 ^w	241.6	328.7 ^w	214.7 180.1 ^t	130.9 ^u , ^r	181.8	260.2	214.9
Phonographs	1.3	3.4	5.2	9.4	28.7	28.7	17.9	20.5	11.3	14.2	14.4 ^s	1.9 ^s				
Radios and phonographs												36.5 ^t	32.9	44.8	48.3	43.5
Engines and tractors			^d	29.7	77.6	77.6	35.6	48.5	51.1	54.3	61.1	} 34.1	23.5 ^o			
Windmills	2.0	1.9	2.3	2.0	1.9	1.9	1.4	1.1	1.4	1.4	1.6					
Engines and windmills, excl. tractors													75.4 ^o	22.1	32.9 25.3	18.7
Steel barrels					3.3	3.3	2.0	2.7	2.0	2.9	4.1	3.3	6.5	5.8	6.2	6.1
Machine tools				•	53.7	53.1	21.3	33.4	30.8	35.3 ^b 32.4	47.4	21.3	12.7	28.2	47.3 37.5	36.6
Machine-tool accessories, n.e.c.										76.9 ^b	26.7 ^s	17.5	12.8	23.1	32.9	25.2
Pumps	0.63	1.4	2.1	2.7 ^d 8.3	16.1	16.1	12.2	14.6	17.9	18.7	23.1	15.2	11.1	15.0 ^a 17.5	28.3	24.2
Textile machinery				•	31.8	31.8	31.0	35.7	27.9	26.2	27.0	18.8	18.6	19.1	25.3	21.9
Gas machines and meters	2.2	2.7	4.8	5.0	5.6	5.6	4.3	6.1	5.5	5.9	6.1	5.0	3.2 ^l			
Refrigerators and ice-mak- ing machinery												26.7	26.4	37.1	50.6	35.2

APPENDIX B

MACHINERY (continued)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
	<i>Industry</i>															
Refrigerators, nonmechanical	3.3	4.0	5.0	5.6	5.8	5.8	5.8	8.5	9.4	9.6	9.8	7.1	j			
Refrigerators, mechanical									k	11.3	16.9	15.6	j			
Scales and balances	2.8	3.1	3.6	4.5	5.4	5.4	3.7	4.2	4.3	3.9	4.1	2.8	2.2	2.5	3.3	2.8
Sewing machines	13.4	17.1	19.3	18.0	19.2	19.2	12.6	13.4	12.1	11.8 ^h	10.5	8.1	6.3	7.5	9.0	7.8
										70.0	10.5	8.1	6.3	7.5	9.0	7.8
Washing and ironing machines	1.5	1.6	1.8	2.3	6.0	5.9	4.1	6.1	7.1	7.8	8.2	6.2	7.0	8.7	9.3	7.5
TOTAL	453.2	531.8	600.5	634.3	1,038.5	1,035.7	688.5	940.0	881.8	913.3	1,121.3	698.3	546.3	800.0	1,110.9	883.6
		500.1	588.2		1,037.2					920.2			545.1		1,081.3	

^a Foundry and machine-shop products, n.e.c., includes iron and steel, processed (shown separately by the Census, 1919-29) and vault, sidewalk, and floor lights, coal covers, and ventilating equipment (shown separately by the Census from 1899 to 1923).

^b After 1899 stoves and hot-air furnaces were transferred from foundry and machine-shop products, n.e.c., to stoves and ranges. Overlapping figures are provided for 1904.

^c Prior to 1909 cast-iron pipe was combined with foundry and machine-shop products, n.e.c. Overlapping figures are provided for 1909.

^d Prior to 1914 the industry engines and tractors, and establishments engaged in the production of power pumps, were included in foundry and machine-shop products. Overlapping figures are provided for 1914. Automobile repairing was first treated as a manufacturing industry in 1914. Prior to that year no special effort was made to canvass this industry but some reports were received in 1909 and were included with foundry and machine-shop products, n.e.c.

^e Prior to 1919 steel barrels, textile machinery, iron and steel, welded, and machine tools were included in foundry and machine-shop products, n.e.c. Overlapping figures are provided for 1919.

^f Between 1923 and 1925 manfolding machinery was transferred from stationery goods, n.e.c., to foundry and machine-shop products, n.e.c.

^g Between 1925 and 1927 a new classification, refrigerators, mechanical, was set up. Establishments there classified were formerly in electrical machinery and foundry and machine-shop products, n.e.c.

^h Between 1927 and 1929 a new classification, machine-tool accessories, n.e.c., was set up. Establishments there classified were formerly in machine tools, foundry and machine-shop products, n.e.c., and tools, other. Overlapping figures are provided for 1927. We obtained the 1927 figures for machine-tool accessories, n.e.c., by subtracting the revised figures published in the 1929 Census of Manufactures for foundry and machine-shop products, n.e.c., tools, other, and machine tools from the respective unrevised figures, published in the 1927 volume, and then totaling the differences.

ⁱ Between 1929 and 1931 dairymen's supplies was abandoned as a separate classification, and the products were divided among foundry and machine-shop products, n.e.c., and other classifications.

Footnotes concluded on next page.

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

MACHINERY (concluded)

¹ Between 1931 and 1933 *refrigerators, mechanical, refrigerators, nonmechanical, and ice-making apparatus, which was previously in foundry and machine-shop products, n.e.c.*, were combined under *refrigerators and ice-making machinery*. Overlapping figures are provided for 1931.

² Between 1933 and 1935 *printing materials, n.e.c., type founding, and engravers' materials* were combined with *foundry and machine-shop products, n.e.c.*

³ Between 1933 and 1935 *gas machines and meters* was abandoned as a separate classification. Gas and water meters were transferred to *instruments, professional and gas generators to machine shops, part of foundry and machine-shop products, n.e.c.* Overlapping figures are provided for 1933.

⁴ Between 1933 and 1935 addressing and mailing machines, check-writing and canceling machines and duplicating or manifolding machines were transferred from *foundry and machine-shop products, n.e.c.*, to *business machines, and numbering machines from hand stamps and stencils to business machines*. Overlapping figures for 1933 are provided by the Bureau of the Census.

⁵ Between 1935 and 1937 air compressors and dry vacuum pumps were transferred from *foundry and machine-shop products, n.e.c.* to *pumps*. Overlapping figures are provided for 1935.

⁶ Between 1933 and 1935 tractors were transferred from *engines to agricultural implements*. Overlapping figures are provided for 1933.

⁷ Between 1937 and 1939 *typewriters* were combined with *business machines* and with establishments making stencil cutting and embossing machines (formerly included in *machinery, n.e.c.*, part of *foundry and machine-shop products, n.e.c.*), to

form the industry *office and store machines, n.e.c.* A comparable figure for 1937 is provided.

⁸ Between 1929 and 1931 certain establishments manufacturing typewriter-bookkeeping-billing machines were transferred from *typewriters to business machines*.

⁹ Between 1904 and 1909 establishments manufacturing signs and advertising novelties were transferred from *electrical machinery* and other classifications to a new one, *signs*.

¹⁰ Between 1929 and 1931 molded plastics were transferred principally from *electrical machinery*, but also from *phonographs, machine-tool accessories, n.e.c.* and other classifications to *pulp goods*.

¹¹ In 1931 a new classification, *radios and phonographs*, was set up. Establishments there classified were formerly in *electrical machinery* and *phonographs*. Overlapping figures for 1931 are provided for *electrical machinery* by the Bureau of the Census.

¹² *Electrical machinery* includes *beauty-shop equipment*, listed separately by the Bureau of the Census after 1933. Most of the establishments in the latter industry were formerly classified in *electrical machinery* or in *miscellaneous articles*.

¹³ Between 1933 and 1935 the composition of *dental goods and equipment* was changed to include certain electrical devices formerly in *electrical machinery*.

¹⁴ Between 1927 and 1929 sewing machine cases, cabinets and tables were transferred from *sewing machines to furniture*. Overlapping figures for 1927 are provided by the Census.

TRANSPOR- TATION EQUIPMENT	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Industry</i>																
Aircraft ^a	} 17.5	3.3 ^b	4.4	{ 0.17	3.5	3.5 ^c	1.4	2.9	2.7	4.4	14.7	9.9	7.8	11.4	24.0	48.6
Motorcycles and bicycles																
Automobiles, incl. bodies and parts														4	571.3	399.0

TRANSPOR- TATION EQUIPMENT (concluded)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
	<i>Industry</i>															
Automobile bodies and parts		1.8	24.4	47.8	132.6	132.3	69.1	163.5	228.4 ^f	181.5	221.3 ^g 222.8	150.6	145.7	240.8	284.8	^d
Automobiles	^a 2.2	10.2	51.3	79.3	210.6	210.6	143.7	241.4	197.7	187.9	226.1 ^g 224.7	134.9	97.9	147.0	194.5	^d
Carriage and wagon materials	15.4	17.2	17.4	11.1	6.5	6.5	2.7	2.0	1.4	0.76	0.68	^b				
Carriages and sleds, children's	2.7	4.0	5.3	5.9	6.7	6.7	5.5	8.3	6.9	7.0	7.1	4.2	4.0	4.9	5.2	4.3
Carriages, wagons and sleighs	58.7	61.3	53.2	47.6 ⁱ 40.0	16.0	15.5	6.3	8.1	4.8	3.4	2.9	1.4, 7.3	1.4	1.6	1.8	1.3
Cars, railroad, n.e.m.	37.0	38.8	46.7	58.1	55.2	55.2	48.0	80.6	50.4	38.0	40.0	18.8	14.3	21.5	40.5	24.5
Locomotives, n.e.m.	19.0	24.8	14.9	17.4	26.7	26.7	16.6	30.7	12.8	13.0	11.0	5.4	2.4	3.8	9.0	6.5
Ships and boats ^k	46.7	50.8	40.5	44.5	387.4	387.3	106.4	62.3	50.2	55.0	55.1	45.3	30.9	44.8	62.3	69.2
TOTAL	199.4	212.2	258.1	312.6 310.9	856.1	855.2	404.0	606.3	559.6	494.9	583.4	373.8 373.6	307.4	480.9	629.1 667.4	560.4

^a Some degree of incomparability may have been introduced by the following changes in the questionnaire for *aircraft*: For 1935, 1937, and 1939 aircraft were reported as "begun and completed in 1935," 1937 or 1939; for 1933, as "built in 1933"; for 1931, as "built in 1931"; for 1929, as "completed in 1929."

^b Between 1904 and 1909 children's tricycles and velocipedes were transferred from *motorcycles and bicycles to toys and games, n.e.c.*

^c Between 1919 and 1921 establishments engaged primarily in the manufacture of aircraft parts, other than engines and tires, were transferred from *cotton goods, lumber-mill products, n.e.c., planing-mill products, n.e.m., and wood turned and shaped, n.e.c.* to *aircraft*.

^d In 1939 *automobiles* and *automobile bodies and parts* were combined to form a single industry and motor-vehicle hardware plants owned by motor-vehicle manufacturers were transferred to this industry from *hardware, n.e.c.* A comparable figure for the combination is provided for 1937.

^e In 1899 no establishments reported that they were engaged chiefly in the

manufacture of automobile bodies and parts. The Bureau of the Census doubts that there were any such establishments at that time.

^f Between 1925 and 1927 motor-vehicle spring bumpers were transferred from *springs, steel, n.e.m., to automobile bodies and parts*.

^g Between 1929 and 1931 trailers were transferred from *automobiles to automobile bodies and parts*. The resulting discontinuity is slight.

^h In 1931 *carriage and wagon materials* was abandoned as a separate classification. Turned products, such as hubs, felloes and spokes were transferred to *wood turned and shaped, n.e.c.*, and other materials and parts were transferred to *carriages, wagons and sleighs*.

ⁱ Prior to 1914 establishments engaged in repair work were included with *carriages, wagons and sleighs*. Overlapping figures are available for 1914.

^j Between 1931 and 1933 horsedrawn lunch wagons were transferred from *carriages, wagons and sleighs to planing-mill products, n.e.m.* A 1931 figure comparable with later years is provided for *carriages, wagons and sleighs*.

^k Does not include government shipyards.

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

MISCELLANEOUS PRODUCTS	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More											
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939	
<i>Industry</i>																	
Organs	} 21.3	{	3.6	2.4	3.1	1.9	1.9	2.3	1.9	2.5	2.8	2.4	1.5	0.57	0.61	1.1	1.0
Pianos			21.0	25.5	23.9	23.0	23.0	15.8	22.2	20.1	16.6	10.0	4.7	2.7	4.1	5.7	5.3
Organ and piano parts	} 2.4	{	8.5	10.1	10.6	11.0	11.0	5.6	9.7	8.6	5.4	3.1	1.2	0.77	1.2	1.8	1.3
Musical instruments, n.e.c.			2.1	1.8	1.8	4.1	4.1	3.4	4.1	4.6	4.0	3.2	2.6	2.1	2.9	3.4	3.2
Artificial flowers	} 5.3	{	4.8	4.8	4.1	4.1	4.1	3.9	4.7	4.3	4.7	3.2	2.3	3.2	5.7	} 6.6	
Feathers and plumes			4.3	5.2	4.5	3.5	3.5	2.1	1.7	0.89	0.32	0.26	0.53	0.32	0.57		0.56
Artists' materials	0.20	0.27	0.66	0.60	0.93	0.92	1.0	1.4	1.3	1.2	1.2	0.84	0.84 ^a	0.26	0.35	0.37	0.40
Pencils	2.2	3.1	4.1	4.3	6.0	6.0	5.1	5.8	5.6	5.3	5.7	3.5	3.5 ^a	4.0	5.2	5.8	3.8
																4.4	4.4
Brooms	} 10.3	{	5.2	5.6	6.3	6.2	4.3	4.7	4.7	4.4	4.5	4.1	3.8	4.2	4.1	3.8	
Brushes			11.4	7.0	7.2	8.0	7.9	6.5	8.7	7.8	7.7	7.3	5.9	5.8	6.8	7.9	7.9
Buttons	8.7	10.6	16.4	14.5	15.6	15.4	9.7	11.9	11.5	9.6	9.0	8.2	9.9	10.3	12.0	11.0	
Dairymen's supplies	b	2.6	4.9	5.6	6.4	6.4	3.8	5.8	4.8	5.1	5.4	e					
Dental goods and equipment	1.0	1.9	1.6	3.1	5.2	5.2	4.1	4.6	5.3	5.7 ^d	3.8	4.6	3.9	3.1 ^e	3.5 ^f	4.6	4.2
Miscellaneous articles	5.7 ^g	6.6 ^h	6.7 ⁱ	7.4	14.0	13.9	11.5	13.5	14.6	17.0	18.7	} 13.9	} 13.0 ⁱ	} 14.2	} 15.9	} 16.3	
Ivory work	1.3	1.8 ^m	0.91	0.80	0.84	0.83	0.67	0.60	0.49	0.29	0.39						
Combs, n.e.c.	1.4	1.8 ^m	4.6 ⁿ	2.8	2.2	2.2	1.3	2.1	1.3	1.3	0.66	0.65	0.41	0.24			
Foundry supplies	0.28	0.32	0.46	0.56	0.91	0.89	0.57	0.97	1.1	0.94	0.85	0.43	0.33	0.40	0.47	v	
Hair work ^q	0.82	0.86	3.5	1.2	1.1	1.0	1.2	1.3	0.86	0.52	0.36	0.27	0.23	0.50	0.43	0.32	0.32
Hand stamps and stencils	1.5	1.5	1.7	1.8	2.1	2.1	2.1	2.3	2.9	2.7	3.0	2.5	2.2 ^r	2.3	2.4	2.2	
Instruments, professional	2.8	3.4	4.8	7.1	15.9	15.9	9.4	12.3	12.1 ^s	16.4	16.9	9.1	6.2 ^t	8.9	15.2 ^t	17.4	17.7
																78.3	78.3
Optical goods	3.7	4.3	6.4	7.9	14.7	14.7	11.1	12.2 ^u	8.6 ^v	7.6	9.7	7.4	7.6	9.7	12.0	11.6	

MISCELLANEOUS PRODUCTS (continued)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
	<i>Industry</i>															
Jewelry and instrument cases	0.82	1.7	2.1	2.4	2.7	2.7	2.2	3.0	2.7	2.4	2.3	1.4	1.1	2.3 ^v 2.6	4.8	5.1
Lapidary work	0.50	0.51	0.63	0.58	1.2	1.1	0.40	0.64	0.59	0.55	0.51	0.20	0.11	0.15	0.22	0.27
Mattresses and bed springs, n.e.c.	7.6	10.4	11.3	11.7	12.6	12.5	11.7	14.1	14.4 ^w	13.5	17.2	13.6	13.3	15.4	19.2	18.3
Models and patterns, n.e.c. ^q	2.6	2.8	4.2	4.3	6.9	6.8	3.9	5.8	5.3	5.6	6.8	4.3	2.8	4.1	5.7	5.6
Paving materials	2.4	1.9	1.4	19.5	16.1	15.7	15.4	19.4	17.9	19.2 ^x	2.4 ^x 7.4	1.1	1.2	2.2	1.9	2.4
Pens and points	1.2	1.6	1.9 ^v	2.0	4.4	4.4	3.4	4.3	4.2	4.0	4.6	3.9	3.1	3.8	4.3 5.7	4.5
Photographic supplies	3.4	3.8	5.2	8.0 ^a 8.7	13.5	13.4	10.7	9.9	9.2	12.1	13.0	10.6	9.0	12.0	18.4	17.3
Pipes, tobacco	1.6	1.9	2.8	2.4	2.5	2.5	1.8	2.4	2.0	1.8	1.7	1.7	1.4	2.2	2.4	2.5
Signs		^b	5.5	9.6	10.4	10.3	10.4	13.0	15.1	16.9	20.0	14.5	12.0	13.7	16.0	17.2
Soda-water apparatus	0.96	1.5	1.8	2.2	2.6	2.6	2.1	2.7	2.4	2.8	2.8	1.6	0.82	1.1	1.7	1.6
Sporting goods, n.e.c.	2.2	4.3	5.3	5.6	6.4	6.4	7.1	9.7	8.7	9.7	10.8	10.2	8.2	9.7	11.4 72.2	13.8
Surgical equipment	1.8	3.2	4.2	4.8	7.1	7.0	4.8	5.9	6.4	7.3	7.9	6.7	7.0	7.1	8.4	8.5
Theatrical equipment			^{aa}	0.088	0.15	0.15	0.17	0.21	0.39	0.56	0.55	0.36	0.31	0.28	0.40	°
Toys and games, n.e.c.	3.3	4.3 ^{bb}	5.3	7.9	14.2	14.1	9.4	14.5	14.2 ^{cc} 73.6	14.7	16.7	13.2	12.5 ^{dd}	15.4	17.5 77.3	18.7
Umbrellas and canes	5.6	5.4	5.5	4.8	3.4	3.3	3.1	3.8	3.7	3.3	2.9	1.9	2.2	2.2	3.1	2.9
Window shades	1.8	2.6	3.9	4.1	4.4	4.4	3.8	6.0	5.2	4.7	4.7	3.1	2.9	3.0	3.2	3.3
TOTAL	104.9	136.0	179.8	208.9 209.7	256.5	254.8	196.1	247.7	236.5 235.9	238.8 236.9	224.9 223.9	161.9	143.4 146.1	180.0 180.3	220.2 220.1	218.5

For footnotes see next page.

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

MISCELLANEOUS PRODUCTS (concluded)

^a Between 1933 and 1935 crayons were transferred from *artists' materials* to *pencils*. Overlapping figures for 1933 are provided by the Bureau of the Census.

^b In 1899 *dairymen's supplies* was combined with other industries.

^c In 1931 *dairymen's supplies* was abandoned as a separate classification, and the products were divided among *flavorings, planing-mill products, n.e.m., sheet-metal work, n.e.c., tin cans and tinware, n.e.c., wood turned and shaped, n.e.c., foundry and machine-shop products, n.e.c.,* and *stoves and ranges*.

^d After 1927 dental laboratories operating on a custom basis, previously included in *dental goods and equipment*, were not canvassed. Overlapping figures for 1927 are provided by the Bureau of the Census.

^e Between 1933 and 1935 the composition of *dental goods and equipment* was changed to include certain electrical devices formerly in *electrical machinery*, and dental chairs and cabinets formerly in *furniture*.

^f Between 1935 and 1937 establishments manufacturing dental instruments as their major product were transferred from *instruments, professional,* to *dental goods and equipment*.

^g Between 1899 and 1904 establishments engaged in manufacturing statuary and art goods were transferred from *miscellaneous articles* and *plastering and stucco work* (an industry abandoned by the Bureau of the Census in 1904) to a new classification, *statuary and art goods*.

^h Between 1904 and 1909 establishments manufacturing signs and advertising novelties were transferred from *housefurnishings, n.e.c., leather goods, n.e.c., stationery goods, n.e.c., electrical machinery* and *miscellaneous articles to signs*, a new classification.

ⁱ Prior to 1914 aluminum manufactures were included among *miscellaneous articles* and other classifications.

^j Between 1929 and 1931 molded plastics were transferred principally from *electrical machinery*, but also from *miscellaneous articles* and other classifications to *pulp goods*.

^k Between 1929 and 1931 *labels and tags* was abandoned and the products were divided among *miscellaneous articles* and other classifications.

^l Between 1933 and 1935 *stationery goods, n.e.c.*, was abandoned and the products were divided among *miscellaneous articles* and other classifications. At the same time, some establishments making beauty-shop equipment were transferred from *miscellaneous articles* to a new classification, *beauty-shop equipment*, treated by us as part of *electrical machinery*.

^m Between 1904 and 1909 many important establishments making horn, celluloid and other combs were transferred from *ivory work* to *combs, n.e.c.* Hairpins also were transferred from *ivory work* and other industries to *combs, n.e.c.*

ⁿ Between 1909 and 1914 rubber combs and hairpins were transferred from *combs, n.e.c.* to *rubber goods, other* metal hairpins were transferred from *combs n.e.c.* to *needles and pins*.

^o In 1939 *theatrical equipment* was included in *miscellaneous articles*.

^p In 1939 *foundry supplies* were included in the combination of *druggists' preparations* and *patent medicines*.

^q Because this industry contains a large proportion of small establishments, the degree to which it is covered in the Census probably varies from year to year.

^r Between 1933 and 1935 numbering machines were transferred from *hand stamps and stencils* to *business machines*.

^s Between 1925 and 1927 surveyors' nautical instruments and similar instruments were transferred from *optical goods to instruments, professional*.

^t Between 1933 and 1935 *gas machines and meters* was abandoned as a separate classification and gas and water meters were transferred to *instruments, professional*. Overlapping figures are provided for 1933.

^u After 1923 establishments grinding lenses for spectacles and eyeglasses from prescriptions, classified under *optical goods*, were not canvassed by the Bureau of the Census. The comparability of the data for the industry appears to have been seriously affected by this omission.

^v Because of changes in the classification of certain establishments between 1935 and 1937, the 1937 statistics for *jewelry and instrument cases* are not comparable with those for previous years. Comparable figures for 1935 are provided by the Bureau of the Census.

^w After 1925 establishments engaged in renovating mattresses, classified under *mattresses and bedsprings, n.e.c.*, were not canvassed by the Census of Manufactures.

^x Establishments formerly in *paving materials* and engaged primarily in quarrying and crushing stone were not canvassed after 1927. The data on the industry appear to have been seriously affected by this change. Crushed slag was not canvassed after 1929. The 1929 figure for *paving materials* has been revised to make it comparable with that for 1931.

^y Between 1909 and 1914 there was a change in the classification of certain establishments, listed under *pens and points*, which manufactured gold pens and other products.

^z In 1914 motion-picture machines were included in *photographic supplies*, whereas in previous years they were included in *motion pictures*. Overlapping figures for 1914 are provided for *photographic supplies*.

^{aa} Canvassed for the first time in 1914.

^{bb} Between 1904 and 1909 children's tricycles and velocipedes were transferred from *motorcycles and bicycles to toys and games, n.e.c.*

^{cc} Between 1925 and 1927 rubber toy balloons were transferred from *toys and games, n.e.c.*, to *rubber goods, other*. Overlapping figures for 1925 are provided by the Bureau of the Census.

^{dd} The 1933 Census of this industry is considered somewhat incomplete by the Bureau of the Census.

MAJOR GROUPS AND TOTAL MANUFACTUR- ING	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Group</i>																
Foods	304.2	358.9	420.1	498.6 509.0	703.1	699.1	583.1	642.2	635.0	639.5	702.9	605.7	618.0	718.3	788.8 788.6	741.0
Beverages	55.1	68.3	77.8	88.2	55.4	54.5	35.4	31.3	29.6	28.8	30.5	25.5	43.2 42.4	67.9	85.9	65.0
Tobacco products	132.5	159.4	166.8	178.9	157.1	155.0	150.0	146.3	132.1	129.3	116.1	99.8	99.7	90.5	92.2	87.5
Textile products	1,036.7	1,179.1	1,457.1 1,466.3	1,525.8	1,635.6	1,632.3	1,532.0	1,741.7	1,654.3 1,655.6	1,719.7	1,732.0	1,441.1	1,491.0	1,707.5	1,834.6 1,838.5	1,839.9
Leather products	249.7	266.0	311.3	308.2	350.1	349.4	280.4	345.6	315.4 314.1	316.1	318.5	272.8	282.0	310.8	332.0 328.6	327.7
Rubber products	36.6	43.9	49.3	74.0	158.5	158.5	103.3	137.9	141.1 141.9	142.0	149.1	99.3	106.3	114.7	129.8	120.7
Paper products	97.3	125.5	151.0	174.5	219.4	219.2	196.0	232.3	232.9	233.4	244.5	203.2 202.2	199.8	235.7	264.5 266.1	264.0
Printing and publishing	204.6	230.5	271.3	286.3	302.0	294.5	282.5	308.0	315.3	328.6	358.0	317.8	264.1 263.0	304.8	353.1	326.0
Chemical products	108.6	134.0	154.5	183.4	283.8	283.1	190.9	237.2	236.7 236.6	245.6	275.0	226.5	233.9	272.0	309.7 305.9	279.9
Petroleum and coal products	30.8	37.2	45.1 45.2	49.1	94.8	94.8	83.6	100.3	93.0	96.6	105.4	86.6	85.1	98.1	108.9 109.6	101.2
Stone, clay and glass products	240.4	295.9 297.4	349.1	345.9	320.9	318.5	269.7	368.6	371.2	366.7	346.5	234.0 237.3	188.8	257.2	330.3 328.6	311.4
Forest products	704.6	757.2	940.6 941.6	857.6	855.0	841.7	692.6	919.5	902.0	850.1 852.0	863.0	504.0 504.1	452.0	570.3	708.5 677.1	633.6

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

MAJOR GROUPS AND TOTAL MANUFACTURING (concluded)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More											
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939	
<i>Group</i>																	
Iron and steel products	368.7	431.1 477.7	582.6 594.8	617.2	853.9	853.2	568.0	887.8	848.5	830.5 821.8	876.3	594.7 594.3	547.6	720.1	954.4 944.7	805.0	
Nonferrous-metal products	168.4	207.1 190.2	230.3	239.5	304.8	303.7	212.7	293.8	276.6	272.7	314.7	208.6	188.3	265.0	331.4 335.3	303.6	
Machinery	453.2	531.8 500.1	600.5 588.2	634.3	1,038.5 1,037.2	1,035.7	688.5	940.0	881.8	913.3 920.2	1,121.3	698.3	546.3 545.1	800.0	1,110.9 1,081.3	883.6	
Transportation equipment	199.4	212.2	258.1	312.6 310.9	856.1	855.2	404.0	606.3	559.6	494.9	583.4	373.8 373.6	307.4	480.9	629.1 667.4	560.4	
Miscellaneous products	104.9	136.0	179.8	208.9 209.7	256.5	254.8	196.1	247.7	236.5 235.9	238.8 236.9	224.9 223.9	161.9	143.4 146.1	180.0 180.3	220.2 220.1	218.5	
TOTAL MANUFACTURING	4,495.9	5,173.9 5,173.5	6,245.5 6,255.7	6,583.0 6,592.5	8,445.5 8,444.2	8,403.2	6,468.8	8,186.9	7,861.6	7,846.6 7,844.7	8,362.2 8,361.2	6,153.6 6,155.5	5,797.0 5,796.6	7,193.9 7,194.2	8,584.1 8,552.9	7,868.9	

RECONCILIATION WITH CENSUS TOTAL	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More											
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939	
CENSUS TOTAL	4,712.8	5,468.4	6,615.0	7,036.3	9,096.4	9,050.6	6,946.6	8,778.2	8,384.3	8,349.8	8,838.7	6,523.0	6,055.7	7,378.8	8,569.2	7,886.6	
<i>Add or Deduct:</i>																	
Revisions by Census	-0.16					-0.14		-5.0	-7.1		+0.28	-1.3		-0.023	-0.033		
REVISED CENSUS TOTAL	4,712.6	5,468.4	6,615.0	7,036.3	9,096.4	9,050.4	6,946.6	8,773.2	8,377.2	8,349.8	8,839.0	6,521.7	6,055.7	7,378.8	8,569.2	7,886.6	
<i>Deduct:</i>																	
Blended flour																	0.37 ^a
Butter reworking	0.15	0.40	0.30	0.30	0.047	0.047	b										
Coffee and spices	} 6.4 {	6.0	7.5	8.5	10.5	10.5	8.9	9.7	°	8.2	9.1	8.7	d				
Peanuts		1.4	1.9	2.4	2.5	2.5	2.1	1.5	2.0	7.4	7.9	7.6	d				
Poultry				1.4 ^a	2.1	2.1	2.3	1.5	2.8	°e	7.8	7.0	7.5	8.1	8.9	14.5	
Rectified spirits														5.9 ^a	7.1	2.8	
Flax and hemp	0.21	0.21	0.16	0.12	0.42	0.42	0.11	0.062	0.082	0.062	0.047	d					
Wood carpet	0.61	0.37	0.18	0.17	f												
Gas, illuminating	22.5	30.6	37.2	43.8	42.9	42.8	35.0	42.3	47.0	48.5	43.1	34.5	26.2	19.7	d		
Grindstones	1.2	0.71	1.4	0.69													
Grindstones and millstones					0.71	0.71	0.50	0.65	0.45	0.47	d						
Pulpwood	g	g	g	0.42	f												
Pulp, other than wood	0.12	g	g	g	0.064	0.064	g										
Iron and steel, welded				b	1.3	1.3	1.0	1.0	d								
Tinplate and terneplate	3.7	4.8	5.4	5.2	3.1	3.1	i										
Automobile repairing			i	12.6	55.1	50.5	d										
Carriage and wagon repairing			k	1.7	2.5	2.4	1.7	d									
Railroad repair-shop products	180.6	247.9	204.6	365.9	515.7	515.5	418.3	523.4	457.8	428.7	398.2	309.0	241.9	155.3	d		
Dental laboratory work										1.9 ^l							
Motion pictures			0.51 ^a	m	3.6	3.6	6.3	6.4	5.6	8.4	10.8	n					
Ordnance	0.98	0.28	g	g	11.3	11.3 ^l	1.4	f									

For footnotes see next page.

Average Number of Wage Earners in Manufacturing Industries (Unit: 1,000)

RECONCILIATION WITH CENSUS TOTAL (concluded)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More										
	1899	1904	1909	1914	1919	1919	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
	<i>Deduct (continued)</i>															
Rules	0.21	0.15	0.11	0.41	0.17	0.16	0.19	0.22	°							
Straw goods	0.054	0.083	•													
All other industries	0.051	0.064	0.096	0.36	0.099	0.080	0.15	0.63 ¹								
<i>Add:</i>																
Correction in:																
Turpentine and rosin ²													4.6	4.1	30.9	
Cigars ³													12.4			
ADJUSTED CENSUS																
TOTAL	4,495.9	5,175.5	6,255.7	6,592.5	8,444.2	8,403.2	6,468.8	8,185.9	7,861.6	7,846.2	8,362.2	6,154.9	5,797.2	7,193.9	8,584.1	7,868.9
NBER TOTAL	4,495.9	5,173.5	6,255.7	6,592.5	8,444.2	8,403.2	6,468.8	8,186.9	7,861.6	7,844.7	8,362.2	6,153.6	5,797.0	7,193.9	8,584.1	7,868.9
Unexplained difference		-2.0						+1.0		-1.5		-1.3	-0.2			

• Canvassed for the first time.

^b Between 1919 and 1921 *butter reworking* was combined with *all other industries*, and was not listed thereafter.

• Not canvassed.

^d No longer canvassed.

• Between 1927 and 1929 *canned poultry products* were transferred from *food, n.e.c.*, to *poultry products*.

¹ In 1919 *wood carpet* and *pulpwood*, in 1923 *ordnance*, and in 1925 *all other industries* were abandoned as separate classifications.

• Included in *all other industries*.

^b Prior to 1919 *iron and steel, welded*, was included in *foundry and machine-shop products, n.e.c.*

¹ In 1921 *tinplate and terneplate* was combined with *ordnance* and in 1923 with *all other industries*. Since 1923 all the products of this industry have been made as secondary products by the *steel-mill products* and the *tin cans and tinware, n.e.c.*, industries.

¹ Automobile repairing was first treated as a manufacturing industry in 1914. Prior to that year no special effort was made to canvass this industry but some

reports were received in 1909 and were included with *foundry and machine-shop products, n.e.c.*

¹ Prior to 1914 carriage repair work was included in *carriages, wagons and sleighs*.

¹ After 1927 dental laboratories operating on a custom basis, and previously included in *dental goods and equipment*, were not canvassed.

² In 1914 motion-picture machines were included in *photographic supplies*, whereas in 1909 they were included with *motion pictures*.

² No longer considered a manufacturing industry by the Bureau of the Census.

² Between 1923 and 1925 *rules* was abandoned as a separate industry, and the products were divided among *tools, other; wood turned and shaped, n.e.c.*; and other industries, according to the character of the products.

² See footnote ¹ under *forest products*.

³ In 1933 the coverage of *cigars* was incomplete. On the basis of Bureau of Internal Revenue data the coverage may be estimated at about 81.5 percent; the figure for this year has been raised accordingly.

Explanatory Note to Table B-2: Number of Salaried Workers in Manufacturing Industries

This appendix table shows the number of salaried persons employed in each major group of manufacturing industries and in all manufacturing combined. In order to conserve space we do not present a reconciliation of the grand totals arrived at in the present study with the grand totals given in the Census volumes, or a tabulation of data for individual industries. Indexes of total employment, including salaried personnel, are given for many industries in Appendix F, and a reconciliation can readily be prepared by the reader who studies the explanatory note to Appendix Table B-1.

Before the figures assembled here are used, Appendix A and the explanatory note to Appendix Table B-1 should be consulted for general comments concerning the character of the data and our method of presenting them. Salaried personnel includes officers of corporations (except directors not holding other offices on salary), as well as "managers, superintendents, and other responsible administrative employees; foremen and overseers who devote all or the greater part of their time to supervisory duties; clerks, stenographers, bookkeepers, and other clerical employees on salary." ¹

The number of salaried persons is not the average number employed during the year. For 1909-37 it is the number on the payroll on December 14 or 15, and for 1939, the number on the payroll during the period including October 14, unless these were not representative days; in the latter case data for the nearest representative day or payroll period were requested. For 1899 the number of salaried persons reported is the greatest number employed at any one time during the year; and for 1904, the Census requested simply the number, without specifying any date to which it should relate.

Figures for persons in central-administrative offices are included

¹ See p. 2 of the General Schedule used in the 1929 Census of Manufactures. (This schedule is reproduced on p. 331 of the 1929 Report, Vol. I.)

to the extent shown below. A central-administrative office is defined as

an office which operates two or more manufacturing plants, one or more of which are located in cities other than that in which the administrative office is located. . . . At censuses prior to that for 1925 the central-administrative-office employees were allocated to individual plants, usually on the basis of the percentages which the values of products reported by the several plants formed of the total for all manufacturing plants operated by the administrative office, and the numbers of employees and the amounts of their salaries thus added were included in the statistics for the respective industries. . . .²

To circumvent the improper geographical distribution which resulted, as well as the exaggeration of the number of salaried employees caused by the inclusion of central-office employees not properly allocable to manufacturing,³ the Bureau of the Census decided to show the data for the employees in these offices separately, beginning with 1925. Data for these employees were not collected prior to 1909, or in 1927, 1931 and 1933; in 1929, 1937 and 1939 data were collected but not shown, except for all factories combined; ⁴ and in 1935 data were collected but not tabulated. The Census gives no figure for the number of central-office employees in 1909 or in preceding years. For this reason an unavoidable discontinuity occurs between 1904 and 1909 in the series on salaried workers, though it does not appear to be very serious in most cases: in 1923 central-office employees constituted less than 1 percent of the reported total of all workers; in 1929, 2 percent; and in 1937, 1.3 percent. Those interested in the num-

² Census of Manufactures, 1925, Ch. IV.

³ It should be noted that at the decennial Censuses for 1909 and 1919 it was possible to allocate some of the central-office employees to mining. The number involved is not given by the Census.

⁴ The data for 1925-39 for all factories combined are given in Table B-5.

The data presented include figures for those central-administrative offices which made *separate* reports for their personnel. "Many such offices, however, did not report their personnel separately but included data for them in the returns for their plants" (headnote to Table 2, p. 43, 1929 Report, Vol. I).

ber of salaried workers for its own sake should note, however, that even for all manufacturing industries combined central-office employees constituted as much as 7 percent of the reported total of salaried personnel (excluding these employees) in 1923, 15 percent in 1929, and 11 percent in 1937.⁵

The figures for 1933 have been stepped up to include the number of corporate officials, which was not reported in that year. In estimating this number, we made use of the ratio of the number of corporate officials in 1929 and 1935 to the corresponding total of all salaried persons. In 1935 and earlier years manufacturers were requested to report all corporate officers, but after 1935 only those devoted wholly or chiefly to manufacturing. The resulting incomparability is slight. No data on salaried persons were collected in the 1931 Census.

Explanatory Note to Table B-3: Number of Proprietors and Firm Members in Manufacturing Industries

Table B-3 shows the number of proprietors and firm members engaged in manufacturing in the United States, classified by major groups. To save space details by industries are not supplied; indexes of total employment, including proprietors and firm members, are given for many industries in Appendix F. Reference should be made to Appendix A and to the explanatory note to Appendix Table B-1 before the figures presented here are used.

The reader should note that rather serious discontinuities are introduced into the Census series on number of proprietors and firm members because of changes in the Census coverage of small establishments. These changes occur: (1) because the minimum size of establishment included is based on value of products, and is therefore subject to variation as a result of price changes or changes in scale of operation; (2) because of a change between 1919 and 1921 in the minimum size of establishment required to

⁵ Central-office employees are not all salaried. In 1937 a breakdown was published for the first time; this shows that the 131.0 thousand persons in central offices consisted of 122.1 thousand salaried workers, 8.7 thousand wage earners, and 0.2 thousand proprietors and firm members.

TABLE B-2

Number of Salaried Workers in Manufacturing Industries (Unit: 1,000)

MAJOR GROUPS AND TOTAL MANUFACTUR- ING	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More									
	1899	1904	1909	1914	1919	1921	1923	1925	1925	1927	1929	1933	1935 ^a	1937	1939
	Excluding Central- Administrative- Office Employees		Including Central-Administrative- Office Employees					Excluding Central-Administrative- Office Employees							
<i>Group</i>															
Foods	45.0	53.3	85.1	105.1 107.6	163.7	129.5	132.9	129.9	117.2	119.9	121.2	101.8	113.1	116.9 116.8	95.2
Beverages	9.9	12.6	17.0	19.5	14.5	9.1	8.8	7.8	7.8	7.7	8.4	13.3 13.1	16.6	19.6	15.4
Tobacco products	7.8	9.2	13.2	16.8	15.7	14.7	15.7	14.3	10.5	11.6	10.2	3.8	5.0	5.7	4.8
Textile products	45.3	64.2	96.2	112.9 112.8	151.6	131.3	162.8	148.9	142.7	143.1	145.1	106.0	122.5	120.6 121.2	115.8
Leather products	15.3	18.4	28.7	32.5	44.0	33.5	40.1	36.4	34.8	34.3	32.8	23.7	25.4	25.8 25.3	23.9
Rubber products	2.5	3.7	6.7	14.7	47.6	21.4	22.2	23.9	22.9	26.6	22.8	15.6	16.8	20.1	18.6
Paper products	6.8	9.6	14.8	20.0	28.7	25.7	31.5	31.7	29.5	31.1	33.3	28.8	31.2	32.8 33.0	31.0
Printing and publishing	41.9	71.3	103.6	120.9	143.9	143.9	169.1	180.0	179.1	191.6	207.8	152.7 152.4	170.3	204.5	143.2
Chemical products	23.9	30.5	47.5	59.4	95.0	65.4	74.0	71.6	63.5	66.9	72.9	53.6	64.4	70.0 69.4	60.5
Petroleum and coal products	3.0	4.1	6.0	9.9	21.2	16.2	21.6	21.3	16.2	16.9	18.8	12.7	18.2	19.0 19.1	18.7
Stone, clay and glass products	13.9	20.3	29.3	33.5	41.3	34.7	43.4	48.9	44.1	45.0	43.2	25.9	32.8	37.1 36.9	36.2

MAJOR GROUPS AND TOTAL MANUFACTUR- ING (continued)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More									
	1899	1904	1909	1914	1919	1921	1923	1925	1925	1927	1929	1933	1935*	1937	1939
	Excluding Central- Administrative- Office Employees		Including Central-Administrative- Office Employees					Excluding Central-Administrative- Office Employees							
<i>Group</i>															
Forest products	33.7	46.8 47.1	65.1	68.0 67.3	77.6	67.2	78.6	79.7	79.2	75.1 75.2	77.9	44.8	51.6	58.9 57.7	54.3
Iron and steel products	21.1	36.3 29.0	44.6 45.2	52.2 77.3	124.7	93.8	114.4	120.1	106.0	107.1 105.3	110.0	69.1	86.2	108.0 106.1	96.3
Nonferrous-metal products	12.1	18.4	29.5	35.0 32.5	47.9	37.5	45.7	44.3	43.0	45.5	51.6	32.9	43.1	49.7 50.3	43.9
Machinery	45.5	66.2 72.1	109.9 109.3	138.0 116.2	213.2	169.9	204.9	198.1	181.3	195.9 197.6	222.5 222.8	127.4 126.5	169.1	213.3 211.0	177.5
Transportation equipment	10.4	13.3 14.4	26.5	36.0 35.8	90.4	55.1	68.6	68.8	65.0	61.6	67.0	40.2	52.8	74.3 78.3	74.9

Footnote on next page.

Number of Salaried Workers in Manufacturing Industries (Unit: 1,000)

MAJOR GROUPS AND TOTAL MANUFACTUR- ING (concluded)	Establishments with Products Valued at \$500 or More					Establishments with Products Valued at \$5,000 or More									
	1899	1904	1909	1914	1919	1921	1923	1925	1925	1927	1929	1933	1935*	1937	1939
	Excluding Central- Administrative- Office Employees		Including Central-Administrative- Office Employees					Excluding Central-Administrative- Office Employees							
<i>Group</i>															
Miscellaneous products	9.3	14.0 14.5	24.4 26.0	33.8 34.0	46.9	38.7	45.4	45.0	43.1	44.0 43.5	43.2	28.1 28.9	37.0	39.6	35.3
TOTAL	347.6	492.3 492.9	748.1 749.7	908.2 910.7	1,368.0	1,087.7	1,279.8	1,270.6	1,186.0	1,223.8 1,223.3	1,288.7 1,288.9	880.5 879.9	1,056.1	1,215.8 1,214.7	1,045.5

* In 1935 and earlier years manufacturers were requested to report all corporate officers; after 1935, only those devoted wholly or chiefly to manufacturing. The resulting incomparability is slight.

report, from a value of products of \$500 in 1919 to one of \$5,000 in 1921; (3) because the biennial censuses are less adequate in coverage than the quinquennial.¹ That proprietors and firm members are concentrated in the small establishments hardly requires demonstration.² If we assume that to every establishment excluded by the change in the minimum value of products between 1919 and 1921 there corresponds one proprietor or firm member, then we must conclude that the change in the minimum between 1919 and 1921 introduced a serious discontinuity in the series for proprietors and firm members, because the number of small establishments is very large.^{3, 4} Shifts in scale of operation and changes in prices would, on the same assumption, also introduce serious discontinuities, as would reduction of coverage in the biennial Censuses.

Data on number of proprietors and firm members in 1899 are omitted because the available figures cover hand trades and custom establishments, excluded from the later Censuses. An estimate for 1899 and one for 1919 comparable with 1921 are given for all factories combined in Table B-5.

¹ See the discussion in Appendix A, *The Output of Manufacturing Industries, 1899-1937* (National Bureau of Economic Research, 1940).

² Small establishments are most often unincorporated. Further, almost every establishment requires a proprietor or firm member: unincorporated establishments are less frequently associated with central administrative offices. (See Table 2, 1929 Report, Vol. I, p. 95. In 1929, 24,000 out of 102,000 establishments controlled by corporations were operated by central administrative offices; the corresponding figures for noncorporate concerns were 2,000 out of 109,000.) Any supervision by one proprietor or partner of more than one establishment is more than counterbalanced by the supervision of one establishment by more than one partner.

³ This assumption is not valid for all *individual* industries because some industries are large scale and almost entirely incorporated.

⁴ This is pointed out in the Census: see footnote 3 to Table 1, Ch. 3 of the 1929 Report, Vol. I, p. 42. See also p. 20, Vol. VIII, of the 1909 Census.

TABLE B-3

Number of Proprietors and Firm Members in Manufacturing Industries (Unit: 1,000)

MAJOR GROUPS AND TOTAL MANUFACTURING	Establishments with Products Valued at \$500 or More				Establishments with Products Valued at \$5,000 or More								
	1904	1909	1914	1919	1921	1923	1925	1927	1929	1933	1935	1937	1939
<i>Group</i>													
Foods	49.4	61.5	59.0 61.7	62.3	43.8	39.2	34.5	35.0	37.6	23.1	21.2	31.1	36.4
Beverages	6.3	7.2	7.2	6.2	4.2	4.5	4.0	4.8	4.5	1.9	2.5	3.2	3.8
Tobacco products	19.0	17.6	15.2	10.8	4.7	3.3	2.2	2.0	1.6	0.61	0.67	0.63	0.60
Textile products	21.9	26.8	26.9 26.8	32.8	30.5	28.0	23.8	26.7	23.5	12.2	12.3	13.9	19.2
Leather products	6.0	5.8	6.6	5.7	3.6	3.2	2.8 2.7	2.7	2.3	1.4	1.4	1.4	1.5
Rubber products	0.10	0.10	0.087	0.098	0.095	0.11	0.23	0.10	0.11	0.079	0.11	0.098	0.16
Paper products	1.7	1.6	1.4	1.4	1.4	1.1	1.0	0.86	0.81	0.45	0.56	0.66 0.68	0.84
Printing and publishing	29.3	31.3	32.1	29.5	22.0	17.9	18.2	18.4	14.8	10.8 10.7	13.1	15.2	18.2
Chemical products	5.0	5.7	5.6	4.9	3.3	2.5	2.4	2.4	2.1	1.3	1.7	1.8	2.4
Petroleum and coal products	0.27	0.28	0.18	0.21	0.18	0.20	0.096	0.058	0.067	0.072	0.096	0.095 0.099	0.24
Stone, clay and glass products	11.8	17.2	14.7	11.5	7.5	5.8	6.0	5.3	4.8	1.7	2.6	2.9	3.9
Forest products	40.0	58.6	47.2	44.0	21.1	17.3	16.6	13.1	21.6	7.3	10.9	12.8 11.7	15.3
Iron and steel products	2.3	2.1	1.9 3.6	3.7	3.2	2.5	2.4	2.5 2.3	2.2	1.2	1.5	1.9 1.8	2.4

MAJOR GROUPS AND TOTAL MANUFACTURING (concluded)	Establishments with Products Valued at \$500 or More				Establishments with Products Valued at \$5,000 or More								
	1904	1909	1914	1919	1921	1923	1925	1927	1929	1933	1935	1937	1939
	<i>Group</i>												
Nonferrous-metal products	6.4	8.7	9.8 9.6	9.8	7.2	6.1	5.3	4.9	4.7	2.3	3.0	3.4	4.3
Machinery	10.6	11.1	10.8 9.4	9.5	8.3	6.5	5.7	6.1 6.2	5.3	4.4	4.3	4.6 4.5	6.3
Transportation equipment	8.0	8.2	8.1 7.1	4.6	2.7	2.1	1.2	0.98	1.0	0.42	0.66	0.80 0.83	1.0
Miscellaneous products	7.0	8.2 8.4	9.3	10.8	7.5	7.2	6.6	6.2 5.9	5.5	3.1	4.5	4.6 4.5	6.1
TOTAL	225.0	272.2 272.4	256.0 257.8	247.7	171.5	147.6	132.9	132.0 131.8	132.5	72.3	81.3	99.0 97.8	122.6

PROPRIETORS AND FIRM MEMBERS

Explanatory Note to Table B-4: Number of Nonfactory Personnel in Manufacturing Industries

This table contains the number of nonfactory workers employed in manufacturing in 1935, 1937 and 1939; that is, manufacturing employees not listed in Tables B-1, B-2 and B-3.

In order to conserve space we do not give the figures for individual industries. The indexes in Appendix F below indicate the importance of nonfactory personnel in many individual industries. For 1935, these are persons within the factory engaged wholly or chiefly in distribution; for 1937, all persons engaged in manufacturing activities but not reported as wage earners, salaried persons, proprietors or firm members; for 1939, all persons on factory payrolls engaged wholly or chiefly in distribution, construction, and other nonfactory activities.

As noted in Appendix A, persons engaged in mining and lumbering activities intimately connected with factory operations have always been counted as regular factory workers. It is not certain, however, to what extent the types of workers counted as nonfactory personnel in 1935-39 were reported as regular factory workers in earlier years.¹ The main question concerns factory employees engaged in distribution, transportation and construction activities.

Drivers of delivery wagons, and salesmen associated with a separate sales office to which the factory turns over its products at a given price are excluded from the Census.² This treatment is consistent with the Census definition of factory value of prod-

¹ Mention should be made of the Census treatment of certain other classes of workers. Persons working at home on materials furnished by a manufacturer are excluded. Contract workers (workers employed outside the plant by an independent contractor) also are excluded, though they may be counted in a separate manufacturing industry (e.g., clothing-contract factories). "Wage earners employed indirectly" are included. These are wage earners who, in some factories, actually work for the establishment in the same building as others but do not appear upon its payrolls, being indirectly employed and paid through superintendents, heads of departments, foremen, and the like. The number and compensation of the workers are estimated and included with the corresponding figures for regular payroll employees.

² That is, an effort is made by the Bureau of the Census to exclude them. See Appendix Table B-1, note to the item on ice, concerning delivery employees.

ucts as the f.o.b. value. If, however, the value of products is that reported by the selling department associated with the factory, then the salesmen of the establishment are included.³ Thus the 1909 schedule requested that the number of "clerks, stenographers, salesmen, and other salaried employecs" be reported; that "all salaried officials . . . who devote all or a considerable proportion of their time to the business" be included. It specified further that traveling salesmen were to be included if there was no separate selling department to which the product of a factory was turned over at a given value or price. The 1919 and 1929 schedules and instructions contain essentially the same specifications. In the 1933 schedule⁴ the inquiry on number of persons engaged does not, however, mention salesmen. Only proprietors, officers, administrative employees, clerical employees (clerks, stenographers, and bookkeepers) and wage earners are specified.

The 1935 schedule states: "If you maintain a separate sales department, do not include data for it in your report for the Census of Manufactures; give these data only in the report for the Census of Business, on the last sheet" (the latter is a special sheet requesting distribution and merchandising activities, appended for the first time to the 1935 schedule—see below). The inquiry concerning personnel requests the number of clerical employees—"clerks, stenographers, bookkeepers, timekeepers, and other clerical employees . . . whether in the office or in the factory." Salesmen are not mentioned. The separate "Manufacturer's Distribution Report, 1935," appended to the usual schedule, required that employees engaged in distribution be enumerated. The question reads:

3A Employees engaged in distribution

(Include only those employees who devote all or the major portion of their time to distribution activities, such as selling, advertising, sales promotion, credit, billing, installing, or servicing goods sold, etc. Do not include any em-

³ See p. 36 of the Instructions previously cited in Explanatory Note to Table B-1.

⁴ For 1931 the number of salaried employees was not requested.

employees used primarily in production or in your sales office or branches, if any, located apart from the plant.)

a) Number of paid officers and employees, as described above, full-time and part-time.

b) Number of these, if any, that are also included under Inquiries 4 and 5, page 2 [i.e., in the manufactures schedule]

Some 520,000 persons were reported under (a), and of these, 190,000 under (b).⁵ In other words, 330,000 persons engaged in distribution *within* the manufacturing plant (but whose productive activities were *not* included in the value of products of manufacturing plants) were excluded from the 1935 figures. These are the employees covered in the table below.

In 1937 there seems to have been a repetition of the situation of 1935. The 1937 schedule requested "the total number of employees *in this plant not* reported under Inquiries 4 and 5 or on the Administrative schedule"; and manufacturers were requested to "allocate data for personnel and other items" if the books gave only combined figures for manufacturing and other activities. As indicated in the table following, about 170,000 employees were reported in 1937 as working in the factory but not listed as wage earners or salaried persons.

Finally, for 1939, the Census schedules asked for separate reports on the following classes of employees in the plant: employees whose duties are concerned wholly or chiefly with manufacturing; "those engaged in distribution" (selling, advertising, sales promotion, credit, billing, installing or servicing goods sold, and

⁵ The plants reporting these persons made 49 percent of total net sales in 1935. It is not clear whether the other establishments had no such employees, or had reported them as ordinary factory employees. See *Distribution of Manufactures' Sales, Census of Business, 1935* (Washington, April 1937), p. 23.

Since printing and publishing was not completely covered by this inquiry, the figures cited above are understatements.

other distribution activities); those engaged in "major construction and major repair work" in the plant; and "all other employees." It is at least possible, and indeed it is likely, that employees formerly reported as manufacturing workers were moved into the other three categories in 1939, and are therefore included in the figure of 686,000 given for 1939 in the table following.

It appears reasonable to conclude that changes occurred between 1933 and 1935 (or perhaps between 1929 and 1935) in the coverage of distribution employees; and between 1935 and 1937 and again between 1937 and 1939 in the coverage of all nonfactory employees. The assumption that some of the nonfactory employees reported in the 1935, 1937 and 1939 Censuses were included among production employees in Censuses prior to 1935 is based, first, upon the wording of the earlier schedules in which salesmen and all corporate officials are specifically mentioned as production employees, while they are not so mentioned in later schedules; second, upon the fact that there was no special inquiry to emphasize the distinction between manufacturing and other employees, as there was in 1935, 1937 and 1939.⁶ From the figures cited it appears, however, that the breaks, if any, were not serious for all factories combined, although they were important for some individual industries. In 1935, for example, in as many as 65 industries the number of distribution employees amounted to more than 10 percent of the number of production employees. The indexes given below in Appendix F throw additional light on this point.

⁶ A distinction must be made between instructions on the schedule itself and instructions in the separate booklets entitled "Instructions for Preparing Reports." The latter are much more explicit. Thus, directions in the 1919 "Instruction to Special Agents" stress the need for consistency of treatment of selling departments: either the value of product reported is the value received by the selling department and at the same time salesmen employed in the department are included among the salaried workers, or the value is the transfer value to the department and salesmen are excluded.

TABLE B-4

NUMBER OF NONFACTORY PERSONNEL IN
MANUFACTURING INDUSTRIES

Major Groups and Total Manufacturing

Unit: 1,000

<i>Group</i>	<i>1935</i>	<i>1937</i>	<i>1939</i>
Foods	100.0	60.9	147.5
Beverages	13.4	9.0	47.0
Tobacco products	4.2	.5	3.8
Textile products	51.0	9.2	63.9
Leather products	9.9	1.3	8.3
Rubber products	5.2	2.3	10.4
Paper products	8.8	4.4	20.3
Printing and publishing	.2 ^a	12.5	85.0
Chemical products	23.2	10.6	52.5
Petroleum and coal products	3.1	5.2	15.9
Stone, clay and glass products	9.2	4.3	19.3
Forest products	20.4	10.0	30.0
Iron and steel products	15.3	11.5	37.3
Nonferrous-metal products	10.3	2.0	24.4
Machinery	32.9	17.6	76.7
Transportation equipment	7.3	4.7	19.2
Miscellaneous products	12.7	6.0	25.2
TOTAL MANUFACTURING	327.1	171.9	686.5

^a Book, job and music printing and publishing only.

Explanatory Note to Table B-5: Aggregate Number of Personnel in Manufacturing Industries

This table brings together, for total manufacturing, the detailed data shown in preceding appendices, together with certain estimates needed to round out the picture. The resulting table shows all types of personnel in manufacturing industries during each of the Census years 1899–1939. The numbers are not strictly comparable from year to year, but the incomparabilities are slight, as is indicated by the more detailed data given in Appendix Tables B-1 to B-4, inclusive. The number of wage earners is the average number employed during the year. Practically all other figures relate to the number on the payroll in a single week, usually the week including December 15.

TABLE B-5

AGGREGATE NUMBER OF PERSONNEL IN MANUFACTURING INDUSTRIES, CENSUS YEARS, 1899-1939

Unit: 1,000

Census Years	Wage Earners	Salary Earners		Proprietors and Firm Members	Total of Preceding Columns		Workers not Covered in Preceding Totals ^d
		In Factories ^b	In Factories and Central-Administrative Offices ^c		In Factories	In Factories and Central-Administrative Offices	
ESTABLISHMENTS WITH PRODUCTS VALUED AT \$500 OR MORE							
1899	4,496	348		219 ^e	5,063		
1904	5,173	493		225	5,891		
1909	6,256		750	272		7,278	
1914	6,592		911	258		7,761	
1919	8,445		1,368	248		10,061	
ESTABLISHMENTS WITH PRODUCTS VALUED AT \$5,000 OR MORE							
1919	8,403		1,368 ^g	188 ^a		9,975	
1921	6,469		1,088	171		7,728	
1923	8,187	1,194	1,280	148	9,529	9,615	
1925	7,862	1,184	1,271	133	9,179	9,266	
1927	7,845	1,221		132	9,298		
1929	8,361	1,288	1,496	132	9,781	9,989	
1931	6,155						
1933	5,797	880 ^d		72	6,749		
1935	7,194	1,056		81	8,331		327
1937	8,553	1,215 ^f	1,346	98	9,866	9,997	172
1939	7,869	1,045		123	9,037		686

^a Estimated in part. It was assumed that the 60,000 establishments with products valued at between \$500 and \$5,000 were each managed by one proprietor, thus yielding an estimate of 188,000 proprietors and firm members (248 - 60 = 188).

^b Includes some workers in central offices not reported separately.

^c Includes a small number of wage earners and proprietors in central-administrative offices, not shown separately in most years.

^d For 1935, persons within the manufacturing plant engaged wholly or chiefly in distribution activities; for 1937, all persons in the plant not reported in preceding columns; for 1939, all persons on factory payrolls engaged wholly or chiefly in distribution, construction, and other nonfactory activities.

^e Estimated in part. The figure reported in the 1899 Census is 330,000, exclusive of hand trades but inclusive of nine industries not canvassed in later Censuses and of proprietors and firm members in 66,000 custom mills and factories. Exclusive of the nine industries the figure is 304,000. This was further reduced by 85,000, the estimated number of proprietors in the 66,000 custom establishments (85,000 = 66,000 × 1.29, where 1.29 is the average number of proprietors per nonincorporated establishment in 1899).

^f Includes only salaried officers whose duties were "concerned wholly or chiefly with manufacturing."

^g Assumed equal to the corresponding figure for establishments with products valued at \$500 or more.

Appendix C

Hours Worked in Manufacturing Industries, per Week per Wage Earner

Appendix C

Hours Worked in Manufacturing Industries, per Week per Wage Earner

INTRODUCTORY NOTE

THIS appendix consists of two tables. Table C-1 gives available annual data on both full-time and actual hours of work in all factories combined, for the years 1899-1939. Footnotes to this table describe the sources of the figures.

In the second table, C-2, we present hours data for individual industries for Census years 1909-39. These data cover only industries for which we have been able to compute indexes of physical output and employment, and are given only for those Census years to which the indexes apply. Data for some other industries and other years are available in the sources cited, which are as follows: NICB refers to the National Industrial Conference Board (*Wages, Hours and Employment in the United States, 1914-1936*, and later supplementary publications); BLS, to the Bureau of Labor Statistics (*Hours and Earnings in the United States, 1932-40*, Bulletin No. 697), and to unpublished estimates prepared by Witt Bowden and presented here through the courtesy of A. F. Hinrichs, Acting Commissioner of Labor Statistics; and Census, to the Census of Manufactures (*Census of Manufactures: 1939, Man-Hour Statistics for 171 Selected Industries*, prepared by A. F. Beal and published jointly by the Department of Commerce and the Department of Labor, and similar publications for 1933, 1935, and 1937; and the Census of Manufactures report for 1909). Other sources are specifically noted.

Sometimes the Census and BLS industry classifications bearing the same title really refer to different industries. At other times different titles refer to the same industry. This difficulty occurs also among Census and NICB industries and NICB and BLS industries. Reconciliations of the BLS and the Census industry classifications, and of the NICB and Census classifications (generously sent to us by the Bureau of Labor Statistics and by the National Industrial Conference Board) are too long to reproduce here. We have, however, used this information in matching the BLS and NICB data with the Census industries. The percentages

TABLE C-1

ALL MANUFACTURING INDUSTRIES COMBINED

Average Hours of Work per Week per Wage Earner

Year	<i>Full-Time Hours</i>			<i>Actual Hours</i>		
	Dept. of Commerce and Labor —Bureau of Labor Statistics	Census of Manufac- tures	National Industrial Conference Board	Bureau of Labor Statistics	National Industrial Conference Board	Census of Manufac- tures
	(a)	(b)	(c)	(d)	(e)	(f)
1899	59.1					
1900	59.0					
1901	58.7					
1902	58.3					
1903	57.9					
1904	57.7					
1905	57.7					
1906	57.3					
1907	57.3					
1908	56.8					
1909	56.8	56.8		52.7		
1910	56.6					
1911	56.4					
1912	56.0					
1913	55.5					
1914	55.2	55.1	54.9	51.0	51.5	
1915	55.0					
1916	54.9					
1917	54.6					
1918	53.6					
1919	52.3	50.8		47.8		
1920	51.0		49.9	47.1	48.2	
1921	50.7	50.3	49.6	45.2	45.6	
1922	51.2		49.9	47.1	49.2	
1923	51.0	51.1	49.9	47.3	49.2	
1924	50.4		49.7	45.4	46.9	
1925	50.3		49.8	46.3	48.2	
1926	50.3		49.8	46.5	48.1	
1927			49.5	46.3	47.7	
1928			49.6	46.1	47.9	
1929		50.6	49.6	45.7	48.3	
1930			48.6	43.5	43.9	
1931			48.0	41.7	40.4	
1932			47.9	38.2	34.8	
1933				37.8	36.4	38.1
1934				34.5	34.7	
1935				36.5	37.2	36.4
1936				39.1	39.5	
1937			40.8	38.6	38.7	37.2
1938			40.3	35.5	34.3	
1939			40.3	37.6	37.6	37.0

of coverage of the Census, the Bureau of Labor Statistics, and the National Industrial Conference Board samples of hours data vary. The Census coverage is greatest and that of the NICB samples is smallest, though not always in every industry.

The data for individual industries represent actual hours worked per week per worker in every case, except those for 1909, which are "full-time" or "prevailing" hours of labor per week, reduced to approximate actual hours.¹ The figures are annual averages except in the case of those for 1914, which relate to July only.

¹ As published in the Census, the 1909 figures are presented in the form of open-end frequency distributions, thus necessitating estimation of the mean value in each of the classes, including the open-end classes, in order to secure a mean covering the entire distribution. The 1909 full-time figures for every industry have been reduced by the percentage difference between actual and full-time hours worked in all factories combined in 1909. This is hardly a satisfactory expedient, yet it is better than none at all.

Footnotes to Table C-7.

^a Based on data for 14 industries taken from the *Nineteenth Annual Report* of the U. S. Commissioner of Labor (1904) and later reports of the Commissioner, and bulletins of the U. S. Bureau of Labor Statistics; see Paul H. Douglas, *Real Wages in the United States, 1890-1926* (Houghton Mifflin, 1930), p. 116. The series for 1899-1903 differs only slightly from an average computed from figures published in the *Nineteenth Annual Report* covering 456 occupations in 48 industries; see Leo Wolman, *Hours of Work in American Industry*, Bulletin 71 (National Bureau of Economic Research, 1938).

^b Computed from frequency distributions published in the U. S. Census of Manufactures: 1909-21, by P. F. Brissenden *Earnings of Factory Workers*, p. 354; 1923 and 1929, by Leo Wolman, *op. cit.*

^c Covers 24 industries through 1932 (not including iron and steel), *Wages in the United States in 1931* (National Industrial Conference Board, 1932) and Leo Wolman, *op. cit.*; covers 25 industries beginning with 1937, *The Conference Board Economic Record* (Mar. 28, 1940), and later releases. The 1914 figure is for July; the 1920 figure, for June-Dec. 1920; the 1922 figure, for July-Dec. 1922.

^d For 1932-39, U. S. Bureau of Labor Statistics, *Hours and Earnings in the United States, 1932-40* (Bulletin 697, 1942), covers a large sample of establishments in practically all manufacturing industries. For 1909-32 from Witt Bowden, "Wages, Hours, and Productivity of Industrial Labor, 1909 to 1939," *Monthly Labor Review*, Sept. 1940, and unpublished data provided by Mr. Bowden; derived, from data for 12 industries, by dividing payrolls by average hourly earnings and by average number employed, and adjusting to the level of hours in all manufacturing industries combined in 1909, 1919, 1929 and 1932. These levels were derived from the Census full-time hours, after adjustment for under-time, except for 1932, which is the 1932 level of the BLS series of actual hours for all manufacturing industries combined. For 1919-23, based on figures presented in the National Research Project report on *Production, Employment and Productivity in Manufacturing* already cited.

^e Based on a sample of 25 industries; see M. A. Beney, *Wages, Hours and Employment in the United States, 1914-1936* (National Industrial Conference Board, 1936), pp. 44-47, *The Conference Board Economic Record* (Mar. 28, 1940), and later releases. The 1914 figure is for July; the 1920 figure for June-Dec. 1920; the 1922 figure, for July-Dec. 1922.

^f For 1933, 32 industries; for 1935, 59; for 1937, 105; and for 1939, 171 industries. A 52-week year was assumed in converting the Census data, which are given on a monthly basis. See A. F. Beal, *Manhour Statistics for 105 Selected Industries*, Census of Manufactures: 1937, published by the Bureau of the Census and the Bureau of Labor Statistics (rotoprinted, Dec. 1939), and similar reports for other Census years. The corresponding figures for the 32 industries for 1935 and 1937 are 36.3 and 36.9 respectively; see A. F. Hinrichs and A. F. Beal, in *Monthly Labor Review* (June 1940).

TABLE C-2

SELECTED INDIVIDUAL INDUSTRIES

Hours Worked in Factories, per Week per Wage Earner, Census Years, 1909-39

<i>Industry</i>	<i>Source</i>	1909	1914	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Foods</i>													
Bakery products	BLS										40.5	42.6	41.7
Butter	BLS											47.9	46.7
Cereals	Census									37.1	35.6	39.3	37.4
Confectionery	BLS									37.2	36.7	39.3	38.1
Feeds	Census									40.8	39.7	43.6	41.7
Canned fish, fruits and vegetables	Census	56									35.9	37.9	36.9
Flour	BLS									43.4	39.4	44.3	42.3
	Census	57								43.8	39.8	44.3	42.2
Ice	Census	63								49.7	49.2		
Ice cream	BLS									47.6	45.4	47.9	46.2
Meat packing	NICB		55.8	46.9	49.7	49.6	50.2	50.6	49.0	44.8	40.6	39.8	40.1
	BLS				51.9	53.5	54.2	53.5	52.5	43.3	40.4	41.0	40.6
	Census	54								44.1	40.4	41.1	40.6
Sugar, beet	BLS									49.0	42.1	42.6	42.9
	Census	64								51.0	44.8	45.0	43.7
Cane-sugar refining	BLS										38.5	41.0	37.6
	Census	60								42.5	36.6	37.9	35.8
<i>Beverages</i>													
Beverages, non-alcoholic, and liquors, malt	BLS									41.7	39.0	40.4	39.0
Liquors, distilled	Census	55										39.7	38.9
Liquors, malt	Census											38.8	39.5

Industry	Source	1909	1914	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Tobacco products</i>													
Cigars and cigarettes	BLS										35.0	37.2	35.6
	Census									34.8	33.5	35.3	33.8
Cigarettes	Census									32.7	34.1	35.2	34.5
Cigars	Special ^a						48.8						
	Census									35.5	33.1	35.3	33.3
Chewing and smoking tobacco	BLS									38.8	34.9	36.2	34.1
	Census									34.4	33.6	34.6	34.3
Tobacco products, total	Census	50								34.4	33.5	35.2	33.8
	BLS											37.1	35.4
<i>Textile products</i>													
Carpets and rugs, wool	NICB ^b										35.8	34.4	34.7
	BLS									36.8	36.5	34.1	36.1
	Census	53								35.1	35.8	33.2	35.0
Clothing, men's	BLS						39.3	38.0	36.6	33.2	30.4	32.0	33.2
	Census											31.6	33.5
Clothing, women's, n.e.c.	BLS										31.9	31.8	33.9
Cotton goods ^c	BLS				47.8	45.4	49.9	47.0	45.1	41.4	34.6	36.2	36.7
	Census	55								40.2	33.7	35.4	36.3

^a Based on a sample covering 25 percent of the wage earners in the industry, collected by Rossmore, Robbins and Co. See H. Magdoff, I. H. Siegel, and M. B. Davis, *Production, Employment, and Productivity in 59 Manufacturing Industries, 1919-36, Part Two* (National Research Project, Philadelphia, 1939), p. 217.

^b The NICB designation is "Other woolen products" and applies principally to rugs, according to the NICB.

^c The available NICB series relates to cotton manufacturing in the Northern states alone. An NICB series for "cotton-south" is available for the period through 1928, but it is considered by the NICB to be based on an inadequate sample.

Hours Worked in Factories, per Week per Wage Earner, Census Years, 1909-39

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<i>Industry</i>	<i>Source</i>	1909	1914	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Textile products (concluded)</i>													
Hats, fur-felt	BLS										31.8	33.0	32.2
	Census	50											
Knit goods	NICB		50.8	46.8	46.3	45.1	47.0	47.6	42.2	39.2	34.5	36.6	36.6
	BLS									39.7	34.6	36.0	36.2
	Census	54								38.4	34.1	34.9	35.8
Hosiery	BLS									39.9	34.3	35.5	35.6
	Census									38.6	33.7	34.7	35.6
Underwear	BLS									39.3	34.5	35.7	36.9
	Census									38.0	33.4	35.0	36.0
Outerwear	BLS										36.3	37.1	37.0
	Census										36.0	35.0	35.8
Shirts and collars, men's	BLS										32.3	34.0	34.9
	Census											33.2	34.6
Silk and rayon goods	NICB		50.8	44.9	46.5	46.9	45.9	47.8	44.3	37.5	32.1	35.3	35.2
	BLS									37.1	34.8	35.9	36.5
	Census	53								37.8	34.5	35.0	36.6
Woolen and worsted goods	NICB ^d		53.1	45.9	47.5	44.1	45.1	46.4	41.8	39.5	37.3	35.0	36.6
	BLS				47.8	47.4	46.9	45.4	45.4	41.3	36.8	35.3	36.4
	Census	54								39.4	36.0	34.3	36.0

APPENDIX C

<i>Industry</i>	<i>Source</i>	1909	1914	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Leather products</i>													
Leather	NICB		50.1	46.6	47.6	47.5	45.8	47.6	45.2	41.8	38.1	38.2	38.6
	BLS									41.1	38.2	38.8	38.7
	Census	54								40.2	38.0	37.8	37.8
Shoes, leather	NICB ^e		53.6	45.7	45.6	45.8	45.2	44.2	44.5	39.6	37.1	38.3	36.0
	BLS				46.6	44.6	44.7	43.5	41.6	39.0	35.5	36.1	35.7
	Census	52											
<i>Rubber products</i>													
Rubber goods, other	BLS									37.9	37.5	39.1	38.9
	Census										36.7	37.8	38.2
Shoes, rubber	BLS										36.2	38.3	37.5
	Census										36.0	35.3	34.3
Tires and tubes	NICB											31.5	34.7
	BLS									31.6	32.3	31.8	35.0
	Census										31.3	31.1	34.2
Rubber products, total	NICB		49.1	43.8	44.8	44.5	45.4	44.8	38.1	32.7	33.1	33.3	35.5
	BLS										34.7	35.4	36.9
	Census										33.8	34.1	35.8
<i>Paper products</i>													
Paper and pulp	NICB		53.9	49.2	51.8	51.3	51.5	52.1	44.1	41.1	39.6	42.1	40.7
	BLS									40.6	38.9	41.0	40.3
	Census	58								40.4	38.6	40.9	40.3
Paper Pulp	Census									40.5	38.7	41.0	40.6
	Census									40.2	38.2	40.6	39.3

^d Includes rugs and miscellaneous wool products up through 1933.

^e Includes shoe cut stock and findings.

Hours Worked in Factories, per Week per Wage Earner, Census Years, 1909-39

<i>Industry</i>	<i>Source</i>	1909	1914	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Printing and publishing</i>													
Printing and publishing, total	NICB ^f		46.5	44.4	45.5	45.8	46.2	45.9	42.5	38.6	37.3	39.2	38.1
	BLS ^f				45.5	46.4	47.6	44.9	42.8	37.9	37.1	38.2	37.2
	Census	47											
<i>Chemical products</i>													
Chemicals, industrial	BLS									41.0	39.7	39.9	40.0
Rayon	BLS									41.2	37.9	38.5	37.9
	Census									39.8	37.1	37.1	36.6
Chemicals, industrial, incl. rayon and gases	BLS											39.3	39.1
	Census	58											
Cottonseed products	BLS										44.7	52.2	44.3
	Census	65											
Explosives	BLS									35.2	35.9	39.6	38.9
	Census	55											
Fertilizers	BLS									40.0	33.6	40.1	35.8
	Census	57											
Paints and varnishes	NICB		52.5	47.3	49.8	52.7	50.5	51.8	44.4	40.3	39.9	41.2	40.7
	BLS									40.5	39.8	41.2	40.5
	Census	52											

<i>Industry</i>	<i>Source</i>	1909	1914	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939
<i>Chemical products (concluded)</i>													
Soap	BLS									40.5	38.0	39.8	39.8
	Census	52								39.5	37.4	38.4	38.1
Chemical products, total	NICB [‡]		56.8	49.7	52.8	52.7	50.1	50.6	44.6	39.2	39.3	39.9	39.5
	BLS										38.8	40.5	39.5
<i>Petroleum and coal products</i>													
Petroleum refining	NICB											36.4	36.4
	BLS									37.9	35.0	36.0	36.1
	Census	55						51.3 [‡]	46.3 [‡]	38.9	35.5	36.0	37.1
<i>Stone, clay and glass products</i>													
Cement	NICB											37.8	38.4
	BLS									34.1	33.9	38.8	38.2
	Census	61									34.3	38.3	37.9
Clay products	BLS									32.2	35.8	40.2	37.8
	Census										35.4	38.8	37.5
Glass	BLS									35.9	35.4	37.1	35.2
	Census	52									36.0	36.2	35.4
Lime	Census	57										41.5	39.7

[†] Weighted combination of the two industries: printing, book and job; and printing, newspapers and magazines.

[‡] Weighted combination of the two NICB industries, chemicals and paints and varnishes.

[‡] Based on unpublished Census data supplied to the National Research Project. See H. Magdoff, I. H. Siegel and M. B. Davis, *op. cit.*, Part Two, p. 183, note 5.

Hours Worked in Factories, per Week per Wage Earner, Census Years, 1909-39

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<i>Industry</i>	<i>Source</i>	1909	1914	1921	1923	1925	1927	1929	1931	1933	1935	1937	1936
<i>Forest products</i>													
Lumber and millwork	NICB ⁱ		53.0	47.7	49.5	49.1	47.7	45.4	40.1	35.4	39.3	40.1	39.6
	BLS ^j										37.6	43.1	38.9
Planing-mill products	BLS										39.5	42.0	41.1
	Census												39.7
Lumber-mill products, n.e.c.	BLS				44.4	45.8	45.7	45.4	43.0	37.4	37.2	43.3	38.4
	Census	56											37.4
<i>Iron and steel products</i>													
Blast-furnace and steel- mill products	NICB		57.0	54.1	57.7	53.6	53.1	54.9	43.4	34.0	34.2	36.6	34.6
	BLS				48.1	45.6	45.2	45.7	35.0	32.5	34.9	38.7	35.5
	Census	58								34.8	36.4	38.5	35.7
Blast-furnace products	Census	66						57.6 ^k		38.1	39.7	42.3	37.8
Cast-iron pipe	BLS									29.7	31.0	37.8	36.4
	Census											36.7	37.1
Steel-mill products	Census	57								34.7	36.2	38.3	35.7
Tin cans and tinware	BLS										38.3	39.2	38.8
	Census											38.8	37.5
Wire, n.e.m.	Census	55										37.1	37.9
Wrought pipe, n.e.m.	Census											34.5	36.0

APPENDIX C

<i>Industry</i>	<i>Source</i>	1909	1914	1921	1923	1925	1927	1929	1931	1933	1935	1937	1939	HOURS WORKED PER WEEK	
<i>Nonferrous-metal products</i>															
Clocks, watches and materials	BLS									37.7	39.9	40.5	37.9		
Copper	Census	55										44.9			
Lead	Census	55										42.3			
Zinc	Census	58										39.3			
Nonferrous-metal products, n.e.c.	BLS									35.6	39.3	39.6	39.6		
	Census											39.4	40.3		
Primary nonferrous metals	BLS										38.9	41.3	38.2		
	Census											42.4	39.5		
<i>Machinery</i>															
Agricultural implements	NICB ¹		52.0	41.3	49.5	49.9	49.2	49.6	35.5						
Refrigerators, mechanical	Census											38.0	36.8		
Typewriters	BLS									36.3	38.2	40.2	37.3		
<i>Transportation equipment</i>															
Automobiles, incl. bodies and parts	NICB		51.4	44.7	47.7	47.3	46.4	46.8	36.9	36.0	37.4	35.3	34.9		
	BLS				47.1	45.5	43.8	42.8	35.6	35.2	37.1	35.9	35.5		
	Census	53								34.3	37.6	35.2	34.9		
Cars, railroad	BLS										35.2	39.4	36.0		
	Census	53													
Locomotives, n.e.m.	BLS										34.4	43.7	36.7		
	Census	56													
Ships and boats	BLS									31.0	32.8	37.1	38.0		
	Census	52													

¹ Includes the minor industries boxes and cooperage; excludes logging camps, a rather important branch of the sawmill industry.

² Weighted combination of the two BLS industries, planing-mill products and lumber-mill products, n.e.c.

^k Derived from a special Census study. See *Monthly Labor Review* (Aug. 1932), p. 263.

¹ Includes tractors.

Appendix D

Note on Factory Output

Appendix D

Note on Factory Output

THE data on factory output utilized in this study are described in detail in Chapter 2 and Appendix A of *The Output of Manufacturing Industries, 1899-1937*. This discussion is summarized here very briefly.¹

The indexes of output for individual industries presented in this report are indexes of physical, rather than pecuniary, output. They measure those changes in the aggregate value of each industry's production which are attributable exclusively to the actual changes in physical quantities. Prices have been kept constant in the computation of the indexes. Further, the indexes apply to gross physical output rather than to net physical output. They show the changes in the aggregate value of gross output which are attributable to changes in the physical quantities of final products. They do not measure the changes in the value added by the industry in the process of manufacture with prices of final products and of materials and other commodities consumed in the fabrication of the final products kept constant. The indexes for major groups and for total manufacturing also are indexes of physical output. However, because "value added" rather than "value of products" has been used as the weight in combining the indexes of the component individual industries, the group and total indexes do purport to measure net output, at least to a first approximation.

Output may be classified in terms of products as well as in terms of industries. But since employment is given only by industries, we have prepared our indexes of output to correspond with

¹ The indexes of output for 1899-1937 are all taken from the volume cited, except for a few revisions and additions, which are noted below in Appendix F. The indexes for 1869-99 and 1937-39 were constructed in a manner consistent with that followed for the 1899-1937 indexes, and, like the 1899-1937 indexes, are based largely on data collected in the Census of Manufactures.

the employment series. For this reason the measures in this volume relate to the industry which *specializes* in the products that give the industry its name. For example, we present indexes for "oleomargarine, not elsewhere made." The establishments in this industry devote themselves primarily to the production of oleomargarine. Yet a large amount of oleomargarine is made also as a secondary product in the meat-packing industry. Therefore, the number of persons employed in the "oleomargarine, not elsewhere made" industry is considerably fewer than the total number actually engaged in the manufacture of oleomargarine; and the changes in the former do not necessarily correspond to the movements of the total. A somewhat similar difficulty occurs in the case of "butter," the indexes for which relate only to factory production, though a considerable (and changing) fraction of butter production takes place on farms.

Because our interest is concentrated on the relation between output and employment, it is necessary to pay particular attention to the degree to which the two are comparable. So far as output is concerned, a difficulty arises because the Census does not always collect data on the physical quantity of all the products of an industry. We have used a "coverage adjustment," following Frederick C. Mills, by which we may pass from the sample of quantity data for an industry to the total output of the industry. This adjustment has both *a priori* and empirical justification and, it is safe to say, usually surmounts the difficulties raised by incomplete coverage. We have already noted certain of the disturbing characteristics of the employment figures, but since the Census has on the whole defined factory employment in such a way as to make the resulting figures consistent with output, serious problems on this account rarely arise. There is, however, one incomparability which should not be minimized. This occurs in the measure of output, or, according to the point of view, in that of employment. There are changes from time to time in the degree to which manufacturers of complex products make their own parts. Correspondingly, there are changes in the number employed. When parts are made outside the industry, the number of workers employed per unit of final product as recorded is smaller than when parts are made within the industry. More con-

cretely, less men are needed merely to assemble a motor car than to produce the component parts from steel and rubber, and then to assemble them. On this sort of change there is little readily available information. Fortunately, this kind of incomparability arises only in a relatively few industries.

In general the indexes of output are essentially estimates. Lack of detail in the Census data, and incomplete and changing coverage of each industry's output by the Census data on physical quantities, make this statement necessary. We have, however, used every available detail and made elaborate adjustments for coverage in order to render these estimates as reliable as possible.

Appendix E

Note on Data Concerning Manufacturing Capital

Appendix E

Note on Data Concerning Manufacturing Capital

VARIOUS data on capital assets, capital investment, and capital assets per worker have been cited in this report. These data are presented in detail in the accompanying tables, with footnotes to describe sources and methods of estimation. This appendix contains also a discussion of the changes indicated between 1904 and 1937 in capital assets held by all factories combined, in order to convey to the reader some idea of the peculiar pitfalls surrounding data on capital.

In 1904, the only year in the early part of the period covered in this study for which reasonably adequate figures are available, the aggregate book value of land, buildings and equipment reported by manufacturers to the Bureau of the Census was 5.7 billion dollars (Appendix Table E-1).¹ The corresponding 1937 figure, explicitly net of depreciation and depletion reserves, is 23.3 billion dollars. The percentage increase in book values between 1904 and 1937 is therefore about 300. This is probably an understatement of the rise because it is likely that some if not many of the manufacturers failed, in 1904, to deduct depreciation and depletion reserves, reporting gross book values in that year rather than net. The inclusion in 1937 of nonmanufacturing assets held by manufacturing corporations, assets excluded in 1904, only partly counterbalances this effect. Aside from these qualifications, there are other points that must be considered before we may accept the rise of 300 percent in capital assets as a pertinent estimate.

First, it must be noted, the prices implicitly underlying the book valuations did not remain unchanged between 1904 and

¹ We have excluded assets reported by railroad repair shops and gas companies, thus eliminating the greater part of the assets of industries not treated as manufacturing in recent Censuses. We do not cite the 1899 figure because it covers hand trades and other industries.

1937. Book values of capital assets are not identical with current values or values expressed in fixed prices, and these have not changed in the same ratio. Because the prices implicit in book values increased, the rise in book values overstates the rise in assets expressed in fixed prices. It is difficult, however, to state exactly by how much these prices rose. About 80 percent seems to be a reasonable figure.² We may say, then, that net capital assets, in fixed prices, rose at least 120 percent between 1904 and 1937.³

We must consider also the fact that land is included and rented property is excluded from the estimate of capital assets. Available evidence indicates that land fell in relation to other capital assets, but only slightly. Capital assets excluding land therefore closely paralleled capital assets including land (Appendix Table E-2). Rents paid for the use of property amounted to 72 million dollars in 1904, and to 320 million in 1937. Capitalizing these at 10 years purchase, we have a value of rented property equal to 12 percent of owned property in 1904 and 14 percent in 1937. Here also the changes are slight and approximately cancel one another.

It seems fairly safe to conclude that capital assets utilized in manufacturing, expressed in fixed prices, rose by at least 120 percent during the 33 years between 1904 and 1937.⁴ This compares

² See Solomon Fabricant, *Capital Consumption and Adjustment* (National Bureau of Economic Research, 1938), Table 50, for an index of prices underlying net book values of business capital assets, 1913-35. Estimates for 1913-18 and 1935-37 were prepared in accordance with the procedure outlined in the volume cited. They indicate that these prices in 1913 were about 62 percent of prices in 1937. The estimates for 1904-13 are based simply on Frederick C. Mills' index of the prices of new processed capital goods (*Economic Tendencies in the United States*, National Bureau of Economic Research, 1932, p. 586), in which 1904 appears as 89 percent of 1913. Difficulties arise because book values of assets purchased prior to 1913 are usually based on 1913 prices and not on original cost, but these are of minor importance in view of the sort of data on book values and prices that are available. More serious, perhaps, are revaluations, which were rather extensive just before 1904, during the 1920's, and in the depression following 1929. Little can be done about these revaluations; the net effect may be that we are overstating the rise in prices.

³ $4.00 \div 1.80 = 2.22$.

⁴ We are ignoring such problems, relatively minor in the present context, as arise from the ownership of nonmanufacturing assets by manufacturers, and in general all incomparabilities between the establishment classification in the Census and the enterprise classification in the income-tax reports.

with a rise of 65 percent in the number of wage earners, 70 percent in the total number of all personnel, 20 percent in the number of wage-earner manhours, and 200 percent in the volume of physical output. Capital assets per worker or per manhour therefore rose.

The preceding figures suggest that capital assets per unit of product fell, on net balance, between 1904 and 1937. It must be remembered, however, that the rise of 120 percent in capital assets is a minimum estimate. The true rise may have been well above the minimum,⁵ but since we do not know by just how much, no very exact conclusion about change in capital assets per unit of product can be drawn from the available data. Perhaps one may hazard the statement that if net capital assets held by factories rose more rapidly than factory output between 1904 and 1937, the differential was not great. It is certainly true, however, that the compounded growth in both quantity and quality of capital assets definitely exceeded that of output between these two years.⁶ And certainly between 1904 and 1929 (or between 1904 and the average of 1929-37) capital assets rose more in volume than did output, as the annual data in Appendix Table E-1 indicate.

⁵ In 1937 gross capital assets were 1.8 times net capital assets (*Statistics of Income for 1937*, Part 2, p. 24). If the 1904 figure is taken to refer entirely to gross capital assets and not at all to net, then the rise from 1904 to 1937 in gross capital assets was about 300 percent, and the rise in net capital assets somewhat less than 300 percent but much more than 120 percent. (Less than 300 because it is possible that the ratio of gross to net assets in 1937 was greater than the corresponding ratio in 1904, owing to the very low level of gross capital formation during the 1930's.) This is an extreme assumption, of course.

⁶ Output has also been affected by quality changes, but hardly to the same extent as capital assets.

TABLE E-1

ALL MANUFACTURING INDUSTRIES COMBINED
 Estimates of Gross Capital Formation (Current Prices)
 and Net Capital Assets (Book Valuation)

Unit: billion dollars

Year	Gross Capital Formation (Excluding Inventories) ^a	Net Capital Assets (End of Year)			
		Per Books ^b		Derived ^c	
		Un- consolidated Reports	Con- solidated Reports	Un- consolidated ^c Reports	Con- solidated Reports
1904		5.7			
1915	0.6				
1916	1.1				
1917	1.7				
1918	2.5				23.9
1919	2.2				24.6
1920	3.2				26.5
1921	1.4	20.6			26.6
1922	1.5				26.7
1923	2.1	24.9			27.2
1924	1.7	28.1			27.4
1925	2.0				27.7
1926	2.4		28.8		28.1
1927	2.1		28.0		28.2
1928	2.3		29.2		28.4
1929	2.7		30.5		29.0
1930	1.9		31.3		28.7
1931	1.1		29.6		27.8
1932	0.6		27.6		26.6
1933	0.7		26.3	22.8	25.6
1934	1.0	22.2	24.8	22.2	24.8
1935	1.2	22.0		21.8	
1936	1.5	22.8		21.8	
1937	2.2	23.3		22.3	

^a Lowell Chawner, in *Survey of Current Business* (March 1941).

^b The 1904 figure is taken from the Census of Manufactures. It does not cover railroad repair shops and other branches treated as nonmanufacturing in later years. The other figures are from *Statistics of Income* for the respective years, adjusted to include nonreporting corporations and unincorporated enterprise. Not included in the *Statistics of Income* data for manufacturing are any manufacturing companies that may have been placed in the category "combination, predominant industry not ascertainable." This category was of importance only in 1921, 1923 and 1924, in which years the capital assets held by companies included in it amounted in the aggregate to about one billion, 500 million, and again 500 million dollars, respectively.

^c Estimates of net capital formation were derived from Chawner's estimates of gross capital formation, and depreciation charges reported in *Statistics of Income*. These estimates were then cumulated and tied to the book values of capital assets in 1934 (shown in the preceding columns) to yield annual estimates of capital assets.

TABLE E-2

MAJOR GROUPS OF MANUFACTURING INDUSTRIES

Number of Wage Earners, Net Book Value of Capital Assets,
and Capital Assets per Wage Earner, 1904 and 1937

Group	Number of Wage Earners		Capital Assets (excl. land) Net Book Value		Capital Assets (excl. land) per Wage Earner	
	1904 unit: 1,000	1937	1904 unit: \$1,000,000	1937	1904 unit: \$1	1937
Foods	359	789	525.9	2,269	1,465	2,876
Beverages	68	86	299.2	562	4,400	6,535
Tobacco products	159	92	29.7	84	187	913
Textile products	1,179	1,834	740.4	1,703	628	929
Leather products	266	332	112.4	142	423	428
Rubber products	44	130	26.4	235	600	1,808
Paper products	125	264	204.8	1,272	1,638	4,818
Printing and publishing	230	353	223.0	651	970	1,844
Chemical and coal products	154	335	319.5	1,415	2,075	4,224
Petroleum products	17	83	65.2	3,554	3,835	42,819
Stone, clay and glass products	297	330	270.6	982	911	2,976
Forest products	757	709	370.5	1,142	489	1,611
Iron and steel products	478	954	759.6	3,284	1,589	3,442
Nonferrous-metal products	190	331	201.2	537	1,059	1,622
Electrical machinery	64	309	50.7	396	792	1,282
Machinery, other than electrical	436	802	436.8	1,128	1,002	1,406
Automobiles, incl. bodies and parts	12	479	8.0	982	667	2,050
Transportation equipment, other than automobiles	200	150	141.0	434	705	2,893
Miscellaneous products	136	220	60.4	467	444	2,123
TOTAL MANUFACTURING	5,173	8,584	4,845.3	21,238	937	2,474

Sources: Wage earners—Table B-1, above.

Capital assets, excluding land—for 1904, Census of Manufactures; for 1937, a special tabulation of corporate income-tax return data, provided through the courtesy of the U. S. Bureau of Internal Revenue, stepped up to include nonreporting corporations and unincorporated enterprise.

Capital assets, excluding land, per wage earner—derived from the preceding figures.

Appendix F

Indexes of Output, Employment, Manhours, Employment per Unit of Product, and Manhours per Unit of Product in Manufacturing Industries

Appendix F

Indexes of Output, Employment, Manhours, Employment per Unit of Product, and Manhours per Unit of Product in Manufacturing Industries

INTRODUCTORY NOTE

THE various indexes of labor input, output, and labor per unit, given only in summary or chart form in the text of this report, are presented in Table F-1 in full. They are supplied for every manufacturing industry or group of industries for every year for which we have data on both output and employment. Occasionally data on physical output, and almost always data on employment, are available for industries and years not covered here, but (except for the groups) these are generally omitted because they do not cover both series for the same year.

The indexes of physical output (described briefly in Appendix D, above) are reproduced from *The Output of Manufacturing Industries, 1899-1937*,¹ for the period covered by that volume, with a few additions or corrections mentioned in footnotes to the present tables. Output indexes for the period prior to 1899 and for 1937-39 were computed along lines similar to those laid down in the volume cited, and utilizing the same sort of data, mostly from the Census of Manufactures.

The indexes of wage-earner employment are based on the Census of Manufactures data given in Table B-1 above, except those for the period preceding 1899 which are not reproduced in the present report.² In the computation of the indexes of wage-earner employment due account was taken of all the discontinuities shown in Table B-1, whenever overlaps were provided by the Census, or whenever reasonable estimates of such overlaps could be prepared. In a few cases, when the discontinui-

¹ National Bureau of Economic Research, 1940.

² The indexes of wage-earner employment were extrapolated beyond 1899 *via* total employment, rather than wage earners alone, since there are several rather definite indications in the early Census reports and schedules that the figures on employment covered all workers and not wage earners exclusively.

ties seemed sufficiently serious and nothing could be done to bridge them, part of the data had to remain unused.

The indexes of total employment (including wage earners, salaried workers, proprietors and firm members) are based on the Census data described in Appendix B, above. Except for total manufacturing, the indexes are given only for 1904-39. The year 1931 is excluded in every case, whereas the year 1899 was not covered, except for total manufacturing, because the published 1899 figures for proprietors pertain to custom establishments, hand trades, and other plants excluded in later years. Various items of information are available in the 1899 Census report on the number of proprietors in such establishments, but it appeared advisable to use this information only to obtain an 1899 figure, comparable with later years, for all factories combined. The total of salaried personnel for 1933, including corporate officials, was estimated on the basis of that year's report for salaried persons excluding corporate officials, and of corresponding figures for 1929 and 1935. No adjustment could be made for the break between 1904 and 1909 caused by the inclusion of central-office personnel among salaried workers in the latter year but not in the earlier year. (Central-office personnel are not included in our total employment indexes for the period following 1925.) The break between 1919 and 1921 caused by the exclusion after 1919 of establishments with value of products of \$500 to \$5,000, was treated as follows: The series on salaried personnel was assumed to be unaffected by the break, since few such persons are employed in small establishments. As for proprietors and firm members, their number in plants with over \$5,000 products in 1921, expressed as a percentage of their number in plants with over \$5,000 products in 1919, was assumed equal to the corresponding percentage for wage earners and salaried workers combined.³

³ Occasionally this assumption yielded an absurd result; i.e., in effect it led to a negative figure for the number of proprietors in 1919 in establishments with a product of \$500-\$5,000. An alternative procedure was then followed: it was assumed that the number of proprietors in the class of establishments with products valued at between \$500 and \$5,000 in 1919 was equal to the number of establishments, and this number was then subtracted from the total number of proprietors in all establishments with product over \$500 to yield the number of proprietors in establishments with product over \$5,000, a number comparable with that available for 1921. (This assumption was used for total manufacturing to pass over the break between 1919 and 1921

Indexes of total employment, including nonfactory personnel employed in factories, are given for the years 1935-39 in footnotes to the various tables below. The basic data on nonfactory personnel are described in the note to Table B-4, and reasons are there given for the belief that some part of this personnel was reported as wage earners, salaried persons or proprietors in years preceding 1935. But since it is unlikely that *all* such persons were reported prior to 1935, these indexes should be considered to be *maximum* estimates of the number of all persons employed in factories in 1935-39 relative to the corresponding number employed in 1929.

The data on hours of labor worked per week by wage earners, given in Appendix C, were converted to indexes and multiplied by the corresponding indexes of wage-earner employment to obtain the indexes of manhours worked by wage earners presented below. Where two estimates of manhours are given, "Estimate A" was obtained by use of the Census and Bureau of Labor Statistics data⁴ shown in Appendix C, and "Estimate B" was obtained by use of the National Industrial Conference Board series.

The indexes of employment per unit of product and of manhours per unit were derived by division of the appropriate indexes of employment or manhours by the corresponding indexes of output.⁵ Since the indexes were originally computed to more significant figures than are published here, and then were rounded off, some apparent inconsistencies may be found, but none is serious.

The bases of the indexes following are 1929, except when no 1929 figure is given, in which case the base is 1937.⁶ The indexes for total manufacturing are on the 1899 base.

The industries are presented by groups, with the groups arranged in the order set forth in earlier appendices; total manufacturing is given at the end of the table. Within each group the industries are listed in the order most economical of space.

even though the first assumption noted would not result in absurdity. For total manufacturing we found it worth while to examine all the Census data in detail, arriving at the conclusion that the procedure followed was most satisfactory.)

⁴ If data were available from both Census and BLS sources, the former were utilized.

⁵ Estimates of manhours per unit obtained from special studies are identified by footnotes describing the sources of these estimates.

⁶ These are the "comparison bases." The bases utilized in computing the original indexes of output are different; see *The Output of Manufacturing Industries, 1899-1937*, Appendix A.

TABLE F-1

Indexes of Output, Employment, Manhours, Employment per Unit of Product, and Manhours per Unit of Product in Manufacturing Industries

FOODS

BAKING POWDER

SHORTENINGS

Year	Output	Employment		Employment per Unit		Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*		Wage Earners	Total*	Wage Earners	Total*
1927	88	101	110	114	124	99	89	85	90	86
1929	100	100	100	100	100	100	100	100	100	100
1931	96	96	..	99	..	100	123	..	124	..
1933	74	89	91	122	123	98	122	119	125	121
1935	73	89	92	122	126	134	162	156	120	116
1937	63	79	80	125	126	148	164	162	111	110
1939	69	78	78	112	112	148	156	150	106	102

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
<i>Baking powder</i>	Employment	103	84	110
	Employment per unit	142	133	159
<i>Shortenings</i>	Employment	168	167	170
	Employment per unit	125	113	115

BAKERY PRODUCTS^a

Year	Output	Employment		Employment per Unit		Man-hours Wage	Manhours per Unit Wage Earners (ESTIMATE A)
		Wage Earners	Total*	Wage Earners	Total*		
1923	77	81	83	106	108	..	..
1925	80	80	81	100	102	..	..
1927	90	86	86	95	96	..	..
1929	100	100	100	100	100	..	..
1931	91	91	..	101	..	..	..
1933	74	91	89	122	119	..	..
1935	88	109	103	124	116	87	96
1937	97	119	115	122	118	100	100
1939	102	115	110	113	108	94	91

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	117	120	124
Employment per unit	133	123	122

^a Combination of *bread and cake* and *biscuits and crackers*. Data on hours are not available for these separately.

BISCUITS and CRACKERS^a

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1923	81	104	103	127	126
1925	86	96	95	112	111
1927	91	97	97	107	106
1929	100	100	100	100	100
1931	86	84	..	98	..
1933	78	80	77	103	99
1935	96	86	83	90	87
1937	106	85	83	80	78
1939	113	86	82	76	73

BREAD and CAKE^a

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1923	75	76	79	102	105
1925	78	77	78	98	101
1927	90	83	85	93	94
1929	100	100	100	100	100
1931	92	93	..	101	..
1933	74	93	91	126	123
1935	86	113	106	131	123
1937	96	126	121	132	127
1939	99	121	115	122	116

^a Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
<i>Biscuits and crackers</i>	Employment	93	..	93
	Employment per unit	98	..	83
<i>Bread and cake</i>	Employment	122	..	130
	Employment per unit	141	..	131

^a For indexes of manhours and manhours per unit see the combination *bakery products*.

CANE-SUGAR REFINING^a

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit ^b
		Wage Earners	Total*	Wage Earners	Total*		
1909	55	68	65	123	118	107	173
1914	66	81	79	123	120	..	..
1919	79	131	131	165	166	..	..
1921	74	111	112	150	151	..	..
1923	87	110	110	127	127	..	..
1925	106	104	104	98	99	..	..
1927	100	101	101	100	100	..	..
1929	100	100	100	100	100	..	..
1931	87	85	..	98	..	..	..
1933	77	83	82	107	106	92	106
1935	83	99	97	120	118	95	103
1937	89	101	100	113	113	100	100
1939	83	102	101	123	122	95	102

^a Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	98	104	107
Employment per unit	119	117	130

^a For indexes back to 1899 see the combination *cane sugar, total*.

BEET SUGAR

Year ^a	Output	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit	Wage Earners	hours per Unit ^b	Wage Earners
						(ESTIMATE A)		(ESTIMATE B)	
1899	6	26	..	392	..	..	..	..	..
1904	23	53	51	234	227	..	..	..	..
1909	45	96	91	212	200	109	289	..	..
1914	68	107	104	156	152	..	..	..	..
1919	67	157	154	233	228	..	..	..	205
1921	96	181	174	189	180	..	..	..	133
1923	68	101	104	147	152	..	..	..	138
1925	100	118	116	118	116	..	..	..	135
1927	84	99	99	118	118	..	..	..	104
1929	100	100	100	100	100	..	..	..	100
1931	107	83	..	78	..	..	..	..	82
1933	151	143	133	94	88	130	102	..	77
1935	111	123	121	111	108	98	106	..	80
1937	120	125	122	104	102	100	100	..	..
1939	149	139	133	93	89	108	87	..	..

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	121	128	138
Employment per unit	109	107	92

^a Crop years; see Appendix B-1, FOODS, footnote 1.

^b Derived from a series on "manhours per 100-pound bag of sugar produced," R. K. Adamson and M. E. West, *Productivity and Employment in Selected Industries: Beet Sugar* (National Research Project in cooperation with National Bureau of Economic Research, Philadelphia, 1938), p. 79. The data are based on a field study of 31 factories.

CONFECTIONERY

Year	Output	Employment		Employment per Unit		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit	Wage Earners
						(ESTIMATE A)	
1925	91	100	102	110	112	..	..
1927	94	99	101	106	107	..	..
1929	100	100	100	100	100	..	..
1931	80	81	..	101	..	..	..
1933	79	80	78	101	99	89	125
1935	100	82	80	82	79	91	100
1937	111	85	81	76	73	100	100
1939	113	78	75	69	66	90	88

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	86	87	84
Employment per unit	86	78	74

CANE SUGAR, not elsewhere made*

CORN PRODUCTS

Year	Output	Employment		Employment per Unit		Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*		Wage Earners	Total*	Wage Earners	Total*
1909	168	177	193	106	115	47	71	71	152	151
1914	132	156	165	118	125	50	67	72	133	144
1919	125	262	256	210	205	69	116	105	167	152
1921	129	117	124	91	96	57	91	86	159	151
1923	88	122	137	139	156	76	97	94	127	123
1925	69	89	92	129	134	76	96	95	127	126
1927	36	42	45	115	123	92	104	100	112	109
1929	100	100	100	100	100	100	100	100	100	100
1931	91	88	..	96	..	76	99	..	130	..
1933	125	102	101	82	81	84	113	106	135	127
1935	174	127	136	73	78	68	109	105	161	155
1937	192	182	177	95	92	84	104	99	124	117
1939	244	182	180	74	74	97	100	96	103	98

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
<i>Cane sugar, n.e.m.</i> Employment	137	178	194
Employment per unit	79	93	79
<i>Corn products</i> Employment	108	100	109
Employment per unit	159	118	112

a For indexes back to 1899 see the combination *cane sugar, total*. For this industry, years refer to crop years; see Appendix B-1, FOODS, footnote l.

ICE CREAM

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1923	77	103	98	135	128	..	..
1925	84	103	100	123	119	..	..
1927	88	98	98	112	112	..	..
1929	100	100	100	100	100	..	..
1931	83	80	..	96	..	..	..
1933	60	64	71	106	117	76	139
1935	82	77	77	95	94	88	117
1937	109	83	84	76	77	100	100
1939	116	70	70	60	61	81	76

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	105	112	120
Employment per unit	129	103	103

CANE SUGAR, TOTAL^aBUTTER, CHEESE and CANNED MILK^b

Year	Output	Employment		Employment per Unit		Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*		Wage Earners	Total*	Wage Earners	Total*
1899	52	87	..	168	..	20	43	..	213	..
1909	67	83	84	124	125	33	62	70	190	213
1919	84	150	150	179	179	70	119	110	171	158
1929	100	100	100	100	100	100	100	100	100	100
1937	96	112	112	117	116	114	111	107	98	94
1939	93	113	113	121	121	126	110	108	87	86

* Excludes nonfactory personnel, 1937-39. The following indexes (1929:100) cover all personnel:

	1937	1939
<i>Cane sugar, total</i>		
Employment	115	120
Employment per unit	119	129
<i>Butter, cheese and canned milk</i>		
Employment	133	124
Employment per unit	117	98

^a Combination of two industries, *cane sugar, n.e.m.* and *cane-sugar refining*. Data for 1899 are not available for these separately.

^b Combination of three industries. Data for 1899 are not available for these separately.

BUTTER^a

Year	Output	Employment		Employment per Unit		Man-hours Wage	Manhours per Unit Wage Earners (ESTIMATE A)
		Wage Earners	Total*	Wage Earners	Total*		
1904	33	50	56	153	172	..	..
1909	40	60	68	152	170	..	..
1914	50	74	75	147	150	..	..
1919	60	92	92	154	153	..	..
1921	72	97	94	135	132	..	..
1923	84	106	104	126	124	..	..
1925	92	93	92	102	101	..	..
1927	97	105	104	108	107	..	..
1929	100	100	100	100	100	..	..
1931	102	82	..	80	..	..	..
1933	110	86	81	79	74	..	..
1935	104	97	93	92	89	..	..
1937	105	102	98	97	94	100	100
1939	115	94	94	82	82	90	82

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	119	127	113
Employment per unit	114	121	98

^a For indexes back to 1899 see the combination *butter, cheese and canned milk*.

CHEESE^a

MILK, CANNED^a

Year	Output	Employment		Employment per Unit		Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*		Wage Earners	Total*	Wage Earners	Total*
1904	56	77	92	138	164	11	48	37	438	335
1909	55	79	108	143	195	18	59	49	329	273
1914	66	85	85	128	129	36	85	75	237	210
1919	86	116	105	135	122	84	194	163	230	193
1921	77	103	95	133	123	69	134	121	194	176
1923	101	126	115	125	114	73	117	112	161	154
1925	100	100	96	100	96	76	101	98	132	129
1927	97	103	97	107	100	88	105	103	120	117
1929	100	100	100	100	100	100	100	100	100	100
1931	92	87	..	95	..	100	87	..	87	..
1933 ^b	95	92	76	98	80	98	90	87	91	89
1935	126	128	92	101	73	115	120	116	104	101
1937	129	132	118	102	92	128	127	127	99	99
1939	147	147	140	100	95	144	137	134	95	92

^a Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
Cheese	Employment	107	138	147
	Employment per unit	84	107	100
Milk, canned	Employment	122	146	146
	Employment per unit	106	114	101

^a For indexes back to 1899 see the combination *butter, cheese and canned milk*.

^b The 1933 Census of the *cheese* industry is considered by the Bureau of the Census to be somewhat incomplete.

CEREALS

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1925	70	95	91	136	130	..	..
1927	80	93	88	116	110	..	..
1929	100	100	100	100	100	..	..
1931	100	108	..	108	..	..	..
1933	79	110	101	139	128	83	81
1935	70	122	113	175	162	88	98
1937	77	125	114	162	148	100	100
1939	74	120	109	163	147	91	95

^a Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	118	115	115
Employment per unit	170	149	156

FRUITS and VEGETABLES, CANNED^a

ICE

Year	Output	Employment		Employment per Unit		Output	Employment ^o		Employment ^o per Unit	
		Wage Earners	Total*	Wage Earners	Total*		Wage Earners	Total*	Wage Earners	Total*
1899	17	44	..	262	..	9.8	21	..	217	..
1904 ^b	24	48	49	205	206	17	31	32	187	193
1909	29	50	52	174	184	30	49	51	167	172
1914	42	63	65	150	156	44	71	72	162	166
1919	55	77	81	141	148	60	93	94	155	157
1921	38	52	55	139	146	67	75	78	111	115
1923	67	73	75	110	112	77	83	86	108	112
1925	82	87	87	105	105	88	77	80	88	91
1927	82	82	83	100	101	88	69	74	78	84
1929	100	100	100	100	100	100	100	100	100	100
1931	91	81	..	89	..	96	78	..	82	..
1933	88	85	84	97	96	74	66	72	89	98
1935	127	118	116	92	91	72	59	68	82	94
1937	151	139	135	92	90	75	58	64	77	85
1939	159	118	116	74	73	75	49	56	66	74

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
<i>Fruits and vegetables, canned</i> Employment	119	139	121
Employment per unit	94	92	76
<i>Ice</i> Employment	90	76	95
Employment per unit	124	100	127

^a For indexes of manhours and manhours per unit see the combination *fish, fruits and vegetables, canned*.

^b Packing and shipping houses that handled dried fruits completely processed on fruit farms were included in *canned fruits and vegetables* in 1904 only.

^c Incomparabilities mar the series for *ice* because of the erroneous inclusion, in varying degree, of some wage earners employed in delivery service.

FEEDS

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1927	74	75	78	100	106	..	..
1929	100	100	100	100	100	..	..
1931	76	83	..	109	..	..	..
1933	70	86	83	123	119	57	91
1935	90	114	108	126	120	73	90
1937	111	141	135	127	122	100	100
1939	130	151	135	116	104	102	88

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	127	143	172
Employment per unit	141	128	133

FISH, CANNED*

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1904	65	62	64	94	98
1909	78	72	74	93	96
1914	73	81	84	112	115
1919	85	91	94	107	111
1921	45	58	62	131	138
1923	59	67	72	114	123
1925	73	77	79	106	108
1927	77	93	94	120	122
1929	100	100	100	100	100
1931	64	63	..	99	..
1933	69	73	74	107	108
1935	103	98	97	95	94
1937	104	134	130	129	126
1939	113	131	128	116	114

CHOCOLATE

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1904	..	..	..	..	..
1909	..	..	..	..	..
1914	..	..	..	..	..
1919	..	..	..	..	..
1921	60	106	114	177	189
1923	82	110	119	134	144
1925	90	114	120	127	134
1927	96	103	104	108	109
1929	100	100	100	100	100
1931	98	91	..	92	..
1933	105	103	103	99	98
1935	140	133	133	95	95
1937	124	118	120	96	97
1939	145	103	103	71	70

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
<i>Fish, canned</i> Employment	101	135	132
Employment per unit	98	130	117
<i>Chocolate</i> Employment	145	122	125
Employment per unit	104	98	86

* For indexes on manhours and manhours per unit see the combination *fish, fruits and vegetables, canned*.

OLEOMARGARINE, not elsewhere made

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1925	72	107	102	148	142
1927	79	98	98	124	123
1929	100	100	100	100	100
1931	71	68	..	96	..
1933	63	55	54	87	86
1935	94	77	71	81	76
1937	126	79	75	63	60
1939	112	64	59	57	53

MACARONI

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1925	..	..	..	..	..
1927	91	90	93	100	102
1929	100	100	100	100	100
1931	97	94	..	97	..
1933	..	108	106	..	..
1935	116	118	115	102	99
1937	123	127	122	104	99
1939	128	119	112	93	88

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
<i>Oleomargarine, n.e.m.</i> Employment	80	102	81
Employment per unit	85	81	72
<i>Macaroni</i> Employment	129	127	133
Employment per unit	112	104	104

FLOUR

Year	Output	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit Wage Earners (ESTIMATE A)	hours per Unit Wage Earners (ESTIMATE B)	hours per Unit Wage Earners (ESTIMATE A)	hours per Unit Wage Earners (ESTIMATE B)
1869	41	76	..	185	..	..	..	..	..
1879	60	76	..	125	..	..	..	..	..
1889	70	82	..	117	..	..	..	..	..
1899	94	119	..	127	..	..	..	..	..
1904	98	144	143	148	147	..	..	..	..
1909	102	145	158	142	155	190	159	..	144
1914	108	146	157	136	146	..	..	..	156
1919	114	168	182	148	160	..	..	..	129
1921	94	131	137	139	146	..	..	..	116
1923	106	130	134	123	126	..	..	..	110
1925	102	118	119	116	117	..	..	..	105
1927	100	111	112	111	112	..	..	..	105
1929	100	100	100	100	100	..	..	..	100
1931	91	84	..	93	..	..	..	..	91
1933	80	86	80	107	100	87	93	..	89
1935	82	98	91	119	110	90	94	..	93
1937	86	98	89	114	104	100	100	..	..
1939	92	92	82	99	89	90	83	..	..

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	101	92	97
Employment per unit	123	108	105

^a Derived from indexes in an unpublished report on "Productivity and Employment in Selected Industries: Wheat Flour" (National Research Project, in cooperation with the National Bureau of Economic Research, Philadelphia, 1938). The series is a chain of link ratios of comparable aggregates based on a sample of 5 to 34 mills (1909-29), and the usual ratio for a constant sample of 41 mills (1929-35).

FISH, FRUITS and VEGETABLES, CANNED^a

Year	Output	Employment		Employment per Unit		Man- Manhours	
		Wage Earners	Total	Wage Earners	Total	hours per Unit Wage Earners (ESTIMATE A)	hours per Unit Wage Earners (ESTIMATE A)
1909	22	38	..	170	..	56	249
1935	86	83	..	97	..	79	92
1937	100	100	..	100	..	100	100
1939	106	87	..	82	..	84	80

^a Combination of *fish, canned*, and *fruits and vegetables, canned*. Data on hours are not available for these separately.

MEAT PACKING

Year	Output	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit	Wage Earners	hours per Unit	Wage Earners
						(ESTIMATE A)		(ESTIMATE B)	
1879	26	18	..	70	..	..	..	..	..
1889	47	32	..	68	..	..	..	..	..
1899	56	56	..	100	..	..	..	..	..
1904	64	61	57	96	90	..	..	..	..
1909	72	72	70	100	96	73	101	..	..
1914	71	81	79	114	112	..	..	89	125
1919	93	131	129	141	138	..	..	..	..
1921	77	96	98	123	127	..	..	88	114
1923	97	108	109	112	112	105	109	106	110
1925	92	98	99	106	108	98	106	96	104
1927	95	97	98	102	103	98	103	96	101
1929	100	100	100	100	100	100	100	100	100
1931	94	87	..	92	..	85	90	84	89
1933	95	92	92	97	96	75	78	82	86
1935	85	95	95	112	112	71	83	76	90
1937	94	104	104	111	111	78	84	82	87
1939	104	98	95	95	91	73	70	78	75

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	103	110	116
Employment per unit	121	117	112

SAUSAGE, not elsewhere made

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1929	100	100	100	100	100
1931	108	106	..	98	..
1933	..	132	128	..	..
1935	154	155	146	101	95
1937	182	173	161	95	88
1939	203	170	158	84	78

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	172	171	200
Employment per unit	112	94	99

RICE

Year	Output	Employment Wage		Employment per Unit Wage	
		Earners	Total*	Earners	Total*
1899	21	41	..	198	..
1904	51	94	91	183	178
1909	52	78	83	150	159
1914	55	79	81	143	147
1919	88	133	151	151	171
1921	94	122	125	131	133
1923	95	111	112	117	118
1925	76	82	88	107	115
1927	100	96	101	96	101
1929	100	100	100	100	100
1931	102	95	..	93	..
1933	90	103	96	115	107
1935	96	127	123	133	129
1937	106	140	131	132	124
1939	121	148	138	122	115

TOTAL FOODS

Year	Output	Employment Wage		Employment per Unit Wage	
		Earners	Total*	Earners	Total*
1899	30	44	..	145	..
1904	37	52	53	140	143
1909	45	61	65	135	145
1914	53	72	76	136	144
1919	65	99	105	153	161
1921	64	83	86	129	134
1923	80	91	93	114	116
1925	85	90	91	106	107
1927	90	91	92	101	102
1929	100	100	100	100	100
1931	91	86	..	95	..
1933	82	88	86	107	105
1935	92	102	99	110	107
1937	104	112	109	108	104
1939	111	105	101	95	91

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
<i>Rice</i>	Employment	128	131	152
	Employment per unit	133	124	125
<i>Total foods</i>	Employment	111	116	118
	Employment per unit	120	111	106

BEVERAGES

MALT

Year	Output	Employment Wage		Employment per Unit Wage	
		Earners	Total*	Earners	Total*
1925	83	96	94	116	113
1927	80	85	85	105	105
1929	100	100	100	100	100
1931	89	92	..	103	..
1933	125	144	142	115	113
1935	213	244	232	114	109
1937	245	279	265	114	108
1939	235	247	235	105	100

BEVERAGES, NONALCOHOLIC*

Year	Output	Employment Wage		Employment per Unit Wage	
		Earners	Total*	Earners	Total*
1925	..	..	..	..	..
1927	..	..	..	..	..
1929	..	..	..	..	..
1931	66	85	..	129	..
1933	35	54	58	153	164
1935	52	60	65	116	126
1937	100	100	100	100	100
1939	142	76	86	53	60

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
<i>Malt</i>	Employment	244	289	257
	Employment per unit	115	118	109
<i>Beverages, nonalcoholic</i>	Employment	73	100	137
	Employment per unit	140	100	96

* For indexes of manhours and manhours per unit back to 1933 see the combination *beverages and malt liquors*.

LIQUORS, MALT^a

Year	Output ^b	Employment		Employment per Unit		Man-hours Wage Earners (ESTIMATE A)	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1899	62	84	..	134	..	..	..
1904	82	102	101	125	123	..	..
1909	96	116	116	121	121	..	..
1914	112	132	131	117	117	..	..
1919	47	73	74	155	158	..	..
1921	16	..	40	..	256	..	..
1923	9.0	..	..	..	..	..	..
1925	8.7	..	..	..	..	..	..
1927	7.4	..	..	..	..	..	..
1929	6.6	..	..	..	..	..	..
1931	5.3	..	..	..	..	..	..
1933	19	50	53	266	282	..	..
1935	77	83	83	108	108	..	..
1937	100	100	100	100	100	100	100
1939	95	77	73	80	76	78	82

* Excludes nonfactory personnel, 1935-39. The following indexes (1937:100) cover all personnel:

	1935	1937	1939
Employment	91	100	104
Employment per unit	118	100	109

^a For indexes of manhours and manhours per unit back to 1933 see the combination *beverages and malt liquors*.

^b The output series for 1899-1937 are based on data compiled by the Bureau of Internal Revenue and cover fiscal years ending June 30.

LIQUORS, DISTILLED

Year	Output ^a	Employment		Employment per Unit		Man-hours Wage Earners (ESTIMATE A)	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1899	2,574	251	..	9.7	..	..	..
1904	2,892	361	390	12	13	..	..
1909	3,356	433	449	13	13	94	301
1914	4,257	424	449	10	11	..	..
1919	108	93	94	86	87	..	..
1921	117	77	77	66	66	..	..
1923	92	72	81	78	89	..	..
1925	55	94	94	171	171	..	..
1927	48	80	80	167	168	..	..
1929	100	100	100	100	100	..	..
1931	94	67	..	71	..	..	..
1933 ^b	322	169	173	53	54	..	..
1935	6,986	831	769	12	11	..	..
1937	10,696	634	600	5.9	5.6	100	100
1939	6,803	417	409	6.1	6.0	64	101

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	796	761	460
Employment per unit	11	7.1	6.8

^a The output series for 1899-1937 are based on data compiled by the Bureau of Internal Revenue and cover fiscal years ending June 30.

^b The 1933 Census of this industry is considered by the Bureau of the Census to be somewhat incomplete.

BEVERAGES and MALT LIQUORS^a

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1933	23	51	55	227	242	53	234
1935	69	75	76	109	111	72	105
1937	100	100	100	100	100	100	100
1939	110	76	78	70	71	74	67

* Excludes nonfactory personnel, 1935-39. The following indexes (1937:100) cover all personnel:

	1935	1937	1939
Employment	83	100	118
Employment per unit	121	100	107

^a Combination of *beverages, nonalcoholic, and liquors, malt*. Data on hours are not available for these separately.

LIQUORS, VINOUS

Year	Output ^a	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1899	..	..	..	..	..
1904	..	..	..	..	..
1909	..	..	..	..	..
1914	..	..	..	..	..
1919	..	..	..	..	..
1921	..	..	..	..	..
1923	123	277	264	226	215
1925	32	142	145	447	454
1927	39	81	95	208	246
1929	100	100	100	100	100
1931	58	52	..	88	..
1933	165	678	744	412	452
1935	809	1,255	1,318	155	163
1937	1,075	1,616	1,615	150	150
1939	2,038	1,105	1,160	54	57

TOTAL BEVERAGES

Year	Output ^b	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1899	143	..
1904	74	140	135
1909	86	138	136
1914	97	131	129
1919	64	268	278
1921	44	..	..
1923	40	..	..
1925	37	..	..
1927	37	..	..
1929	39	..	..
1931	29	..	..
1933	53	292	312
1935	80	112	114
1937	100	100	100
1939	77	70	72

* Excludes nonfactory personnel, 1935-39. The following indexes (on the 1929 base for *liquors, vinous*, and the 1937 base for *total beverages*) cover all personnel:

	1935	1937	1939
<i>Liquors, vinous</i> Employment	1,517	1,661	1,459
Employment per unit	187	154	72
<i>Total beverages</i> Employment	85	100	111
Employment per unit	121	100	104

^a The output series are based on data compiled by the Bureau of Internal Revenue and cover fiscal years ending June 30.

^b The output series in large part are based on data compiled by the Bureau of Internal Revenue and cover fiscal years ending June 30.

TOBACCO PRODUCTS

CHEWING and SMOKING TOBACCO

Year	Output ^a	Employment		Employment per Unit		Man-hours Wage Earners (ESTIMATE A)	Manhours per Unit ^b
		Wage Earners	Total*	Wage Earners	Total*		
1899	89	269	..	304	..	..	..
1904	106	222	211	208	198	..	..
1909	130	251	..	194	..	..	..
1914	133	240	254	181	192	..	..
1919	128	169	179	133	140	..	..
1921	116	154	161	132	139	..	..
1923	124	151	157	121	126	..	..
1925	124	139	141	112	113	..	..
1927	114	121	121	107	107	..	..
1929	100	100	100	100	100	..	..
1931	96	106	..	111	..	..	..
1933	81	95	91	116	112	100	102
1935	82	93	93	113	113	97	98
1937	83	94	95	113	114	100	100
1939	76	85	86	113	113	90	99

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	103	96	92
Employment per unit	125	115	122

^b For 1909 indexes see the group total, *tobacco products*.

CIGARETTES

Year	Output	Employment		Employment per Unit		Man-hours Wage Earners (ESTIMATE A)	Manhours per Unit ^b
		Wage Earners ^a	Total*	Wage Earners ^a	Total*		
1899	3.1	..	..	..	..	..	..
1904	2.8	21	..	743	..	..	..
1909	5.6	39	..	688	..	..	..
1914	14	55	52	403	380	..	..
1919	43	107	98	248	228	..	..
1921	42	102	95	240	224	..	..
1923	54	100	92	185	169	..	..
1925	67	..	..	..	..	..	..
1927	81	102	..	126	..	..	..
1929	100	100	100	100	100	..	..
1931	96	95	..	100	..	..	..
1933	96	107	91	112	95	80	112
1935	113	116	99	102	88	91	108
1937	134	124	105	92	78	100	100
1939	144	130	110	90	76	103	96

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	106	106	117
Employment per unit	94	79	81

^a For indexes covering all Census years 1899-1939 see the combination *cigars and cigarettes*. The output series up through 1937 are based on data compiled by the Bureau of Internal Revenue and cover fiscal years ending June 30.

^b For 1909 indexes see the group total, *tobacco products*.

CIGARS*

Year	Output	Employment		Employment per Unit		Man-hours ^b	Manhours per Unit ^b
		Wage Earners	Total*	Wage Earners	Total*		
1869	15	24	..	155	..	..	..
1879	32	49	..	154	..	..	..
1889	58	90	..	156	..	..	..
1899	80	117 ^o	..	147	..	..	..
1904	106	153	..	144	..	..	..
1909	111	154	..	138	..	..	..
1914	119	165	169	138	142	..	..
1919	112	136	138	121	123	..	..
1921	107	133	135	124	126	..	..
1923	108	129	132	120	123	..	..
1925	100	..	..	..	..	..	..
1927	100	112	..	112	..	..	..
1929	100	100	100	100	100	100	100
1931	82	81	..	99	..	..	..
1933	66	80	77	121	118	58	88
1935	70	67	66	95	94	45	64
1937	80	66	66	83	83	48	60
1939	78	60	60	78	77	41	53

CIGARS and CIGARETTES*

Year	Output	Employment		Employment per Unit		Man-hours ^b	Manhours per Unit ^b
		Wage Earners	Total*	Wage Earners	Total*		
1899	22	97	..	438	..	..	..
1904	28	127	129	447	456	..	..
1909	32	131	..	408	..	..	..
1914	41	143	143	345	345	..	..
1919	61	130	129	212	211	..	..
1921	59	127	126	214	212	..	..
1923	68	123	123	183	182	..	..
1925	75	111	110	148	147	..	..
1927	86	110	111	128	129	..	..
1929	100	100	100	100	100	..	..
1931	92	84	..	91	..	..	..
1933	89	85	80	96	91	108	149
1935	104	76	73	74	71	93	110
1937	122	78	75	64	61	100	100
1939	128	74	71	58	56	92	88

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
Cigars	Employment	67	67	61
	Employment per unit	96	84	78
Cigars and cigarettes	Employment	76	75	74
	Employment per unit	73	62	58

^a *Cigars and cigarettes* is a combination of two industries; separate data for these are not available for all years. The output series up through 1937 are based on Bureau of Internal Revenue data and cover fiscal years ending June 30.

^b For 1909 indexes see the group total, *tobacco products*.

^o The 1899 figure for cigar employment is based on the corresponding figure for *cigars and cigarettes* combined. Cigarettes were of very slight importance in that year.

TOTAL TOBACCO PRODUCTS

Year	Output ^a	Employment		Employment per Unit		Man-hours Wage	Manhours per Unit Earners (ESTIMATE A)
		Earners	Total*	Earners	Total*		
1899	30	113	..	378	..	..	..
1904	37	135	137	362	366	..	..
1909	43	142	144	326	332	254	686
1914	53	152	154	288	292	..	..
1919	69	133	134	193	193	..	..
1921	66	129	129	196	195	..	..
1923	74	126	126	171	171	..	..
1925	81	114	113	140	139	..	..
1927	90	111	112	124	125	..	..
1929	100	100	100	100	100	..	..
1931	93	86	..	93	..	..	..
1933	88	86	81	98	93	106	142
1935	101	78	75	77	75	94	109
1937	117	79	77	68	66	100	100
1939	120	75	73	63	60	91	89

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	78	77	76
Employment per unit	78	66	63

^a The output series up through 1937 are based on data compiled by the Bureau of Internal Revenue and cover fiscal years ending June 30.

TEXTILE PRODUCTS

ARTIFICIAL LEATHER^a

Year	Output	Employment		Employment per Unit	
		Earners	Total*	Earners	Total*
1923	102	95	100	94	99
1925	109	103	98	95	90
1927	104	105	104	101	100
1929	100	100	100	100	100
1931	59	75	..	128	..
1933	..	75	73	..	..
1935	91	87	85	96	94
1937 ^b	118	98	93	83	79
1939	..	..	..	..	..

OILCLOTH and ARTIFICIAL LEATHER^c

Year	Output	Employment		Employment per Unit	
		Earners	Total	Earners	Total
1923	84	92	..	109	..
1925	..	..	..	..	..
1927	..	..	..	..	..
1929	100	100	..	100	..
1931	..	..	..	..	..
1933	..	..	..	..	..
1935	..	..	..	..	..
1937 ^b	96	97	..	101	..
1939	116	99	..	86	..

* Excludes nonfactory personnel, 1935-37. The following indexes (1929:100) cover all personnel:

	1935	1937
Employment	..	94
Employment per unit	..	80

^a For 1939 figures see the combination *oilcloth and artificial leather*.

^b The data for *artificial leather* are based on figures given in the 1937 Census report. Slightly revised 1937 figures are given in the 1939 report for *oilcloth and artificial leather* in combination.

^c Combination of two industries. Data for 1939 not available separately.

OILCLOTH^aLINOLEUM and
ASPHALTED-FELT-BASE
FLOOR COVERING^o

Year	Output	Employment		Employment per Unit		Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*		Wage Earners	Total	Wage Earners	Total
1904	36	37	34	104	94	..	..	..	..	..
1909	62	69	65	111	105	..	..	..	..	..
1914	61	87	86	142	141	..	..	..	..	..
1919	38	80	79	210	208	55	69	..	125	..
1921	46	67	73	146	159	..	..	..	..	..
1923	61	85	82	139	134	..	..	..	..	..
1925	66	82	81	124	122	..	..	..	..	..
1927	79	76	76	96	96	..	..	..	..	..
1929	100	100	100	100	100	100	100	..	100	..
1931	77	87	..	113	..	..	..	..	..	..
1933	..	89	87	..	..	..	..	..	..	..
1935	76	99	97	129	127	..	..	..	..	..
1937 ^b	66	90	90	137	137	104	103	..	99	..
1939	..	..	..	..	..	106	89	..	84	..

* Excludes nonfactory personnel, 1935-37. The following indexes (1929:100) cover all personnel:

	1935	1937
Employment	..	91
Employment per unit	..	139

^a For 1939 figures see the combination *oilcloth and artificial leather*.

^b The data for *oilcloth* are based on figures given in the 1937 Census report. Slightly revised 1937 figures are given in the 1939 report for *oilcloth* and *artificial leather* in combination.

^o Combination of two industries. Separate data for 1919 and 1939 are not available.

CLOTHING, MEN'S^a

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1927	96	99	101	103	105	103	107
1929	100	100	100	100	100	100	100
1931	75	82	..	110	..	80	106
1933	79	93	91	117	115	82	103
1935	100	114	111	113	110	92	91
1937	99	120	116	122	118	102	103
1939	116	124	119	107	102	111	96

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	114	117	123
Employment per unit	114	119	106

^a Includes *clothing, men's, work; clothing, men's, n.e.c.; clothing, men's, buttonholes; and cloth sponging and refinishing*.

ASPHALTED-FELT-BASE
FLOOR COVERING^a

LINOLEUM^a

Year	Output	Employment		Employment per Unit		Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*		Wage Earners	Total*	Wage Earners	Total*
1921	24	35	36	144	147	82	88	78	107	96
1923	56	72	56	127	98	99	113	106	114	108
1925	74	105	99	142	134	86	88	79	102	91
1927	105	104	103	99	98	92	97	89	106	97
1929	100	100	100	100	100	100	100	100	100	100
1931	78	83	..	106	..	45	52	..	115	..
1933	84	97	89	115	106	42	51	44	120	104
1935	113	115	107	102	94	60	67	57	111	95
1937	144	140	129	97	90	83	87	76	105	92

* Excludes nonfactory personnel, 1935-37. The following indexes (1929:100) cover all personnel:

		1935	1937
Asphalted-felt-base floor covering	Employment	..	130
	Employment per unit	..	90
Linoleum	Employment	..	76
	Employment per unit	..	92

^a For 1919 and 1939 indexes see the combination *linoleum and asphalted-felt-base floor covering*.

CARPETS and RUGS, WOOL

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1899	61	87	..	144	..	..	..
1904	65	102	98	156	150	..	..
1909	78	102	99	130	126	172	204
1914	71	96	94	135	133	..	..
1919	62	70	69	114	112	..	..
1921	59	70	69	119	116	..	..
1923	101	108	105	107	104	..	..
1925	96	104	102	109	107	..	..
1927	89	101	99	113	111	..	..
1929	100	100	100	100	100	..	..
1931	63	70	..	112	..	..	..
1933	61	65	65	108	107	73	112
1935	86	85	85	99	99	97	104
1937	92	94	94	102	102	100	100
1939	91	80	81	87	89	89	90

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	85	195	84
Employment per unit	100	102	92

CORDAGE and TWINE

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1899	67	90	..	136	..
1904	..	101	97	..	..
1909	82	101	98	123	119
1914	98	109	106	111	108
1919	93	122	121	131	130
1921	75	101	101	134	135
1923	96	113	113	118	117
1925	95	106	106	112	112
1927	95	104	104	110	110
1929	100	100	100	100	100
1931	69	77	..	112	..
1933	71	77	77	109	109
1935	72	85	85	117	117
1937	92	97	96	105	104
1939	93	83	83	90	90

JUTE GOODS

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1899	61	91	..	149	..
1904	..	123	117	..	..
1909	109	135	130	124	119
1914	138	162	156	117	113
1919	117	145	142	124	122
1921	77	115	113	148	146
1923	104	123	121	118	116
1925	105	128	127	122	121
1927	97	109	108	112	111
1929	100	100	100	100	100
1931	79	77	..	97	..
1933	89	86	86	96	96
1935	100	93	94	93	94
1937	143	132	131	92	91
1939	100	75	77	75	77

* Excludes nonfactory personnel: 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
<i>Cordage and twine</i>	Employment	86	96	86
	Employment per unit	118	105	93
<i>Jute goods</i>	Employment	94	132	78
	Employment per unit	94	92	78

HATS, STRAW, MEN'S

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1927	122	97	99	79	81
1929	100	100	100	100	100
1931	99	84	..	84	..
1933	..	93	91	..	..
1935	143	86	86	60	60
1937 ^a	158	89	89	56	56
1939	117	79	78	67	66

HATS, CLOTH

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1927	97	108	110	112	114
1929	100	100	100	100	100
1931	59	59	..	100	..
1933	..	70	68	..	..
1935	71	65	64	91	89
1937 ^a	53	59	57	112	108
1939	..	..	..	..	..

* Excludes nonfactory personnel, 1935-39. The following figures (1929:100) cover all personnel:

		1935	1937	1939
<i>Hats, straw, men's</i>	Employment	96	91	86
	Employment per unit	67	57	73
<i>Hats, cloth</i>	Employment	70	58	..
	Employment per unit	98	109	..

^a The 1937 Census of *hats, cloth* is considered by the Bureau of the Census to be somewhat incomplete.

HATS, FUR-FELT

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1899	79	114	..	144	..	..	..
1904	106	133	129	126	122	..	..
1909	126	151	148	120	118	239	190
1914	91	129	125	142	138	..	..
1919	94	112	111	118	118	..	..
1921	81	84	84	104	104	..	..
1923	93	101	102	108	109	..	..
1925	86	92	92	106	106	..	..
1927	104	96	96	92	92	..	..
1929	100	100	100	100	100	..	..
1931	78	85	..	110	..	..	..
1933	..	76	74	..	..	..	..
1935	94	89	87	94	93	89	94
1937	100	96	93	96	93	100	100
1939	108	89	88	82	81	90	83

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	91	93	91
Employment per unit	96	93	84

GLOVES, TEXTILE, not elsewhere made

HANDKERCHIEFS

Year	Output	Employment		Employment per Unit		Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*		Wage Earners	Total*	Wage Earners	Total*
1927	104	111	109	107	105	99	111	112	111	113
1929	100	100	100	100	100	100	100	100	100	100
1931	67	77	..	115	..	75	79	..	105	..
1933	..	93	91	..	..	..	78	78	..	..
1935 ^a	61	87	85	142	140	78	81	81	104	104
1937	97	137	132	141	136	86	83	82	97	96
1939	96	133	131	138	136	90	80	79	89	88

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
<i>Gloves, textile, n.e.m.</i> Employment	87	133	134
Employment per unit	143	137	140
<i>Handkerchiefs</i> Employment	85	83	84
Employment per unit	109	96	93

^a The 1935 figures for *handkerchiefs* are considered by the Bureau of the Census to be roughly but not exactly comparable with those for other years because some leading manufacturers reported unsatisfactorily the detailed breakdown of their 1935 output.

HATS, WOOL-FELT

WOOL SHODDY

Year	Output	Employment		Employment per Unit		Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*		Wage Earners	Total	Wage Earners	Total
1879	236	201	..	85	..	..	..	..	..	..
1889	165	132	..	80	..	52	99	..	191	..
1899	135	104	..	77	..	55	103	..	188	..
1904	68	74	71	109	106	75	111	108	149	144
1909	101	98	95	97	94	68	109	105	160	155
1914	64	61	61	95	96	82	121	116	147	140
1919	79	71	74	90	93	98	145	143	148	146
1921	50	70	71	142	142	46	66	70	143	151
1923	72	96	99	133	138	100	121	118	121	119
1925	73	91	93	126	127	110	126	123	114	112
1927	87	104	101	120	116	71	95	95	134	133
1929	100	100	100	100	100	100	100	100	100	100
1931	84	76	..	91	..	59	61	..	103	..
1933	..	80	77	..	..	87	87	84	100	97
1935	185	148	142	80	77	..	..	..	..	..
1937	256	199	194	78	76	..	..	..	..	..
1939	308	218	214	71	69	..	..	..	..	..

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	142	195	216
Employment per unit	77	76	70

CLOTHING, WOMEN'S, not elsewhere classified

Year	Output	Employment		Employment per Unit		Man-hours Wage Earners (ESTIMATE A)	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1927	84	82	84	98	100	..	..
1929	100	100	100	100	100	..	..
1931	103	93	..	90	..	..	..
1933*	91	85	82	94	90	..	..
1935	109	118	111	108	102	91	105
1937*	125	130	121	104	97	100	100
1939	142	150	138	106	97	123	108

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	117	122	146
Employment per unit	108	98	103

* The 1933 and 1937 Censuses of this industry are reported by the Bureau of the Census to be somewhat incomplete.

COTTON GOODS

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1869	12	29	..	233	..	..	..
1879	22	38	..	173	..	..	..
1889	32	48	..	147	..	..	..
1899	49	70	..	143	..	..	..
1904	54	73	72	137	135	..	..
1909	68	87	86	129	128	102	152
1914	73	89	88	123	121	..	..
1919	78	101	101	130	130	..	..
1921	70	97	97	140	139	..	..
1923	93	111	110	119	118	113	121
1925	93	105	104	113	112	101	109
1927	104	110	110	106	105	117	112
1929	100	100	100	100	100	100	100
1931	78	78	..	100	..	75	96
1933	87	89	89	102	102	79	90
1935 ^a	78	87	87	111	111	64	82
1937	99	99	99	100	100	77	78
1939	106	91	91	86	86	72	68

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	88	99	92
Employment per unit	112	100	87

^a The 1935 figures are considered by the Bureau of the Census to be roughly but not exactly comparable with those for earlier years. See Appendix B-1, TEXTILE PRODUCTS, footnote c.

OUTERWEAR, KNIT^a

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1923	119	143	144	120	121	..	..
1925	85	97	98	114	116	..	..
1927	84	85	86	102	103	..	..
1929	100	100	100	100	100	..	..
1931	108	90	..	83	..	..	..
1933	119	93	93	78	78	..	..
1935	142	122	120	86	85	124	103
1937	117	101	100	86	85	100	100
1939	122	93	90	76	74	94	90

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	126	100	95
Employment per unit	89	85	78

^a For indexes covering other years see *knit goods, total*.

LACE GOODS

CLOTH, KNIT^a

Year	Output	Employment		Employment per Unit		Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*		Wage Earners	Total	Wage Earners	Total
1914	74	109	106	147	143	..	..	..	..	..
1919	87	95	94	109	107	..	..	..	..	..
1921	67	93	91	139	136	..	..	..	..	..
1923	101	107	104	106	103	58	85	86	148	150
1925	90	102	101	114	113	64	76	77	119	121
1927	96	95	94	99	98	74	77	78	105	105
1929	100	100	100	100	100	100	100	100	100	100
1931	80	88	..	110	..	148	89	..	60	..
1933	..	86	85	..	..	..	..	..	..	..
1935	143	115	115	80	80	..	..	..	..	..
1937	154	118	117	77	76	..	..	..	..	..
1939	151	106	105	70	70	..	..	..	..	..

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	117	117	109
Employment per unit	82	76	72

^a For indexes covering other years see *knit goods, total*.

HOSIERY, KNIT^a

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1923	57	75	76	131	132	..	..
1925	68	80	81	118	119	..	..
1927	78	87	87	111	111	..	..
1929	100	100	100	100	100	..	..
1931	88	87	..	98	..	..	..
1933	92	91	90	99	98	87	108
1935	102	107	106	104	103	89	100
1937	115	116	115	101	100	100	100
1939	137	123	122	89	89	108	90

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	107	115	124
Employment per unit	105	101	90

^a For indexes covering other years see *knit goods, total*.

UNDERWEAR, KNIT^a

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1923	103	117	117	114	114	..	..
1925	107	116	116	109	108	..	..
1927	102	111	111	109	110	..	..
1929	100	100	100	100	100	..	..
1931	78	77	..	98	..	..	..
1933	98	87	86	88	88	98	102
1935	99	84	85	85	85	84	86
1937	102	96	96	94	94	100	100
1939	109	90	90	82	82	96	90

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	87	96	93
Employment per unit	88	94	85

^a For indexes covering other years see *knit goods, total*.

KNIT GOODS, TOTAL^a

Year	Output	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours Wage Earners (ESTIMATE A)	per Unit	hours Wage Earners (ESTIMATE B)	per Unit
1869	1.9	6.0	..	306	..	..	..	..	..
1879	3.6	12	..	328	..	..	..	..	..
1889	9.1	25	..	270	..	..	..	..	..
1899	19	40	..	210	..	..	..	..	..
1904	24	50	49	209	204	..	..	..	..
1909	33	62	61	187	183	86	301	..	..
1914	45	72	71	160	158	..	..	77	170
1919	55	83	83	149	150	..	..	..	..
1921	59	78	78	131	132	..	..	76	129
1923	75	93	94	125	126	..	..	91	121
1925	77	90	90	116	117	..	..	85	110
1927	83	91	91	110	110	..	..	90	109
1929	100	100	100	100	100	..	..	100	100
1931	92	85	..	92	..	..	..	76	82
1933	100	91	91	91	91	90	105	75	75
1935	111	105	105	95	94	93	97	76	69
1937	116	111	110	96	95	100	100	85	74
1939	132	112	111	85	84	104	91	86	65

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	107	110	114
Employment per unit	97	95	86

^a Combination of four knit goods industries, *hosiery, underwear, outerwear, and cloth*. Data are not available for these separately for all years.

SHIRTS and COLLARS, MEN'S

Year	Output	Employment		Employment per Unit		Man-hours Wage Earners (ESTIMATE A)	Manhours per Unit Wage Earners (ESTIMATE A)
		Wage Earners	Total*	Wage Earners	Total*		
1927	101	96	98	96	98	..	..
1929	100	100	100	100	100	..	..
1931	99	95	..	96	..	..	..
1933	79	88	87	110	109	..	..
1935	91	97	96	107	106	85	87
1937	93	108	106	116	115	100	100
1939	112	112	110	100	98	107	89

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	99	107	112
Employment per unit	109	115	100

WOOLEN and WORSTED GOODS^a

Year	Output	Employment		Employment per Unit		Man-hours per Unit Wage Earners (ESTIMATE A)		Man-hours per Unit Wage Earners (ESTIMATE B)	
		Wage Earners	Total*	Wage Earners	Total*	Wage Earners	Wage Earners	Wage Earners	Wage Earners
1879	49	63	..	130	..	..	..	..	..
1889	55	74	..	133	..	..	..	..	..
1899	71	86	..	120	..	..	..	..	..
1904	86	97	94	112	109	..	..	..	..
1909	103	111	108	108	105	132	128	..	..
1914	102	108	105	106	103	..	..	124	122
1919	98	113	112	116	115	..	..	..	..
1921	93	110	109	119	118	..	..	109	118
1923	120	132	130	110	109	139	116	136	113
1925	108	112	112	104	104	117	109	107	99
1927	103	105	104	102	101	108	106	102	99
1929	100	100	100	100	100	100	100	100	100
1931	81	81	..	100	..	81	100	73	90
1933	87	87	85	100	98	79	91	74	85
1935	116	110	109	95	94	92	79	89	77
1937	114	108	107	94	93	85	74	81	71
1939	116	101	101	87	87	84	72	80	69

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	110	107	102
Employment per unit	95	93	88

^a Combination of two industries, *woolen goods* and *worsted goods*. Data for all years or for hours of labor are not available for these separately.

WOOLEN GOODS^a

WORSTED GOODS^a

Year	Output	Employment		Employment per Unit		Output	Employment		Employment per Unit	
		Wage Earners	Total	Wage Earners	Total		Wage Earners	Total	Wage Earners	Total
1909	78	89	87	114	112	123	125	122	102	99
1914	83	84	82	102	99	118	124	120	105	102
1919	92	108	107	117	116	104	117	116	113	112
1921	80	96	96	121	120	105	120	119	114	114
1923	115	124	122	108	106	130	138	136	106	105
1925	112	115	113	102	101	106	111	111	104	104
1927	105	105	105	101	100	103	104	104	102	101
1929	100	100	100	100	100	100	100	100	100	100
1931	70	73	..	104	..	88	87	..	99	..

^a For indexes covering other years and for indexes of manhours and manhours per unit see the combination *woolen and worsted goods*.

SILK and RAYON GOODS

Year	Output	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit (ESTIMATE A)	hours per Unit (ESTIMATE B)	hours per Unit (ESTIMATE B)	hours per Unit (ESTIMATE B)
1879	5.0	21	..	425	..	..	..	..	..
1889	14	35	..	246	..	..	..	..	..
1899	22	50	..	227	..	..	..	..	..
1904	30	61	60	204	201	..	..	..	..
1909	40	76	75	192	189	128	438	..	..
1914	49	83	82	171	170	..	..	88	181
1919	64	97	97	152	153	..	..	..	..
1921	58	93	94	159	160	..	..	87	149
1923	73	96	98	132	134	..	..	93	128
1925	86	102	102	118	118	..	..	100	115
1927	92	98	99	107	108	..	..	94	103
1929	100	100	100	100	100	..	..	100	100
1931	92	84	..	91	..	..	..	78	84
1933	84	85	84	101	99	102	164	66	79
1935 ^a	133	96	95	73	72	106	108	65	49
1937	135	90	88	66	65	100	100	66	49
1939	175	91	90	52	51	106	82	67	38

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	96	89	91
Employment per unit	73	66	52

^a Owing to shifts in the classification of certain types of textile manufacture the Bureau of the Census believes that the 1935 figures are not comparable with those for earlier years (see Appendix B-1, TEXTILE PRODUCTS, footnote *h*). The index of output is less affected than the indexes of employment and employment per unit (see *The Output of Manufacturing Industries, 1899-1937*, p. 452, footnote *d*), but even the latter do not appear to be so seriously affected as to be worthless.

ELASTIC WOVEN GOODS,
not elsewhere made

Year	Output	Employment Wage		Employment per Unit Wage	
		Earners	Total*	Earners	Total*
1927	76	94	99	123	130
1929	100	100	100	100	100
1931	62	75	..	121	..
1933	..	60	63	..	..
1935	69	63	65	91	94
1937	63	67	66	106	106
1939	69	59	59	85	85

CORSETS

Year	Output	Employment Wage		Employment per Unit Wage	
		Earners	Total*	Earners	Total*
1927	99	101	102	102	102
1929	100	100	100	100	100
1931	111	102	..	92	..
1933	109	103	101	94	93
1935	..	114	113	..	..
1937	129	120	117	93	91
1939	..	..	..	..	..

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
<i>Elastic woven goods, n.e.m.</i> Employment	80	71	66
Employment per unit	116	112	95
<i>Corsets</i> Employment	122	119	..
Employment per unit	..	92	..

LINEN GOODS

Year	Output	Employment Wage		Employment per Unit Wage	
		Earners	Total*	Earners	Total*
1899	137	150	..	110	..
1904	..	174	163	..	..
1909	200	163	155	81	77
1914	192	162	156	85	81
1919	86	86	86	100	100
1921	72	115	114	160	158
1923	125	131	129	105	103
1925	117	119	117	102	100
1927	120	115	114	96	95
1929	100	100	100	100	100
1931	68	71	..	105	..
1933	72	73	71	101	99
1935	73	80	82	109	111
1937	77	85	84	110	109
1939	75	91	90	122	120

TOTAL TEXTILE PRODUCTS

Year	Output	Employment Wage		Employment per Unit Wage	
		Earners	Total*	Earners	Total*
1899	38	60	..	159	..
1904	48	68	..	143	..
1909	60	85	..	140	..
1914	72	88	87	122	121
1919	67	94	95	140	142
1921	64	89	89	137	138
1923	82	101	101	122	123
1925	86	96	96	111	111
1927	94	99	99	106	106
1929	100	100	100	100	100
1931	87	83	..	96	..
1933	85	86	85	101	100
1935	99	99	97	99	98
1937	106	106	104	100	98
1939	119	106	104	89	87

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
<i>Linen goods</i> Employment	82	86	91
Employment per unit	112	111	122
<i>Total textile products</i> Employment	100	104	107
Employment per unit	100	98	90

LEATHER PRODUCTS

LEATHER

Year	Output	Employment		Employment per Unit		Man-hours per Unit		Man-hours per Unit		Man-hours per Unit	
		Wage Earners	Total*	Wage Earners	Total*	Wage Earners	Wage Earners	Wage Earners	Wage Earners	Wage Earners	Wage Earners
						(ESTIMATE A)	(ESTIMATE B)	(ESTIMATE C) ^a			
1889	65	80	..	123	..	..	..	..	..	..	..
1899	70	104	..	150	..	..	..	..	..	..	..
1904	82	115	113	140	137	..	..	..	..	..	..
1909	89	125	123	140	138	175	219	..	..	..	..
1914	84	112	111	133	132	..	..	118	140	..	..
1919	104	145	145	139	139	..	..	..	..	..	..
1921	88	98	99	111	112	..	..	96	109	..	..
1923	120	120	120	99	100	..	..	120	99	..	108
1925	101	105	105	103	104	..	..	104	103	..	104
1927	106	106	106	100	100	..	..	102	96	..	101
1929	100	100	100	100	100	..	..	100	100	..	100
1931	81	84	..	104	..	..	..	80	99	..	93
1933	85	88	88	104	103	93	122	78	91	..	91
1935	104	102	101	98	98	101	109	82	79	..	86
1937	112	102	100	90	90	100	100	82	73	..	..
1939	110	95	94	86	85	93	95	77	70	..	..

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	103	101	95
Employment per unit	99	90	86

^a J. R. Arnold, "Labor Productivity in the Leather Industry," *Monthly Labor Review*, July 1937, Table 3. The data relate to a sample of companies in four major branches of the leather industry.

BELTING, LEATHER

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1927	80	83	86	104	108
1929	100	100	100	100	100
1931	46	63	..	137	..
1933	48	65	68	136	144
1935	76	91	89	119	116
1937	86	109	101	126	117
1939	76	90	83	119	110

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	101	103	92
Employment per unit	132	119	121

SHOES, LEATHER

Year	Output	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit	Wage Earners	hours per Unit	Wage Earners
						(ESTIMATE A)		(ESTIMATE B)	
1869	23	39	..	172	..	..	..	..	..
1879	35	48	..	136	..	..	..	..	..
1889	50	60	..	118	..	..	..	..	..
1899	60	69	..	115	..	..	..	..	..
1904	68	73	71	108	104	..	..	..	..
1909	78	90	89	115	113	108	137	..	..
1914	81	93	93	115	114	..	..	113	139
1919	89	103	104	115	117	..	..	..	..
1921	76	89	90	118	119	..	..	92	122
1923	93	110	110	118	119	117	127	113	122
1925	84	101	101	120	121	103	123	104	124
1927	96	99	99	102	103	102	105	101	105
1929	100	100	100	100	100	100	100	100	100
1931	84	88	..	104	..	84	100	89	105
1933	94	93	91	99	96	83	88	83	88
1935	103	98	96	95	93	80	78	82	80
1937	112	105	102	93	91	87	78	91	81
1939	116	106	103	92	89	87	75	86	75

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	98	102	105
Employment per unit	95	91	91

GLOVES, LEATHER

TOTAL LEATHER PRODUCTS

Year	Output ^a	Employment		Employment per Unit		Employment		Employment per Unit		
		Wage Earners	Total*	Wage Earners	Total*	Wage Earners	Total*	Wage Earners	Total*	
1899	76	131	..	172	..	64	78	..	123	..
1904	87	98	96	113	110	74	83	81	114	110
1909	88	105	106	119	121	83	97	97	118	117
1914	82	98	101	120	124	81	96	97	120	120
1919	94	98	103	105	110	90	109	112	122	124
1921	58	73	75	126	130	74	88	89	118	120
1923	..	92	93	..	..	95	108	109	115	115
1925	..	77	79	..	..	85	99	99	116	118
1927	91	99	101	109	111	97	99	100	102	103
1929	100	100	100	100	100	100	100	100	100	100
1931	74	86	..	116	..	80	86	..	107	..
1933	..	88	88	..	..	86	89	87	103	101
1935	102	107	104	104	102	100	98	95	98	96
1937	98	126	123	129	126	108	104	102	96	94
1939	91	109	106	120	117	110	104	101	94	92

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939	
<i>Gloves, leather</i>	Employment	109	124	110
	Employment per unit	107	126	121
<i>Total leather products</i>	Employment	98	102	103
	Employment per unit	99	94	94

^a The indexes of output for 1899-1921 are revised.

RUBBER PRODUCTS

SHOES, RUBBER^a

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1899	60 ^b	56	..	94	..	..	..
1904	..	74	..	..	..	..	..
1909	..	69	..	..	..	..	..
1914	69	73	69	106	100	..	..
1919	115	128	128	111	112	..	..
1921	91	93	93	102	102	..	..
1923	111	115	112	103	101	..	..
1925	91	97	97	107	106	..	..
1927	120	105	103	87	86	..	..
1929	100	100	100	100	100	..	..
1931	58	62	..	106	..	..	..
1933	71	71	69	99	97	..	..
1935	83	67	66	81	80	96	110
1937	95	72	71	75	74	100	100
1939	81	58	58	72	72	79	93

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	67	71	62
Employment per unit	82	75	76

^a For indexes of manhours and manhours per unit back to 1921 see the group total, *rubber products*.

^b The index for 1899 has been computed since publication of *The Output of Manufacturing Industries, 1899-1937* (National Bureau of Economic Research, 1940). The basic data are from the Census of Manufactures.

TIRES and TUBES, incl. OTHER RUBBER GOODS^a

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1919	48	102	118	212	244
1921	37	65	68	174	184
1923	67	88	89	133	134
1925	83	95	96	114	115
1927	88	93	97	106	110
1929	100	100	100	100	100
1931	71	68	..	95	..
1933	69	71	71	103	103
1935	79	79	79	100	100
1937	90	90	91	100	101
1939	98	86	86	87	87

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	82	92	92
Employment per unit	104	102	94

^a Combination of two industries. Data back to 1919 are not available for these separately. For indexes of manhours and manhours per unit back to 1921 see the group total, *rubber products*.

TIRES and TUBES^a

Year	Output	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours Wage Earners (ESTIMATE A)	per Unit	hours Wage Earners (ESTIMATE B) ^b	per Unit
1914	..	..	..	..	..	..	..	..	429
1919	..	..	..	..	..	..	..	..	..
1921	39	67	71	171	183	..	..	..	..
1923	69	89	90	129	131	..	..	..	138
1925	88	98	100	112	114	..	..	..	135
1927	91	94	99	103	109	..	..	..	109
1929	100	100	100	100	100	..	..	..	100
1931	67	59	..	88	..	..	..	..	78
1933	65	64	64	98	98	82	103	..	..
1935	72	69	68	95	95	91	102	..	..
1937	81	76	77	94	95	100	100	..	..
1939	83	65	66	78	79	94	92	..	..

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	72	78	70
Employment per unit	100	96	84

^a For indexes of output, employment and employment per unit back to 1919 see the combination *tires and tubes incl. other rubber goods*. For indexes of manhours and man-hours per unit back to 1921 see the group total, *rubber products*.

^b B. Stern, *Labor Productivity in the Automobile Tire Industry*, Bulletin No. 585 (Bureau of Labor Statistics, July 1933), p. 9. The data cover 6 large plants.

RUBBER GOODS, OTHER^a

Year	Output	Employment		Employment per Unit		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours Wage Earners (ESTIMATE A)	per Unit
1927	80	92	92	115	116	..	..
1929	100	100	100	100	100	..	..
1931	83	85	..	103	..	..	..
1933	80	88	87	109	108	72	100
1935	96	100	100	105	105	81	95
1937	112	120	118	107	106	100	100
1939	136	129	128	95	94	109	90

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	103	121	139
Employment per unit	108	109	102

^a For indexes of output, employment and employment per unit back to 1919 see the combination *tires and tubes incl. other rubber goods*. For indexes of manhours and man-hours per unit back to 1921 see the group total, *rubber products*.

TOTAL RUBBER PRODUCTS

Year	Output	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit	Wage Earners	hours per Unit	Wage Earners
						(ESTIMATE A)		(ESTIMATE B)	
1899	..	25	..	..	..	..	..	..	..
1904	..	30	28	..	..	..	..	..	..
1909	..	33	32	..	..	..	..	..	..
1914	..	50	52	..	..	..	..	55	..
1919	54	107	120	199	223	..	..	..	..
1921	43	70	72	163	170	..	..	68	160
1923	72	93	93	129	129	..	..	93	129
1925	84	95	96	113	114	..	..	94	112
1927	92	95	98	104	107	..	..	96	105
1929	100	100	100	100	100	..	..	100	100
1931	70	67	..	96	..	..	..	57	81
1933	69	71	71	103	102	..	..	52	75
1935	79	77	76	97	97	88	100	57	72
1937	91	87	87	96	96	100	100	65	71
1939	97	81	81	84	84	98	91	64	66

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	80	89	87
Employment per unit	100	98	90

PAPER PRODUCTS

PAPER^a

Year	Output	Employment		Employment per Unit		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit	Wage Earners
						(ESTIMATE A)	
1927	88	95	95	109	108	..	..
1929	100	100	100	100	100	..	..
1931	85	85	..	99	..	..	..
1933	83	84	84	102	102	78	108
1935	96	100	100	105	105	88	106
1937	115	107	106	93	92	100	100
1939	123	107	107	87	86	99	92

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	101	107	112
Employment per unit	106	93	91

^a For indexes back to 1879 see the combination *paper and pulp*.

PAPER and PULP^a

Year	Output	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit	Earners	hours per Unit	Earners
						(ESTIMATE A)		(ESTIMATE B)	
1879	4.1	18	..	434	..	..	..	..	..
1889	8.4	22	..	266	..	..	..	..	..
1899	19	39	..	200	..	..	..	..	..
1904	28	52	49	187	177	..	..	..	..
1909	36	59	57	162	155	78	255	..	..
1914	44	69	66	155	149	..	..	72	161
1919	53	89	87	168	165	..	..	..	..
1921	44	82	80	185	181	..	..	78	174
1923	66	94	93	143	141	..	..	94	142
1925	75	97	96	128	127	..	..	95	126
1927	88	96	96	110	110	..	..	95	109
1929	100	100	100	100	100	..	..	100	100
1931	86	84	..	98	..	..	..	71	83
1933	84	84	84	100	100	77	110	66	79
1935	98	99	99	102	102	87	107	75	77
1937	120	107	107	90	89	100	100	87	72
1939	128	107	107	84	84	98	92	84	66

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	101	108	113
Employment per unit	103	90	88

^a Combination of two industries. Data prior to 1927 are not available for these separately.

PULP^a

Year	Output	Employment		Employment per Unit		Man- hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
						(ESTIMATE A)	
1927	86	100	101	116	117	..	..
1929	100	100	100	100	100	..	..
1931	88	82	..	93	..	..	..
1933	89	81	82	91	92	74	117
1935	107	96	97	90	90	82	109
1937	141	109	109	77	78	100	100
1939	147	109	110	74	75	96	92

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	97	110	115
Employment per unit	91	78	78

^a For indexes back to 1879 see the combination *paper and pulp*.

WALL PAPER

TOTAL PAPER PRODUCTS

Year	Employment		Employment per Unit		Employment		Employment per Unit			
	Wage Earners	Total*	Wage Earners	Total*	Wage Earners	Total*	Wage Earners	Total*		
1899	..	..	..	..	18	40	..	218	..
1904	..	..	..	..	26	51	49	197	187
1909	..	..	..	..	37	62	60	168	162
1914	..	..	..	..	46	71	70	154	150
1919	..	..	..	..	53	90	89	170	168
1921	..	..	..	..	50	80	79	159	157
1923	..	..	..	..	70	95	94	135	134
1925	..	..	..	..	77	95	95	124	123
1927	..	..	..	..	89	95	95	107	107
1929	100	100	100	100	100	100	100	100	100	
1931	81	79	..	98	..	86	83	..	96	..
1933	77	69	70	89	90	84	82	83	97	98
1935	93	91	90	98	97	102	97	96	95	95
1937	110	97	95	88	87	122	109	107	89	88
1939	100	86	84	86	84	131	108	106	82	81

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
Wall paper	Employment	93	96	90
	Employment per unit	100	87	90
Total paper products	Employment	100	109	113
	Employment per unit	98	89	86

PRINTING AND PUBLISHING

TOTAL PRINTING and PUBLISHING

Year	Output	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit	Earners	hours per Unit	Earners
1899	17	56	..	326	..	..	..	..	..
1904	26	63	55	239	210	..	..	..	..
1909	36	74	68	208	191	77	218	..	..
1914	47	78	73	165	155	..	..	79	167
1919	54	82	79	152	147	..	..	..	..
1921	52	79	77	151	148	..	..	76	146
1923	73	86	85	117	116	87	119	85	116
1925	82	88	88	107	107	91	111	88	107
1927	90	92	93	101	102	97	108	92	102
1929	100	100	100	100	100	100	100	100	100
1931	84	89	..	106	..	84	100	82	98
1933	72	74	74	102	102	62	86	62	86
1935	87	86	84	98	97	71	81	70	80
1937	102	99	99	98	97	84	83	85	83
1939	97	91	84	95	87	76	79	76	79

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	..	101	99
Employment per unit	..	100	102

CHEMICAL PRODUCTS

CHEMICALS, INDUSTRIAL^a

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1927	74	84	83	114	112	..	..
1929	100	100	100	100	100	..	..
1931	81	78	..	96	..	..	..
1933	80	86	85	107	106	69	123
1935	105	106	106	101	101	83	112
1937	141	127	127	90	90	100	100
1939	155	116	119	75	77	92	84

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	108	129	132
Employment per unit	103	91	86

^a For indexes of output, employment and employment per unit back to 1899, see the combination, *chemicals, industrial, incl. rayon and gases*. For indexes of manhours and manhours per unit back to 1914 see the group total, *chemical products*.

CARBON BLACK

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1914	10	18	20	177	199
1919	23	35	38	154	164
1921	24	43	48	182	202
1923	47	68	78	144	166
1925	70	79	81	112	115
1927	67	81	84	121	126
1929	100	100	100	100	100
1931	75	54	..	73	..
1933	74	76	74	102	100
1935	94	95	95	101	101
1937	133	114	112	86	84
1939	140	82	83	59	60

LINSEED PRODUCTS

Output	Employment		Employment per Unit	
	Wage Earners	Total*	Wage Earners	Total*
..
..
..
83	97	94	116	113
100	99	100	99	100
95	100	103	106	109
100	100	100	100	100
67	68	..	101	..
..	60	60	..	..
63	87	88	137	139
86	97	97	113	113
73	78	80	107	110

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
<i>Carbon black</i>	Employment	96	112
	Employment per unit	101	84
<i>Linseed products</i>	Employment	88	97
	Employment per unit	139	111

CHEMICALS, INDUSTRIAL, incl. RAYON and GASES^a

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1899	6.6	17	..	253	..	..	..
1904	8.3	21	20	257	242	..	..
1909	12	25	24	198	191	27	376
1914	20	34	33	167	161	..	..
1919	36	73	75	202	206	..	..
1921	27	47	49	174	180	..	..
1923	55	74	74	135	135	..	..
1925	56	74	73	132	131	..	..
1927	70	78	78	111	111	..	..
1929	100	100	100	100	100	..	..
1931	92	86	..	94	..	..	..
1933	102	96	93	94	92	..	..
1935	130	115	114	88	87	..	..
1937	172	132	132	77	77	100	100
1939	188	119	120	63	64	89	82

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	115	134	131
Employment per unit	88	78	70

^a Combination of three industries. Data back to 1899 are not available for these separately. For indexes of manhours and manhours per unit back to 1914 see the group total, *chemical products*.

RAYON^a

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1923	28	37	..	130	..	..	..
1925	40	49	49	121	121	..	..
1927	60	67	67	111	111	..	..
1929	100	100	100	100	100	..	..
1931	138	99	..	72	..	..	..
1933	201	113	113	56	56	86	133
1935	253	129	131	51	52	92	112
1937	310	141	146	45	47	100	100
1939	346	124	130	36	37	87	78

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	131	148	134
Employment per unit	52	48	39

^a For indexes of output, employment and employment per unit back to 1899 see the combination *chemicals, industrial, incl. rayon and gases*. For indexes of manhours and manhours per unit back to 1914 see the group total, *chemical products*.

EXPLOSIVES

Year	Output	Employment		Employment per Unit		Man-hours Wage Earners (ESTIMATE A)	Manhours per Unit Earners
		Wage Earners	Total*	Wage Earners	Total*		
1889	11	39	..	354	..	..	..
1899	25	80	..	317	..	..	..
1904	45	103	85	231	189	..	..
1909	62	112	84	182	136	161	242
1914	70	112	100	160	143	..	..
1919	94	165	184	176	196	..	..
1921	61	80	83	132	136	..	..
1923	94	114	102	121	108	..	..
1925	92	101	102	110	110	..	..
1927	96	103	104	108	109	..	..
1929	100	100	100	100	100	..	..
1931	67	84	..	126	..	..	..
1933	58	74	73	129	127	68	110
1935	68	81	82	120	121	77	104
1937	93	96	96	104	104	100	100
1939	98	96	95	98	97	98	93

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	84	96	98
Employment per unit	123	104	100

GLUE and GELATIN

GASES, COMPRESSED*

Year	Output	Employment		Employment per Unit		Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*		Wage Earners	Total*	Wage Earners	Total*
1927	96	108	106	112	111	68	95	89	139	131
1929	100	100	100	100	100	100	100	100	100	100
1931	85	85	..	100	..	82	84	..	103	..
1933	..	67	71	..	..	71	82	66	115	93
1935	110	109	110	99	100	95	112	88	118	93
1937	139	118	118	85	85	138	137	96	99	69
1939	123	102	103	83	84	138	117	74	84	53

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
<i>Glue and gelatin</i> Employment	116	130	113
Employment per unit	105	94	92
<i>Gases, compressed</i> Employment	95	97	100
Employment per unit	100	70	72

° For indexes of output, employment and employment per unit back to 1899 see the combination *chemicals, industrial, incl. rayon and gases*. For indexes of manhours and man-hours per unit back to 1914 see the group total, *chemical products*.

FERTILIZERS

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1899	30	55	..	182	..	..	..
1904	37	68	62	181	166	..	..
1909	60	87	85	146	141	124	219
1914	88	109	109	123	123	..	..
1919	80	126	126	156	156	..	..
1921	60	81	83	136	139	..	..
1923	76	89	91	116	119	..	..
1925	87	94	94	108	109	..	..
1927	90	89	90	99	101	..	..
1929	100	100	100	100	100	..	..
1931	78	70	..	89	..	..	..
1933	60	62	63	103	105	62	109
1935	78	83	83	108	107	70	96
1937	106	100	97	94	92	100	100
1939	100	92	88	91	88	82	86

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	91	101	99
Employment per unit	117	95	99

PAINTS and VARNISHES

Year	Output	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours Wage Earners	per Unit (ESTIMATE A)	hours Wage Earners	per Unit (ESTIMATE B)
1899	22	33	..	149	..	..	..	..	..
1904	28	40	38	143	136	..	..	..	..
1909	38	49	50	130	134	57	165	..	..
1914	41	55	59	134	143	..	..	56	135
1919	52	74	78	141	150	..	..	..	..
1921	45	62	65	136	143	..	..	56	125
1923	67	78	80	117	119	..	..	75	112
1925	76	87	89	115	117	..	..	89	117
1927	87	96	97	110	111	..	..	94	108
1929	100	100	100	100	100	..	..	100	100
1931	69	77	..	112	..	..	..	66	96
1933	62	78	74	125	119	71	124	61	97
1935	87	95	92	108	105	85	106	73	84
1937	109	108	104	99	95	100	100	86	79
1939	107	96	88	90	82	88	89	76	71

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	105	109	110
Employment per unit	120	100	103

COTTONSEED PRODUCTS

Year ^a	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1899	51	70	..	137	..	..	..
1904	74	98	98	133	133	..	..
1909	73	108	111	147	151	128	145
1914	134	138	141	103	106	..	..
1919	111	169	168	152	151	..	..
1921	80	102	104	127	130	..	..
1923	70	81	83	116	120	..	..
1925	108	102	101	95	94	..	..
1927	121	116	114	96	94	..	..
1929	100	100	100	100	100	..	..
1931	86	78	..	90	..	..	..
1933	94	90	88	96	94	..	..
1935	66	84	83	127	126	68	86
1937	83	105	102	127	123	100	100
1939	84	96	93	114	111	78	76

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	85	103	98
Employment per unit	130	125	116

^a Reports for 1925 and earlier years relate to the 12-month period ending July 31 following the year specified, while those for 1927 and later years relate to the 12-month period ending July 31 of the year specified. It is likely, however, that some manufacturers reported on a calendar-year basis.

SOAP

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1904	46	77	72	168	157	..	..
1909	61	90	91	147	148	125	223
1914	70	99	98	140	139	..	..
1919	89	142	143	159	160	..	..
1921	79	115	114	146	144	..	..
1923	87	118	121	137	139	..	..
1925	86	107	105	124	122	..	..
1927	93	94	92	100	99	..	..
1929	100	100	100	100	100	..	..
1931	98	99	..	101	..	..	..
1933	98	100	95	102	97	105	117
1935	100	97	89	97	89	97	106
1937	109	98	92	89	85	100	100
1939	126	95	91	76	72	96	84

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	96	94	106
Employment per unit	96	87	84

SALT

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1869	12	38	..	306	..
1879	21	55	..	262	..
1889	36	56	..	155	..
1899	53	87	..	164	..
1904	57	85	83	151	146
1909	67	90	89	134	133
1914	72	93	92	129	127
1919	88	119	123	135	140
1921	71	110	110	155	156
1923	87	125	127	144	147
1925	88	116	115	132	132
1927	92	109	110	119	120
1929	100	100	100	100	100
1931	91	87	..	95	..
1933	84	92	88	110	105
1935	87	91	89	105	103
1937	97	85	82	87	85
1939	96	82	80	86	83

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	95	82	88
Employment per unit	109	85	92

WOOD DISTILLATION and
CHARCOAL MANUFACTURE^aCHARCOAL^b

Year	Output	Employment		Employment per Unit		Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*		Wage Earners	Total	Wage Earners	Total
1921	33	46	48	139	146	192	464	421	241	219
1923	..	..	..	..	..	132	174	200	132	152
1925	..	..	..	..	..	238	274	284	115	120
1927	..	..	..	..	..	144	179	183	124	127
1929	100	100	100	100	100	100	100	100	100	100
1931	..	..	..	..	..	39	64	..	163	..
1933	..	..	..	..	..	..	31	39	..	..
1935	72	82	83	113	114	46	52	57	113	125
1937	101	96	97	95	96	43	83	83	192	192
1939	109	89	91	82	84	..	..	..	..	..

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	83	102	96
Employment per unit	115	101	89

^a Combination of two industries. Data for 1939 are not available for these separately.

^b For 1939 output and employment indexes and indexes covering nonfactory personnel see the combination *wood-distillation and charcoal manufacture*.

Because this industry contains a large proportion of small establishments, the degree to which it is covered by the Census probably varies from year to year.

TANNING and DYE MATERIALS

WOOD-DISTILLATION PRODUCTS^a

Year	Output	Employment		Employment per Unit		Employment			Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*	Wage Earners	Total	Wage Earners	Total	
1899	26	68	..	263	..	28	34	..	120	..
1904	38	112	100	298	265	40	49	51	123	127
1909	54	99	95	184	177	54	59	60	109	110
1914	79	117	112	148	142	58	61	61	104	105
1919	82	179	164	220	201	75	108	109	144	146
1921	69	124	120	180	174	31	41	43	131	140
1923	95	134	130	141	137	80	88	90	109	112
1925	87	103	102	118	116	85	88	89	104	104
1927	88	100	103	113	117	92	97	97	105	106
1929	100	100	100	100	100	100	100	100	100	100
1931	78	81	..	104	..	56	57	..	102	..
1933	74	88	88	120	120	..	59	59	..	..
1935	100	110	113	109	113	73	82	83	113	114
1937	101	116	116	115	115	101	96	97	95	96
1939	124	112	112	91	91	..	..	..	..	..

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	124	122	129
Employment per unit	123	120	105

^a For 1939 output and manufacture indexes and indexes covering nonfactory personnel see the combination *wood-distillation and charcoal manufacture*.

TOTAL CHEMICAL PRODUCTS

Year	Output	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	Wage Earners	per Unit	Wage Earners	per Unit
						(ESTIMATE A)		(ESTIMATE B)	
1899	19	39	..	212	..	..	..	..	..
1904	23	49	47	215	207	..	..	..	..
1909	31	56	57	178	183	..	..	..	..
1914	42	66	69	156	161	..	..	75	176
1919	52	103	106	200	206	..	..	..	..
1921	42	69	72	165	172	..	..	68	162
1923	64	86	87	134	135	..	..	90	139
1925	70	86	86	124	124	..	..	90	129
1927	83	89	90	108	109	..	..	88	107
1929	100	100	100	100	100	..	..	100	100
1931	87	82	..	95	..	..	..	73	83
1933	84	85	83	102	98	..	..	66	79
1935	101	99	97	98	96	84	104	77	76
1937	124	113	109	91	88	100	100	89	72
1939	133	103	99	78	75	89	83	80	61

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	103	112	114
Employment per unit	102	90	86

PETROLEUM AND COAL PRODUCTS

PETROLEUM REFINING

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1879	1.7	11	..	618	..	..	..
1889	3.9	13	..	338	..	..	..
1899	5.9	15	..	256	..	..	..
1904	7.2	21	19	289	261	..	..
1909	11	17	17	157	152	18	168
1914	17	31	31	185	184	..	..
1919	34	73	74	215	217	..	..
1921	40	78	75	194	185	..	..
1923	56	83	83	149	149	..	..
1925	73	81	81	111	111	..	..
1927	81	88	88	109	109	..	..
1929	100	100	100	100	100	100	100
1931	91	85	..	94	..	77	85
1933	86	86	84	99	97	65	75
1935	99	96	98	97	98	66	67
1937	119	103	104	87	88	72	61
1939	128	90	93	71	73	64	50

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	99	109	107
Employment per unit	100	91	84

COKE-OVEN PRODUCTS

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1879	2.5	12	..	473	..
1889	9.0	34	..	379	..
1899	18	83	..	454	..
1904	23	92	84	405	371
1909	38	142	129	372	337
1914	38	103	97	272	257
1919	61	143	136	232	221
1921	43	78	79	181	183
1923	89	138	131	154	146
1925	81	113	111	139	137
1927	84	103	101	123	121
1929	100	100	100	100	100
1931	55	70	..	127	..
1933	43	64	62	148	143
1935	58	81	78	140	135
1937	87	100	97	115	111
1939	87	106	101	121	117

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	82	98	106
Employment per unit	141	113	122

FUEL BRIQUETTES

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1899	..	..	..	..	..
1904	..	..	..	..	..
1909	7.9	21	22	262	275
1914	16	33	34	214	218
1919	21	40	44	191	211
1921	29	87	90	302	313
1923	54	85	84	157	154
1925	59	58	58	98	99
1927	72	64	64	89	89
1929	100	100	100	100	100
1931	50	71	..	141	..
1933	37	69	71	188	193
1935	64	80	81	125	127
1937	79	107	102	136	130
1939	66	96	96	146	145

TOTAL PETROLEUM and COAL PRODUCTS

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1899	8.7	29	..	337	..
1904	10	35	32	347	314
1909	16	43	40	266	246
1914	21	47	46	218	213
1919	39	90	89	230	229
1921	41	79	77	194	188
1923	64	95	94	150	148
1925	75	88	88	117	117
1927	83	92	91	110	110
1929	100	100	100	100	100
1931	84	82	..	98	..
1933	78	81	79	104	101
1935	92	93	94	101	102
1937	114	103	103	91	91
1939	121	95	96	79	79

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
<i>Fuel briquettes</i>	Employment	90	102	98
	Employment per unit	141	130	149
<i>Total petroleum and coal products</i>	Employment	96	107	109
	Employment per unit	105	94	90

STONE, CLAY AND GLASS PRODUCTS

WALL PLASTER and BOARD

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1927	100	134	132	134	132
1929	100	100	100	100	100
1931	65	79	..	122	..
1933	..	59	59	..	..
1935	64	101	97	158	153
1937	112	146	138	130	124
1939	140	164	157	117	112

ASBESTOS PRODUCTS

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1927	73	78	77	108	106
1929	100	100	100	100	100
1931	68	74	..	109	..
1933	56	75	76	134	136
1935	78	119	119	153	153
1937	126	161	156	128	124
1939	..	..	..	..	..

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
<i>Wall plaster and board</i>	Employment	101	140	167
	Employment per unit	159	125	119
<i>Asbestos products</i>	Employment	124	160	..
	Employment per unit	159	127	..

LIME

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit Wage Earners (ESTIMATE A)
		Wage Earners	Total*	Wage Earners	Total*		
1904	81	129	127	160	158	..	..
1909	91	160	161	177	177	192	215
1914	95	144	144	151	152	..	..
1919	77	132	132	172	172	..	..
1921	58	121	120	208	207	..	..
1923	93	144	144	155	156	..	..
1925	102	141	142	139	139	..	..
1927	101	127	128	126	126	..	..
1929	100	100	100	100	100	..	..
1931	78	78	..	101	..	..	..
1933	..	70	70	..	..	..	..
1935	67	88	88	130	131	..	..
1937	102	114	112	112	110	100	100
1939	118	111	111	94	94	93	80

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	90	115	117
Employment per unit	134	113	99

CEMENT

Year	Output	Employment		Employment per Unit		Man-hours per Unit Wage Earners (ESTIMATE A)		Man-hours per Unit Wage Earners (ESTIMATE B)	
		Wage Earners	Total*	Wage Earners	Total*	Wage Earners	Wage Earners	Wage Earners	Wage Earners
1904	19	52	48	279	255	..	..	..	..
1909	43	80	75	185	173	162	256	..	..
1914	61	84	81	137	133	..	..	..	..
1919	57	76	77	134	135	..	..	..	..
1921	60	79	78	131	131	..	..	..	159
1923	77	105	103	136	133	..	..	..	141
1925	94	115	116	122	123	..	..	..	129
1927	100	109	111	108	110	..	..	..	110
1929	100	100	100	100	100	..	..	..	100
1931	75	73	..	98	..	..	..	..	97
1933	36	47	46	131	128	54	102	..	99
1935	44	62	60	140	136	70	108	..	104
1937	68	79	75	116	110	100	100	..	..
1939	72	71	69	99	95	89	84	..	..

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	62	77	73
Employment per unit	140	113	101

^a G. Perazich, S. T. Woal, and H. Schimmel, *Mechanization in the Cement Industry*, (National Research Project in cooperation with the National Bureau of Economic Research, Philadelphia, 1939), p. 89. The basic data were collected in a field study covering 16 to 61 percent of the industry.

CONCRETE PRODUCTS^a

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1925	75	89	86	118	114
1927	94	108	106	115	113
1929	100	100	100	100	100
1931	61	56	..	93	..
1933	25	27	29	108	117
1935	57	51	52	89	90
1937	92	78	74	85	81
1939	153	105	99	69	65

ROOFING

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1925	..	..	..	..	..
1927	..	..	..	..	..
1929	100	100	100	100	100
1931	62	68	..	111	..
1933	..	73	69	..	..
1935	83	107	99	130	120
1937	110	123	115	112	104
1939	127	134	123	105	97

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
Concrete products	Employment	55	76	110
	Employment per unit	97	83	72
Roofing	Employment	108	117	138
	Employment per unit	130	106	108

^a Because this industry contains a large proportion of small establishments, the degree to which it is covered by the Census probably varies from year to year.

CLAY PRODUCTS, not elsewhere classified

Year	Output ^a	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	Wage Earners	per Unit	Wage Earners	per Unit
						(ESTIMATE A)		(ESTIMATE B) ^b	
1914	84	107	107	127	127	..	..	..	..
1919	64	82	84	129	131	..	..	..	114
1921	57	74	75	130	132	..	..	..	109
1923	99	110	110	111	110	..	..	..	102
1925	106	110	110	104	104	..	..	..	100
1927	107	108	108	101	101	..	..	..	100
1929	100	100	100	100	100	..	..	..	100
1931	48	55	..	113	..	..	..	..	131
1933	28	34	35	122	125	40	94	..	128
1935	40	48	48	119	121	62	102	..	121
1937	66	70	69	106	105	100	100	..	..
1939	64	66	66	103	102	91	94	..	..

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	50	70	68
Employment per unit	124	106	106

^a The index for 1914-23 is slightly revised.

^b M. E. West, *Productivity and Employment in Selected Industries: Brick and Tile* (National Research Project, in cooperation with National Bureau of Economic Research, Philadelphia, 1939), p. 115. For 1919-29 the index is based on a sample of 12 to 56 plants, and is a chain of median link relatives; for 1929-35, it is a weighted mean index for 37 identical plants.

GLASS

Year	Output*	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1899	25	78	..	314	..	..	..
1904	33	95	90	285	273	..	..
1909	45	102	98	227	218	125	452
1914	64	110	106	173	167	..	..
1919	64	115	113	178	175	..	..
1921	..	81	81	..	..	..	..
1923	..	109	107	..	..	..	..
1925	84	103	102	122	122	..	..
1927	92	97	97	106	106	..	..
1929	100	100	100	100	100	..	..
1931	81	74	..	91	..	..	..
1933	78	74	74	95	96	64	133
1935	118	99	100	84	84	84	116
1937	163	117	119	72	73	100	100
1939	147	103	105	70	72	86	96

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	101	119	108
Employment per unit	86	73	74

• The index for 1899-1919 has been computed since publication of *The Output of Manufacturing Industries, 1899-1937*. The basic data are from the Census of Manufactures.

SAND-LIME BRICK TOTAL STONE, CLAY and GLASS PRODUCTS

Year	Output	Employment		Employment per Unit		Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*		Wage Earners	Total*	Wage Earners	Total*
1899	..	..	..	..	..	..	69	..	..	..
1904	..	..	..	..	..	..	85	81	..	..
1909	..	..	..	..	..	..	100	98	..	..
1914	59	98	93	167	158	..	99	97	..	..
1919	52	89	85	171	163	..	92	92	..	..
1921	34	66	62	195	183	..	78	78	..	..
1923	76	103	99	136	131	..	106	105	..	..
1925	114	142	134	124	117	91	107	107	117	117
1927	115	140	133	121	116	100	106	106	106	106
1929	100	100	100	100	100	100	100	100	100	100
1931	54	57	..	106	..	67	68	..	100	..
1933	8.7	15	17	170	195	47	54	54	114	116
1935	26	40	38	151	143	69	73	73	107	107
1937	66	73	68	110	103	100	94	93	94	93
1939	67	61	56	91	84	98	89	88	91	90

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939	
<i>Sand-lime brick</i>	Employment	39	68	62
	Employment per unit	146	103	92
<i>Total stone, clay and glass products</i>	Employment	76	94	93
	Employment per unit	110	94	95

FOREST PRODUCTS

EXCELSIOR

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1925	99	105	106	106	107
1927	97	102	103	106	107
1929	100	100	100	100	100
1931	63	75	..	119	..
1933	51	65	66	128	129
1935	60	67	68	112	114
1937	70	77	78	111	112
1939	68	75	76	110	111

BOXES, WOODEN, CIGAR

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1925	..	..	..	..	..
1927	98	105	106	106	107
1929	100	100	100	100	100
1931	84	86	..	103	..
1933	65	78	78	120	119
1935	64	73	72	113	111
1937	83	75	74	91	90
1939	79	71	70	90	89

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
<i>Excelsior</i>	Employment	69	78	78
	Employment per unit	115	112	115
<i>Boxes, wooden, cigar</i>	Employment	76	75	71
	Employment per unit	118	90	90

CASKETS and COFFINS

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1927	77	90	90	116	117
1929	100	100	100	100	100
1931	89	92	..	103	..
1933	..	93	95	..	..
1935	97	106	106	109	110
1937	104	105	106	101	102
1939	105	96	94	91	90

COOPERAGE

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1927	98	107	106	109	108
1929	100	100	100	100	100
1931	68	77	..	112	..
1933	56	79	78	142	140
1935	60	92	90	155	152
1937	63	90	87	142	138
1939	51	67	67	132	132

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
<i>Caskets and coffins</i>	Employment	117	110	108
	Employment per unit	121	106	103
<i>Cooperage</i>	Employment	93	87	69
	Employment per unit	156	138	136

LUMBER-MILL and PLANING-MILL PRODUCTS^a

Year	Output	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit (ESTIMATE A)	hours per Unit (ESTIMATE B)	hours per Unit (ESTIMATE A)	hours per Unit (ESTIMATE B)
1925	109	114	112	104	103	..	..	123	113
1927	97	100	99	103	102	..	..	105	108
1929	100	100	100	100	100	..	..	100	100
1931	52	49	..	95	..	..	..	44	84
1933	38	44	44	114	114	..	..	34	89
1935	53	60	59	113	112	68	90	52	98
1937	70	77	75	109	107	100	100	68	96
1939	74	72	71	97	96	84	80	63	84

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	60	76	74
Employment per unit	114	109	99

^a Combination of two industries, *lumber-mill products* and *planing-mill products*. Indexes of manhours and manhours per unit for 1925-33 are not available for *planing-mill products* separately.

LUMBER-MILL PRODUCTS, not elsewhere classified^a

Year	Output	Employment		Employment per Unit		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit (ESTIMATE A)	hours per Unit (ESTIMATE A)
1899	107	96	..	90	..	..	..
1904	96	94	93	98	97	..	..
1909	105	127	128	122	122	157	150
1914	96	112	112	117	117	..	..
1919	97	112	112	116	116	..	..
1921	80	87	88	108	109	..	..
1923	99	118	117	120	119	116	117
1925	106	111	110	106	104	112	106
1927	97	99	97	102	100	100	102
1929	100	100	100	100	100	100	100
1931	51	47	..	93	..	44	88
1933	40	45	45	112	111	37	92
1935	55	61	60	111	110	50	91
1937	72	77	76	107	106	74	102
1939	72	71	71	98	98	60	83

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	61	77	72
Employment per unit	112	107	101

^a For alternative indexes of manhours and manhours per unit for 1925-33 see the combination *lumber-mill and planing-mill products*.

PLANING-MILL PRODUCTS, not elsewhere made^a

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1925	119	124	121	104	101	..	..
1927	97	107	105	110	108	..	..
1929	100	100	100	100	100	..	..
1931	55	60	..	110	..	..	..
1933	32	39	40	122	124	..	..
1935	46	53	53	117	117	68	96
1937	64	74	71	115	110	100	100
1939	83	78	74	94	89	102	80

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	56	74	80
Employment per unit	123	115	96

^a For indexes of manhours and manhours per unit for 1925-33 see the combination *lumber-mill and planing-mill products*.

TURPENTINE and ROSIN

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1899	119	104	..	87	..
1904	97	83	87	86	90
1909	90	98	103	108	113
1914	82	86	88	105	108
1919	76	69	72	92	95
1921	74	68	71	93	96
1923	88	85	86	97	97
1925	91	73	74	80	81
1927	107	94	95	88	88
1929	100	100	100	100	100
1931 ^a	78	70	..	91	..
1933	82	77	77	94	95
1935	78	78	78	100	100
1937	81	81	83	100	103
1939	67	52	77	78	114

TOTAL FOREST PRODUCTS

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1899	119	104	..	98	..
1904	97	83	87	113	..
1909	90	98	103	130	..
1914	82	86	88	119	119
1919	76	69	72	124	125
1921	74	68	71	96	98
1923	88	85	86	118	116
1925	91	73	74	102	101
1927	107	94	95	99	98
1929	100	100	100	100	100
1931 ^a	78	70	..	92	..
1933	82	77	77	113	113
1935	78	78	78	112	111
1937	81	81	83	108	106
1939	67	52	77	96	96

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
<i>Turpentine and rosin</i> Employment	78	83	78
Employment per unit	100	103	116
<i>Total forest products</i> Employment	68	82	80
Employment per unit	115	108	100

^a The 1931 Census of this industry is reported by the Bureau of the Census to be somewhat incomplete because some establishments failed to report.

IRON AND STEEL PRODUCTS

CAST-IRON PIPE

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1914	62	64	63	103	102	..	..
1919	44	64	65	147	149	..	..
1921	48	63	63	133	133	..	..
1923	93	109	107	117	115	..	..
1925	113	117	115	104	102	..	..
1927	114	116	115	102	101	..	..
1929	100	100	100	100	100	..	..
1931	69	81	..	118	..	..	..
1933	31	48	49	155	157	42	94
1935	46	69	69	148	149	63	93
1937	68	89	89	130	130	100	100
1939	74	84	84	114	114	95	88

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	70	90	86
Employment per unit	150	131	117

FIREARMS

FILES

Year	Output	Employment		Employment per Unit		Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*		Wage Earners	Total*	Wage Earners	Total*
1921	52	69	69	134	134	..	..	..	..	..
1923	77	91	90	118	117	..	..	..	..	..
1925	70	65	66	93	94	..	..	..	..	..
1927	93	90	89	97	96	..	..	..	..	..
1929	100	100	100	100	100	100	100	100	100	100
1931	56	62	..	112	..	63	76	..	121	..
1933	56	49	51	89	92	65	66	67	102	103
1935	72	71	71	99	98	72	73	75	102	104
1937	107	100	96	94	90	106	93	94	89	89
1939	97	73	75	76	77	80	81	83	101	104

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
<i>Firearms</i> Employment	72	96	78
Employment per unit	99	90	81
<i>Files</i> Employment	77	95	87
Employment per unit	108	90	108

BLAST-FURNACE PRODUCTS^a

Year	Output	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit	Wage Earners	hours per Unit	Wage Earners
						(ESTIMATE A)		(ESTIMATE B) ^b	
1889	20	117	..	589	..	..	..	..	..
1899	32	157	..	485	..	..	..	..	..
1904	38	141	130	372	344	..	..	..	..
1909	58	154	150	265	258	176	303	..	..
1914	53	118	116	222	218	..	..	..	..
1919	70	173	170	249	244	..	..	..	208
1921	39	75	80	193	206	..	..	..	169
1923	93	147	144	158	155	..	..	..	141
1925	84	117	116	138	137	..	..	..	105
1927	84	112	111	133	132	..	..	..	100
1929	100	100	100	100	100	100	100	..	..
1931	44	54	..	124	..	..	..	..	..
1933	32	48	48	153	152	32	101	..	..
1935	51	61	61	120	121	42	83	..	..
1937	88	92	91	105	104	68	77	..	..
1939	76	78	78	103	103	51	68	..	..

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	61	94	80
Employment per unit	121	107	106

^a For fuller indexes on manhours and manhours per unit see the combination *blast-furnace and steel-mill products*.

^b Bureau of Labor Statistics, *Productivity of Labor in Merchant Blast Furnaces*, Bulletin No. 474 (Dec. 1938), p. 5. The data relate to 21 to 60 merchant plants. The figure for 1927 covers the first 6 months only.

WROUGHT PIPE, not elsewhere made

Year	Output	Employment		Employment per Unit		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit	Wage Earners
						(ESTIMATE A)	
1925	77	95	94	124	122	..	..
1927	68	97	95	142	139	..	..
1929	100	100	100	100	100	..	..
1931	63	70	..	112	..	..	..
1933	31	57	57	183	182	..	..
1935	56	94	92	168	165	..	..
1937	91	124	119	136	131	100	100
1939	54	73	73	135	134	62	103

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	93	119	75
Employment per unit	167	131	139

STEEL-MILL PRODUCTS*

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1869	1.9	10	..	544	..	..	..
1879	4.4	21	..	470	..	..	..
1889	10	29	..	279	..	..	..
1899	24	46	..	197	..	..	..
1904	29	53	50	181	173	..	..
1909	43	61	59	140	136	74	166
1914	44	63	62	144	142	..	..
1919	63	95	96	150	151	..	..
1921	38	60	61	157	161	..	..
1923	81	98	97	122	120	..	..
1925	82	94	94	115	115	..	..
1927	81	92	92	113	114	..	..
1929	100	100	100	100	100	..	..
1931	47	67	..	142	..	..	..
1933	43	70	70	163	162	52	118
1935	64	91	90	144	142	71	108
1937	97	121	120	125	124	100	100
1939	86	101	101	117	118	78	87

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	91	122	104
Employment per unit	143	125	121

* For fuller indexes on manhours and manhours per unit see the combination *blast-furnace and steel-mill products*.

TIN CANS and TINWARE, not elsewhere classified

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1927	87	94	94	108	108	..	..
1929	100	100	100	100	100	..	..
1931	92	80	..	88	..	..	..
1933	94	74	74	78	78	..	..
1935	119	87	90	73	75	81	109
1937	160	105	109	66	68	100	100
1939	165	101	104	61	63	93	90

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	91	111	108
Employment per unit	76	69	65

BLAST-FURNACE and STEEL-MILL PRODUCTS*

Year	Output	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit	Wage Earners	hours per Unit	Wage Earners
						(ESTIMATE A)		(ESTIMATE B)	
1899	25	53	..	215	..	..	..	..	..
1904	30	58	55	193	184	..	..	..	..
1909	45	66	65	147	144	84	187	..	..
1914	45	66	65	148	146	..	..	69	153
1919	64	100	100	156	157	..	..	..	..
1921	38	61	62	159	164	..	..	60	157
1923	82	101	100	123	122	107	130	106	130
1925	82	95	96	116	116	95	116	93	113
1927	81	93	93	114	114	92	113	90	110
1929	100	100	100	100	100	100	100	100	100
1931	47	66	..	141	..	51	108	52	112
1933	42	69	68	164	163	49	117	43	101
1935	62	89	88	144	142	66	107	56	89
1937	96	120	119	125	124	94	98	80	83
1939	85	100	100	117	118	73	85	63	74

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	89	120	103
Employment per unit	143	125	120

^a Combination of two industries, *blast-furnace products* and *steel-mill products*. Full data on hours of labor are not available for these separately.

WIRE, not elsewhere made

Year	Output	Employment		Employment per Unit		Man- Manhours	Manhours
		Wage Earners	Total*	Wage Earners	Total*		
						(ESTIMATE A)	
1909	66	80	79	121	118	109	146
1914	64	78	78	122	122	..	..
1919	69	88	88	127	127	..	..
1921	51	66	67	130	132	..	..
1923	97	95	93	98	96	..	..
1925	92	83	84	90	91	..	..
1927	98	88	89	90	90	..	..
1929 ^a	100	100	100	100	100	..	..
1931	50	64	..	130	..	..	..
1933	46	65	67	140	144	..	..
1935	67	96	97	143	144	..	..
1937	90	109	111	122	124	100	100
1939	91	98	100	108	110	91	90

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	100	112	104
Employment per unit	148	125	115

^a Between 1927 and 1929 certain large establishments engaged primarily in rolling nonferrous metal and manufacturing nonferrous wire were transferred from *wire, n.e.m.*, to *nonferrous-metal products, n.e.c.* In addition, a somewhat different method of handling data on the custom drawing of nonferrous wire was adopted in that year.

TOTAL IRON and STEEL PRODUCTS

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1899	21	47	..	225	..
1904	29	55	..	190	..
1909	44	67	..	153	..
1914	48	70	69	144	142
1919	59	96	97	164	164
1921	46	64	66	141	144
1923	84	100	99	119	117
1925	87	96	96	110	110
1927	87	94	94	108	108
1929	100	100	100	100	100
1931	54	68	..	125	..
1933	45	63	63	140	140
1935	61	82	82	134	133
1937	89	109	108	122	121
1939	82	93	92	113	112

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	83	109	96
Employment per unit	136	122	117

NONFERROUS-METAL PRODUCTS

PRIMARY NONFERROUS METALS^a

Year	Output	Employment		Employment per Unit		Man-hours Wage Earners (ESTIMATE A)	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1899	25	79	..	318	..	..	..
1904	22	87	81	396	368	..	..
1909	49	96	91	196	186	..	..
1914	57	112	107	197	189	..	..
1919	64	121	118	189	184	..	..
1921	39	60	60	154	154	..	..
1923	75	113	111	151	148	..	..
1925	85	106	104	125	122	..	..
1927	89	98	97	111	110	..	..
1929	100	100	100	100	100	..	..
1931	53	60	..	112	..	..	..
1933	37	47	47	127	128	..	..
1935	52	73	72	140	140	71	107
1937	78	96	96	124	123	100	100
1939	72	81	81	113	113	79	85

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	72	96	85
Employment per unit	140	123	119

^a Combination of three industries, *copper*, *lead*, and *zinc*. Data for 1939 are not available for these separately.

COPPER^a

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit Wage Earners (ESTIMATE A)
		Wage Earners	Total*	Wage Earners	Total*		
1899	22	78	..	361	..	..	..
1904	31	88	82	282	264	..	..
1909	47	107	102	230	218	131	226
1914	52	122	118	235	229	..	..
1919	60	119	119	199	198	..	..
1921	34	57	59	167	173	..	..
1923	69	115	117	168	171	..	..
1925	78	107	104	137	134	..	..
1927	82	96	95	116	115	..	..
1929	100	100	100	100	100	..	..
1931	54	59	..	110	..	..	..
1933	30	38	40	129	133	..	..
1935	48	72	72	149	149	..	..
1937	80	100	99	124	124	100	100

* Excludes nonfactory personnel, 1935-37. The following indexes (1929:100) cover all personnel:

	1935	1937
Employment	72	99
Employment per unit	149	124

^a For 1939 indexes see the combination *primary nonferrous metals*.

COLLAPSIBLE TUBES

SECONDARY METALS,
NONPRECIOUS

Year	Output	Employment		Employment per Unit		Employment		Employment per Unit		
		Wage Earners	Total*	Wage Earners	Total*	Wage Earners	Total*	Wage Earners	Total*	
1925	94	107	..	114	..	78	71	74	91	95
1927	103	109	110	106	107	84	67	70	80	84
1929	100	100	100	100	100	100	100	100	100	100
1931	102	95	..	93	..	58	64	..	110	..
1933	108	96	97	89	90	67	71	74	105	110
1935	110	108	109	98	99	87	91	94	105	109
1937	124	109	110	88	89	124	120	122	97	98
1939	126	106	108	85	86	100	87	88	87	88

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
<i>Collapsible tubes</i>	Employment	109	110
	Employment per unit	100	89
<i>Secondary metals, nonprecious</i>	Employment	97	123
	Employment per unit	111	99

LEAD^a

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1899	38	173	..	448	..	..	..
1904	51	157	142	309	279	..	..
1909	63	154	141	245	224	238	220
1914	72	153	141	212	195	..	..
1919	63	134	129	213	205	..	..
1921	60	94	89	156	149	..	..
1923	83	129	123	154	148	..	..
1925	99	127	120	128	120	..	..
1927	101	112	108	110	107	..	..
1929	100	100	100	100	100	..	..
1931	58	54	..	93	..	..	..
1933	36	44	44	121	121	..	..
1935	43	66	65	153	151	..	..
1937	58	84	83	144	142	100	100

* Excludes nonfactory personnel, 1935-37. The following indexes (1929:100) cover all personnel:

	1935	1937
Employment	65	83
Employment per unit	152	142

^a For 1939 indexes see the combination *primary nonferrous metals*.

ZINC^a

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1899	21	42	..	203	..	..	..
1904	30	56	52	188	175	..	..
1909	41	57	54	141	133	86	183
1914	57	83	78	146	138	..	..
1919	74	119	113	161	153	..	..
1921	34	50	49	147	144	..	..
1923	82	103	97	125	118	..	..
1925	90	97	96	107	106	..	..
1927	94	96	95	102	101	..	..
1929	100	100	100	100	100	..	..
1931	48	62	..	129	..	..	..
1933	50	59	59	119	119	..	..
1935	64	76	76	118	118	..	..
1937	86	97	97	113	113	100	100

* Excludes nonfactory personnel, 1935-37. The following indexes (1929:100) cover all personnel:

	1935	1937
Employment	76	97
Employment per unit	119	113

^a For 1939 indexes see the combination *primary nonferrous metals*.

CLOCKS, WATCHES and MATERIALS

Year	Output	Employment		Employment per Unit		Man-hours Wage Earners (ESTIMATE A)	Manhours per Unit Earners
		Wage Earners	Total*	Wage Earners	Total*		
1927	113	105	103	92	91	..	..
1929	100	100	100	100	100	..	..
1931	64	76	..	119	..	..	..
1933	48	60	60	124	124	52	148
1935	78	84	85	108	109	76	137
1937	139	108	108	78	77	100	100
1939	114	83	82	73	72	72	88

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	86	109	89
Employment per unit	111	78	78

NONFERROUS-METAL PRODUCTS, not elsewhere classified

Year	Output	Employment		Employment per Unit		Man-hours Wage Earners (ESTIMATE A)	Manhours per Unit Earners
		Wage Earners	Total*	Wage Earners	Total*		
1925	70	82	81	117	116	..	..
1927	72	83	83	116	116	..	..
1929 ^a	100	100	100	100	100	..	..
1931	59	62	..	105	..	..	..
1933	43	60	61	140	141	52	106
1935	62	79	80	129	130	75	108
1937	88	105	104	118	117	100	100
1939	90	93	92	103	103	90	89

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	82	104	98
Employment per unit	132	117	109

^a Between 1927 and 1929 certain large establishments engaged primarily in rolling nonferrous metal and manufacturing nonferrous wire were transferred from *wire, n.e.m.*, to *nonferrous-metal products, n.e.c.* In addition, a somewhat different method of handling data on the custom drawing of nonferrous wire was adopted in that year.

TOTAL NONFERROUS-METAL PRODUCTS

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1899	..	49	..	..	..
1904	..	60	..	..	..
1909	..	73	..	..	..
1914	..	76	75	..	..
1919	..	96	96	..	..
1921	..	68	69	..	..
1923	..	93	93	..	..
1925	79	88	88	111	111
1927	84	87	87	102	103
1929	100	100	100	100	100
1931	64	66	..	103	..
1933	47	60	60	127	128
1935	66	84	84	128	127
1937	89	105	104	118	116
1939	89	95	94	107	105

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	87	104	100
Employment per unit	131	116	112

MACHINERY

TYPEWRITERS

Year	Output	Employment		Employment per Unit		Man-hours Wage Earners (ESTIMATE A)	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1921	51	74	76	143	147	..	..
1923	74	83	84	111	114	..	..
1925	78	83	88	106	113	..	..
1927	91	92	94	102	103	..	..
1929	100	100	100	100	100	..	..
1931	54	64	..	121	..	..	..
1933	44	57	60	130	129	40	106
1935	80	91	92	114	115	68	98
1937	115	127	125	110	108	100	100

* Excludes nonfactory personnel, 1935-37. The following indexes (1929:100) cover all personnel:

	1935	1937
Employment	101	125
Employment per unit	126	108

AGRICULTURAL IMPLEMENTS^a

Year	Output	Employment		Employment per Unit		Man-hours Wage Earners (ESTIMATE A)	Manhours per Unit Wage Earners
		Wage Earners	Total	Wage Earners	Total		
1921	68	73	80	107	116	61	89
1923	64	74	77	117	121	74	117
1925	61	69	72	113	117	69	113
1927	73	80	81	110	112	79	109
1929	100	100	100	100	100	100	100
1931	30	42	..	138	..	30	99

^a Owing to a serious change in the definition of the industry between 1931 and 1933 no indexes are given for 1933-37.

PHONOGRAPHS

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total	Wage Earners	Total
1899	8.3	8.8	..	106	..
1904	..	24	24	..	..
1909	29	36	35	123	121
1914	38	65	68	172	180
1919	182	199	202	110	112
1921	80	124	130	154	162
1923	105	142	138	136	132
1925	80	78	79	97	98
1927	114	99	98	87	86
1929	100	100	100	100	100

SCALES and BALANCES

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1927	83	95	96	115	116
1929	100	100	100	100	100
1931	60	68	..	113	..
1933	35	53	57	153	164
1935	62	60	63	97	102
1937	87	80	80	92	92

* Excludes nonfactory personnel, 1935-37. The following indexes (1929:100) cover all personnel:

	1935	1937
Employment	71	82
Employment per unit	115	94

ELECTRIC LAMPS^a

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total	Wage Earners	Total		
1920	58	240	..	412	..	229	394
1921	39	166	..	422	..	149	381
1922	51	163	..	318	..	149	292
1923	65	169	..	260	..	160	246
1924	67	137	..	204	..	134	200
1925	72	120	..	166	..	118	164
1926	76	113	..	149	..	110	144
1927	87	111	..	128	..	111	128
1928	86	100	..	116	..	99	115
1929	100	100	..	100	..	100	100
1930	87	91	..	105	..	86	99
1931	80	83	..	104	..	73	91

^a Electric lamps constitute a branch of the Census industry "electrical machinery."

Source: H. Magdoff, I. H. Siegel and M. B. Davis, *Production, Employment and Productivity in 59 Manufacturing Industries, 1919-1936* (National Research Project, Philadelphia, 1939), pp. 66, 69. The index of output is a weighted arithmetic mean of 1929 base relatives of five products, the weight in each case being the number of manhours used in the production of the commodity. The original data on output, employment, and manhours are those compiled in a field study by Witt Bowden of the Bureau of Labor Statistics.

REFRIGERATORS, MECHANICAL

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1921	0.6	..	..	..	..	..	..
1923	2.0	..	..	..	..	..	..
1925	8.4	..	..	..	..	..	..
1927	44	67	69	152	158	..	..
1929	100	100	100	100	100	..	..
1931	118	93	..	78	..	..	..
1933	130	94	94 ^a	72	72 ^a	..	..
1935	212	132	129	62	61	..	..
1937	317	179	172	56	54	100	100
1939	273	125	121	46	44	67	78

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	133	177	130
Employment per unit	63	56	48

^a Owing to lack of published data, the 1933 index for total employment (1929:100) was assumed to be the same as the corresponding index for wage earners.

SEWING MACHINES

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1927	101	96	97	95	96
1929	100	100	100	100	100
1931	49	77	..	158	..
1933	26	60	59	232	226
1935	57	72	71	126	126
1937	100	86	84	86	83
1939	72	75	74	105	103

WASHING and IRONING MACHINES

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1927	73	95	95	130	130
1929	100	100	100	100	100
1931	79	76	..	96	..
1933	92	85	84	92	92
1935	132	107	104	81	79
1937	146	114	107	78	73
1939	135	91	87	68	65

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
Sewing machines	Employment	73	84	79
	Employment per unit	128	84	110
Washing and ironing machines	Employment	107	110	97
	Employment per unit	82	75	72

TOTAL MACHINERY

Year	Output	Employment	
		Wage Earners	Total*
1899	..	37	..
1904	..	44	..
1909	..	53	..
1914	..	57	56
1919	..	93	92
1921	..	62	64
1923	..	84	85
1925	..	79	80
1927	..	82	83
1929	..	100	100
1931	..	62	..
1933	..	49	50
1935	..	71	72
1937	..	99	99
1939	..	81	81

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	75	100	87

TRANSPORTATION EQUIPMENT

AUTOMOBILES, incl. BODIES and PARTS

Year	Output ^a	Employment		Employment per Unit		Man- Manhours		Man- Manhours	
		Wage Earners	Total*	Wage Earners	Total*	hours per Unit	Wage Earners	hours per Unit	Wage Earners
						(ESTIMATE A)		(ESTIMATE B)	
1899	0.05	0.50	..	1,000	..	..	..	..	..
1904	0.25	2.7	2.7	1,080	1,070	..	..	..	..
1909	1.8	17	17	939	956	21	1,160	..	..
1914	8.5	28	29	334	346	..	..	31	367
1919	28	77	80	272	283	..	..	..	..
1921	25	48	50	194	204	..	..	46	185
1923	63	90	91	144	145	100	158	92	146
1925	72	95	96	132	133	101	141	96	134
1927	63	83	84	131	133	84	134	82	130
1929	100	100	100	100	100	100	100	100	100
1931	44	64	..	145	..	53	120	50	114
1933	35	54	55	154	157	45	127	42	119
1935	74	87	86	117	116	78	106	69	94
1937	90	107	107	119	119	90	100	81	90
1939	67	84	85	124	126	70	104	62	93

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	87	108	87
Employment per unit	118	120	130

^a In the computation of this index only finished automobiles and chassis were considered. Bodies and parts were not included because no separate data for replacement bodies and parts are available; replacement bodies and parts are combined with a percentage, unknown and varying, of the bodies and parts used in the manufacture of new automobiles. The omission from the index of replacement bodies and parts probably results in an understatement of the long-term growth of the industry, and an exaggeration of the cyclical fluctuations of the index of output.

CARS, RAILROAD, not elsewhere made

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1899	119	93	..	78	..	..	..
1904	122	97	87	79	71	..	..
1909	114	117	107	103	94	155	127
1914	154	145	133	94	86	..	..
1919	171	138	130	81	76	..	..
1921	96	120	114	125	119	..	..
1923	229	201	189	88	82	..	..
1925	139	126	123	91	89	..	..
1927	101	95	96	94	95	..	..
1929	100	100	100	100	100	..	..
1931	31	47	..	149	..	..	..
1933	..	36	36	..	..	..	..
1935	30	54	53	182	181	47	150
1937	93	101	98	108	104	100	100
1939	42	61	62	146	147	55	123

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	..	98	62
Employment per unit	..	104	149

LOCOMOTIVES, not elsewhere made

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1889	222	135	..	61	..	..	..
1899	264	172	..	65	..	..	..
1904	366	225	202	61	55	..	..
1909	282	135	132	48	47	211	41
1914	204	157	148	77	73	..	..
1919	321	242	224	75	70	..	..
1921	175	150	143	86	82	..	..
1923	412	278	261	68	64	..	..
1925	137	116	114	85	84	..	..
1927	105	117	114	112	109	..	..
1929	100	100	100	100	100	..	..
1931	23	49	..	212	..	..	..
1933	..	21	25	..	..	..	..
1935	..	34	37	..	..	..	..
1937	55	81	86	148	155	100	100
1939	29	59	62	199	211	60	113

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	..	88	65
Employment per unit	..	159	220

SHIPS and BOATS

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit
		Wage Earners	Total*	Wage Earners	Total*		
1899	97	85	..	87	..	..	..
1904	80	92	88	114	110	..	..
1909	74	74	73	100	99	91	99
1914	74	81	79	109	107	..	..
1916	122	132	..	108	..	..	..
1919	551	703	671	128	122	..	..
1921	213	193	186	91	88	..	..
1923	99	113	111	114	112	..	..
1925	90	91	91	101	101	..	..
1927	110	100	99	91	90	..	..
1929	100	100	100	100	100	..	..
1931	78	82	..	105	..	..	..
1933	23	56	57	247	253	42	147
1935	..	81	84	..	..	64	..
1937	80	113	114	140	142	100	100
1939	110	126	126	114	115	114	83

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	..	115	128
Employment per unit	..	143	116

CARRIAGES, WAGONS and SLEIGHS

MOTORCYCLES and BICYCLES

Year	Output	Employment		Employment per Unit		Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*	Wage Earners	Total	Wage Earners	Total
1889	1,080	1,616	..	150	..	..	..	..	..
1899	1,317	1,901	..	144	..	141	399	..	283
1904	1,392	1,983	1,933	142	139	32	76	71	239
1909	1,333	1,721	1,718	129	129	64	101	95	158
1914	1,123	1,347	1,405	120	125	121	152	151	126
1919	647	540	553	83	85	180	248	238	138
1921	182	219	234	120	129	81	98	102	121
1923	300	282	280	94	94	128	150	147	117
1925	216	168	164	78	76	98	95	97	98
1927	173	118	118	68	68	87	89	90	102
1929	100	100	100	100	100	100	100	100	100
1931	36	50	..	138	..	..	..	..	..
1933	40	53	52	133	129	..	..	..	..
1935	59	60	58	101	98	..	..	..	..
1937	71	69	66	96	93	..	..	..	..
1939	54	47	46	88	85	..	..	..	..

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	59	66	48
Employment per unit	100	93	90

CARRIAGES and SLEDS, CHILDREN'S

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1899	..	..	..	..	..
1904	..	..	..	..	..
1909	..	..	..	..	..
1914	..	..	..	..	..
1919	..	..	..	..	..
1921	..	..	..	..	..
1923	..	..	..	..	..
1925	92	98	98	106	106
1927	90	99	99	110	110
1929	100	100	100	100	100
1931	71	59	..	82	..
1933	59	56	55	95	94
1935	70	69	69	98	98
1937	89	74	73	83	82
1939	89	61	60	69	68

TOTAL TRANSPORTATION EQUIPMENT

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1899	7.3	34	..	466	..
1904	7.5	36	35	481	472
1909	11	44	44	411	413
1914	20	53	54	262	266
1919	61	147	145	241	238
1921	38	69	70	183	186
1923	76	104	103	138	137
1925	76	96	96	126	127
1927	68	85	86	126	127
1929	100	100	100	100	100
1931	46	64	..	140	..
1933	33	53	53	158	160
1935	72	82	82	115	114
1937	91	108	108	119	119
1939	74	91	92	122	124

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
<i>Carriages and sleds, children's</i>	Employment	72	73	63
	Employment per unit	103	82	71
<i>Total transportation equipment</i>	Employment	83	109	95
	Employment per unit	116	120	127

MISCELLANEOUS PRODUCTS

PENCILS

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1929	100	100	100	100	100
1931	74	61	..	82	..
1933	..	61	57	..	..
1935	134	78	73	58	54
1937	130	87	78	67	60
1939	118	74	68	63	57

PENS and POINTS

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1929	100	100	100	100	100
1931	83	86	..	103	..
1933	..	67	71	..	..
1935	144	82	85	57	59
1937	221	94	96	43	44
1939	225	74	73	33	32

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
<i>Pencils</i>	Employment	79	78	78
	Employment per unit	59	61	66
<i>Pens and points</i>	Employment	91	97	91
	Employment per unit	63	44	40

BUTTONS

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1914	96	159	160	165	166
1919	121	171	175	141	144
1921	78	107	111	138	143
1923	113	131	132	116	116
1925	111	127	127	115	115
1927	91	107	106	117	116
1929	100	100	100	100	100
1931	88	91	..	103	..
1933	..	109	107	..	..
1935	121	114	115	94	95
1937	126	133	132	106	105
1939	128	121	121	95	95

BROOMS

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1914	..	..	..	..	..
1919	..	..	..	..	..
1921	..	..	..	..	..
1923	..	..	..	..	..
1925	..	..	..	..	..
1927	93	98	100	106	107
1929	100	100	100	100	100
1931	88	90	..	103	..
1933	76	83	80	110	106
1935	90	92	91	101	101
1937	81	90	88	110	108
1939	82	83	83	102	101

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
Buttons	Employment	120	133	126
	Employment per unit	99	105	99
Brooms	Employment	98	89	88
	Employment per unit	109	109	107

PORTING GOODS, not elsewhere classified

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1929	100	100	100	100	100
1931	96	94	..	98	..
1933	..	76	76	..	..
1935	69	90	89	129	129
1937	91	106	103	116	113
1939	124	120	116	97	94

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	92	104	124
Employment per unit	133	114	100

ORGANS

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1904	168	151	145	90	86
1909	124	100	99	80	79
1914	130	128	126	98	97
1919	92	81	82	88	89
1921	125	98	98	78	78
1923	96	78	80	81	84
1925	104	103	102	99	98
1927	125	116	114	93	91
1929	100	100	100	100	100
1931	54	61	..	113	..
1933	..	24	27	..	..
1935	31	26	28	83	90
1937	..	..	..	..	..
1939	..	..	..	..	..

PIANOS

Year	Output	Employment		Employment per Unit	
		Wage Earners	Total*	Wage Earners	Total*
1904	114	211	208	185	183
1909	156	256	255	164	163
1914	156	239	241	153	154
1919	189	230	231	122	122
1921	128	159	160	124	125
1923	210	223	216	106	103
1925	198	201	197	102	100
1927	151	166	165	110	110
1929	100	100	100	100	100
1931	43	48	..	110	..
1933	..	27	27	..	..
1935	40	41	41	104	105
1937	66	57	56	87	86
1939	65	53	52	82	80

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

		1935	1937	1939
Organs	Employment	33	..	..
	Employment per unit	107	..	..
Pianos	Employment	42	58	54
	Employment per unit	106	87	83

TOTAL MISCELLANEOUS PRODUCTS

Year	Output	Employment	
		Wage Earners	Total*
1899	..	46	..
1904	..	60	..
1909	..	79	..
1914	..	92	90
1919	..	112	112
1921	..	86	87
1923	..	109	108
1925	..	104	103
1927	..	105	105
1929	..	100	100
1931	..	72	..
1933	..	64	64
1935	..	79	80
1937	..	96	95
1939	..	96	93

* Excludes nonfactory personnel, 1935-39. The following indexes (1929:100) cover all personnel:

	1935	1937	1939
Employment	84	97	102

ALL MANUFACTURING INDUSTRIES COMBINED

Year	Output	Employment		Employment per Unit		Man-hours	Manhours per Unit Wage Earners (ESTIMATE A)
		Wage Earners	Total*	Wage Earners	Total*		
1899	100	100	100	100	100	100	100
1900	102	104	..	101	..	..	..
1901	115	109	..	94	..	..	..
1902	129	118	..	91	..	..	..
1903	132	122	..	93	..	120	91
1904	124	115	116	92	94	..	..
1905	148	128	..	87	..	..	..
1906	159	134	..	85	..	..	..
1907	161	140	..	87	..	136	84
1908	133	124	..	94	..	..	..
1909	158	139	143	88	90	134	85
1910	168	145	..	87	..	..	..
1911	161	145	..	90	..	..	..
1912	185	151	..	81	..	..	..
1913	198	152	..	77	..	..	..
1914	186	146	152	79	82	136	73
1915	218	153	..	70	..	..	..
1916	259	179	..	69	..	..	..
1917	257	191	..	74	..	..	..
1918	254	195	..	77	..	..	..
1919	222	188	197	84	89	164	74
1920	242	188	..	78	..	161	67
1921	194	144	152	74	78	119	61
1922	249	160	..	64	..	137	55
1923	280	183	190	65	68	158	56
1924	266	170	..	64	..	141	53
1925	298	175	183	59	61	148	50
1926	316	179	..	57	..	152	48
1927	317	175	184	55	58	148	47
1928	332	175	..	53	..	147	44
1929	364	187	197	51	54	156	42
1930	311	162	..	52	..	129	41
1931	262	137	..	52	..	104	40
1932	197	117	..	59	..	82	41
1933	228	129	136	57	59	89	39
1934	252	151	..	60	..	95	38
1935	301	160	167	53	56	107	35
1936	353	174	..	49	..	124	35
1937	376	191	198	51	53	134	36
1938	295	160	..	54	..	104	35
1939	374	176	181	47	48	121	32

* Excludes nonfactory personnel, 1935-39. The following indexes (1899:100) cover all personnel:

	1935	1937	1939
Employment	174	201	195
Employment per unit	58	54	52

For source of data see next page.

Source of data: See Explanatory Note (p. 261) for the sources of data for Census years. The intercensal indexes of output are based on various sources (see *The Output of Manufacturing Industries, 1899-1937*, p. 44); the index for 1938 is based on the Federal Reserve index (see current issues of the *Federal Reserve Bulletin*). The intercensal indexes of employment are based on samples collected by several states and by the U. S. Bureau of Labor Statistics—for 1899-1919, see P. H. Douglas, *Real Wages in the United States, 1890-1926*; and for 1919-39, see the mimeographed summary prepared by the Bureau of Labor Statistics. The index of hours used in computing the index of man-hours is based on the B.L.S. series on actual hours for 1909-39; estimates for earlier years have been computed by extrapolating this series by the series on full-time hours derived from the Department of Commerce and Labor—B.L.S. data by P. H. Douglas (see Appendix C).

Appendix G

Derived Tables Underlying Certain Text Charts

TABLE G-1
 MAJOR GROUPS AND TOTAL MANUFACTURING
 Components of Percentage Change in Wage Earners Employed per Unit of Product,* Selected Periods

Industry	1899-1937			1899-1909			1909-1919			1919-1929			1929-1937		
	Total	Component A B		Total	Component A B		Total	Component A B		Total	Component A B		Total	Component A B	
Foods	-22	-47	+26	-11	-15	+4	+15	+13	+2	-30	-33	+2	+8	+5	+3
Beverages	-35	-26	-8	-3	-7	+4	+87	+66	+22	..	..	..	..	..	..
Tobacco products	-81	-91	+10	-13	-13	-0.2	-41	-22	-19	-48	-24	-24	-32	-11	-22
Textile products	-36	-43	+7	-10	-11	+0.2	-3	-5	+3	-25	-25	+0.4	-2	-0.3	-2
Leather products	-24	-24	+0.1	-4	-4	0.0	-1	-0.5	-0.4	-15	-16	+1	-6	-6	+0.3
Rubber products	..	..	..	..	..	..	..	..	..	-50	-46	-4	-4	-6	+2
Paper products	..	..	..	..	..	..	..	..	..	..	..	..	-10	-10	+0.1
Chemical products	-56	-59	+2	-18	-17	-1	+5	+5	+0.2	-44	-42	-1	-13	-20	+7
Petroleum and coal products	-74	-64	-10	-25	-27	+2	-20	-8	-13	-57	-53	-4	-9	-8	-1
Stone, clay and glass products	..	..	..	..	..	..	..	..	..	..	..	..	-7	-5	-2
Forest products	+19	+19	0.0	+33	+34	-1	-6	-6	-0.2	-11	-12	+1	+8	+8	+0.4
Iron and steel products	-42	-43	+1	-32	-32	+0.2	+6	+5	+0.5	-36	-37	+1	+19	+19	+0.1
Nonferrous-metal products	..	..	..	..	..	..	..	..	..	..	..	..	+14	+11	+3
Transportation equipment	-63	-94	+31	-12	-0.4	-12	-41	-41	0.0	-59	-45	-14	+20	+20	-0.4
TOTAL MANUFACTURING	-55	-52	-2	-14	-8	-5	-10	-12	+2	-39	-32	-7	+1	+3	-2

For footnote see pp. 886-87.

^a Total percentage change: From Appendix H ("unadjusted" figures).

Component A: Change in total attributable to average change in the employment-output ratios for component individual industries (the relative contribution of each to the total product kept constant).

Component B: Change in total attributable to average change in the relative contribution of the component individual industries (the ratios for each kept constant).

The sum of A and B may differ slightly from the total owing to the rounding of figures.

The procedure used to break down the total change is as follows:

Let N_0, N_1 = number of wage earners employed in a given industry in year 0 or year 1;

Q_0, Q_1 = quantity of output produced in a given industry in year 0 or year 1;

P_0, P_1 = price per unit of output produced in a given industry in year 0 or year 1;

P_w = price per unit of output in the weight base period, year 0 and year 1 combined,

$$= \frac{P_0 + P_1}{2};$$

$P_w Q_0, P_w Q_1$ = value added in a given industry in year 0 or year 1, at weight-base prices.

The aggregative measure of change in employment per unit of product,

$$\frac{\frac{\Sigma N_1}{\Sigma P_w Q_1}}{\frac{\Sigma N_0}{\Sigma P_w Q_0}} - 1 = \frac{\frac{\Sigma N_1}{\Sigma P_w Q_1} - \frac{\Sigma N_0}{\Sigma P_w Q_0}}{\frac{\Sigma N_0}{\Sigma P_w Q_0}}$$

may be broken down into two parts, one reflecting changes in the measures for individual industries, the other the change in the relative importance of industries with different employment-output levels. That is,

$$\begin{aligned} & \frac{\frac{\Sigma N_1}{\Sigma P_w Q_1} - \frac{\Sigma N_0}{\Sigma P_w Q_0}}{\frac{\Sigma N_0}{\Sigma P_w Q_0}} \\ &= \frac{\Sigma \left[\left(\frac{N_1}{P_w Q_1} - \frac{N_0}{P_w Q_0} \right) \frac{P_w Q_0}{\Sigma P_w Q_0} \right]}{\frac{\Sigma N_0}{\Sigma P_w Q_0}} + \frac{\Sigma \left[\frac{N_1}{P_w Q_1} \left(\frac{P_w Q_1}{\Sigma P_w Q_1} - \frac{P_w Q_0}{\Sigma P_w Q_0} \right) \right]}{\frac{\Sigma N_0}{\Sigma P_w Q_0}}, \\ & \text{or} = \frac{\Sigma \left[\left(\frac{N_1}{P_w Q_1} - \frac{N_0}{P_w Q_0} \right) \frac{P_w Q_1}{\Sigma P_w Q_1} \right]}{\frac{\Sigma N_0}{\Sigma P_w Q_0}} \\ & \quad + \frac{\Sigma \left[\frac{N_0}{P_w Q_0} \left(\frac{P_w Q_1}{\Sigma P_w Q_1} - \frac{P_w Q_0}{\Sigma P_w Q_0} \right) \right]}{\frac{\Sigma N_0}{\Sigma P_w Q_0}}, \\ & \text{or} = \frac{\Sigma \left[\left(\frac{N_1}{P_w Q_1} - \frac{N_0}{P_w Q_0} \right) \cdot \frac{1}{2} \left(\frac{P_w Q_0}{\Sigma P_w Q_0} + \frac{P_w Q_1}{\Sigma P_w Q_1} \right) \right]}{\frac{\Sigma N_0}{\Sigma P_w Q_0}} \\ & \quad + \frac{\Sigma \left[\left(\frac{P_w Q_1}{\Sigma P_w Q_1} - \frac{P_w Q_0}{\Sigma P_w Q_0} \right) \cdot \frac{1}{2} \left(\frac{N_0}{P_w Q_0} + \frac{N_1}{P_w Q_1} \right) \right]}{\frac{\Sigma N_0}{\Sigma P_w Q_0}}. \end{aligned}$$

Footnote concluded on next page

Footnote to Table G-1, concluded.

Our choice of the third equation is arbitrary. The first term of the right side of the equation represents the average change in the employment-output ratios for individual industries, the change for each industry being weighted by its average relative contribution to output; the second term represents the change in the relative contribution of industries with different average employment-output ratios. When $\frac{P_w Q_1}{\Sigma P_w Q_1} = \frac{P_w Q_0}{\Sigma P_w Q_0}$ for each industry, the second term vanishes and the first term is equal to the left side of the equation. This means that the change in the group employment-output ratio is the result exclusively of changes in

the ratios for individual industries: different ratios have not changed in respect of weight, because none of the industries has changed in importance. When $\frac{N_1}{P_w Q_1} = \frac{N_0}{P_w Q_0}$ for each industry, the first term vanishes and the second term is equal to the left side of the equation. This means that the change in the group employment-output ratio is entirely attributable to changes in the relative contributions of industries to the group's output: ratios for individual industries have remained the same, but are weighted differently. The measures are converted to percentages by multiplying them by 100.

TABLE G-2

INDIVIDUAL MANUFACTURING INDUSTRIES

Wage Earners per Unit of Product: Frequency Distributions of Industries by Average Annual Rates of Change between Selected Years, and by Changes in Average Annual Rates of Change

Unit: 1 percent

Interval	Number of Industries with Specified Average Annual Rate of Change						Number of Industries with Specified Change in Average Annual Rate of Change		
	1899 to 1909	1909 to 1919	1909 to 1919	1919 to 1929	1919 to 1929	1929 to 1937	1899-1909 to 1909-1919	1909-1919 to 1919-1929	1919-1929 to 1929-1937
20.0 to 20.9		1	1						
..									
18.0 to 18.9							1		
..									
11.0 to 11.9									3
10.0 to 10.9									1
9.0 to 9.9									4
8.0 to 8.9									1
7.0 to 7.9			1				3		7
6.0 to 6.9			1				1	1	8
5.0 to 5.9						1	4	1	2
4.0 to 4.9		1	1			3	4	1	5
3.0 to 3.9	1	3	3			6	4		14
2.0 to 2.9	4	4	3	2	2	5	7	2	7
1.0 to 1.9	3	3	5	4	3	12	9	2	7
0.0 to 0.9	3	15	19	2	2	12	6	7	3

Interval	Number of Industries with Specified Average Annual Rate of Change						Number of Industries with Specified Change in Average Annual Rate of Change		
	1899	1909	1909	1919	1919	1929	1899-1909	1909-1919	1919-1929
	to 1909	to 1919	to 1919	to 1929	to 1929	to 1937	to 1909-1919	to 1919-1929	to 1929-1937
-0.1 to -1.0	8	8	9	3	3	16	5	3	3
-1.1 to -2.0	11	8	8	7	8	7	1	7	1
-2.1 to -3.0	7	5	6	9	11	1	2	8	3
-3.1 to -4.0	7	2	5	11	11	6	4	8	
-4.1 to -5.0	4	2	2	10	11	1		8	1
-5.1 to -6.0	5			4	5		1	8	
-6.1 to -7.0				4	4			3	
-7.1 to -8.0				5	6			1	
-8.1 to -9.0				4	4			1	
-9.1 to -10.0			1	1	1			2	
-10.1 to -11.0								1	
-11.1 to -12.0		1	1				1		-
..									
-13.1 to -14.0								1	
-14.1 to -15.0								1	
..									
-19.1 to -20.0								1	
..									
-29.1 to -30.0						1			
..									
-31.1 to -32.0									1
TOTAL NUMBER OF INDUSTRIES	53	53	66	66	71	71	53	66	71

Source: Based on Table 4.

TABLE G-3

INDIVIDUAL MANUFACTURING INDUSTRIES

Ranked According to Change in Unit Costs, Prices and Other Economic Quantities, 1909-37^a

Industry	Average Rank	Rise in Physical Output	Rise in Aggregate Wage-earner Hours	RANK IN RESPECT OF			
				Decline in Aggregate Wage-earner Hours per Unit of Product	Decline in Wages per Unit of Product	Decline in Value Added per Unit of Product	Decline in Selling Price ^a
Automobiles, incl. bodies and parts	1.0	1	1	1	1	1	1
Chemicals, industrial, incl. rayon and compressed gases	3.2	2	3	4	3	3	4
Petroleum refining	5.5	3	2	6	11	9	2
Beet sugar	6.1	7	10	5	5	2	7½
Canned fish, fruits and vegetables	7.0	4	4	9	9	10	6
Glass	7.5	5	13	2	2	6	17
Copper	8.0	12	15	10	4	4	3
Fertilizers	9.1	11	11½	14	8	5	5
Paper and pulp	10.2	6	6	8	10	13	18
Blast furnace products	12.7	15	25	3	6	8	19
Soap	13.5	10	14	11	19	17	10
Leather	14.5	19	20	13	15	7	13
Lead	14.7	23	24	12	7	11	11
Cane-sugar refining	14.8	13	9	21	20	18	7½
Zinc	15.0	9	7	18	22	25	9
Cement	15.5	14	17	7	12	23	20
Steel-mill products	15.5	8	5	22	24	22	12
Cotton goods	15.7	16	16	17	16	14	15
Shoes, leather	16.8	17	11½	20	13	15	24
Flour	18.5	24	21	23	17	12	14
Lime	18.7	21	22	15	14	19	21
Meat packing	18.8	18	8	25	25	21	16
Woolen and worsted goods	20.7	22	18	19	23	20	22
Carpets and rugs, wool	20.8	20	19	16	21	24	25
Lumber-mill products	21.5	25	23	24	18	16	23

^a Changes in selling prices are from 1913 to 1937.

Source: Based on Table 8.

Appendix H

Alternative Measures of Change in Wage Earners per Unit of Product

Appendix H

Alternative Measures of Change in Wage Earners per Unit of Product

THE declines in workers per unit turned out to be so large that we thought it well to make sure they were not the result of some quirk in our methods of computation. It must be remembered that the changes we find in wage earners per unit of product are conditioned by the technical characteristics of the particular methods we employ in passing from the available samples of industries for which output data are obtainable to the group totals or the total of all industries combined. We should therefore compare our indexes of wage earners per unit with measures restricted to the samples or estimated for the entire group or grand total by alternative methods.

A group index is based, to begin with, on a sample of industries in that group for which the Census has collected adequate data on quantity of physical output. The index covering the sample is identified in the accompanying table by the term "unadjusted." This sample index we adjusted for changes in the sample's relative importance (this involved adjusting the index of output, as described in *The Output of Manufacturing Industries, 1899-1937*, Chapter 2 and Appendix A, and using an index of employment in the entire group rather than in the sample industries alone). The resulting adjusted index is identified in Table H-1 by the word "adjusted."¹ In the case of the index for total manufacturing, two methods of passing from the sample index of output to the adjusted index of output (identified by "A" and "B") were used; these methods are described in detail in the source cited.

¹ No similar comparison could be made of the adjusted indexes for individual industries with indexes restricted to the samples of products for which quantity data are available, because employment data are given by the Census

The indexes of output (and, therefore, of workers per unit) for the years 1899–1904 were computed on the 1909 base; those for 1909–14, on the 1919 base; those for 1919–37, on the 1929 base; and those for 1939, on the 1937 base. Comparisons between 1899 and 1937, for example, we then made *via* 1929, 1919 and 1909, by chaining the various indexes. Indexes obtained by chaining are called here “chain comparisons.” To check the chain comparison between 1899 and 1937 we computed a special set of indexes for 1937 on the 1899 base. These are called “direct comparisons” in the table below.

It is clear from the table that alternative methods yield changes in wage earners per unit for all manufacturing combined that differ only fractionally from one another. As for the groups, only for forest products are the several measures of net change over the 38 years from 1899 to 1937 considerably different from one another. Yet even in this case the signs of all the changes indicated are uniform. For decade periods, also, the alternative measures differ in only a few cases, and in no case is the difference greater than 10 percent.²

²Not only are there various ways of deriving measures of percentage changes in workers per unit of product; there are also different methods of measuring change in this ratio. Arithmetic changes, for example, are as reasonable measures as percentage changes. If 5 men were employed in turning out a unit of a certain product in 1899 and 4 men in 1937, the decline can be measured either by 1 man or by 20 percent. (Since units vary between industries, there is a problem of setting up a homogeneous unit of product so that arithmetic changes in number of workers per unit in various industries can be compared with one another; for such a unit see the last section of Chapter 2, above.) As a matter of fact, arithmetic and percentage changes in workers per unit are highly correlated: industries with relatively large declines according to one measure usually show large declines also according to the other measure.

TABLE H-1
 MAJOR GROUPS AND TOTAL MANUFACTURING
 Comparison of Alternative Measures of Wage Earners per Unit of Product: Percentage Changes
 over Specified Periods

Group	<i>Net Percentage Change between 1899 and 1937</i>				<i>Net Percentage Change between 1899 and 1909</i>				<i>Net Percentage Change between 1909 and 1919</i>				<i>Net Percentage Change between 1919 and 1929</i>				<i>Net Percentage Change between 1929 and 1937</i>			
	Ad- justed	Unad- justed	Ad- justed	Unad- justed	Ad- justed	Unad- justed	Ad- justed	Unad- justed	Ad- justed	Unad- justed	Ad- justed	Unad- justed	Ad- justed	Unad- justed	Ad- justed	Unad- justed				
	Chain Comparison		Direct Comparison		D i r e c t C o m p a r i s o n															
Foods	-26	-22	-28	-22	-7	-11	+13	+15	-35	-30	+8	+8								
Beverages	-30	-31	-33	-35	-4	-3	+94	+87	..	..	..	..				
Tobacco products	-82	-82	-81	-81	-14	-13	-41	-41	-48	-48	-32	-32								
Textile products	-37	-35	-36	-36	-12	-10	0	-3	-29	-25	0	-2								
Leather products	-21	-24	-22	-24	-4	-4	+3	-1	-18	-15	-4	-6								
Rubber products	..	..	..	..	..	..	..	..	-50	-50	-4	-4
Paper products	-59	-55	-51	-55	-23	-18	+1	+4	-41	-41	-11	-10								
Printing and publishing ^a	-70	-70	-70	-70	-36	-36	-27	-27	-34	-34	-2	-2								
Chemical products	-57	-58	-56	-56	-16	-18	+12	+5	-50	-44	-9	-13								
Petroleum and coal products	-73	-76	-70	-74	-21	-25	-14	-20	-56	-57	-9	-9								
Stone, clay and glass products	..	..	..	..	..	..	..	..	..	..	-6	-7
Forest products	+10	+21	+8	+19	+32	+33	-4	-6	-20	-11	+8	+8								
Iron and steel products	-46	-45	-45	-42	-32	-32	+7	+6	-39	-36	+22	+19								
Nonferrous-metal products	..	..	..	..	..	..	..	..	..	..	+18	+14
Transportation equipment	-74	-74	-63	-63	-12	-12	-41	-41	-58	-59	+19	+20								
TOTAL MANUFACTURING		-52		-55		-14		-10		-39		+1								
Adjusted by method A	-54		-54		-13		-10		-40		-2									
Adjusted by method B	-49		-47		-12		-4		-39		-1									

^a For printing and publishing there is only one series, covering the entire group.

Index

The industry titles used here are short titles; complete Census titles will be found in the index to The Output of Manufacturing Industries, 1899-1937 (National Bureau of Economic Research, 1940). N.e.c. means not elsewhere classified; n.e.m., not elsewhere made; and n.e.d., not elsewhere done.

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