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Chapter Title: Trends among Major Industrial Groups

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Chapter 2

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 here¹) 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

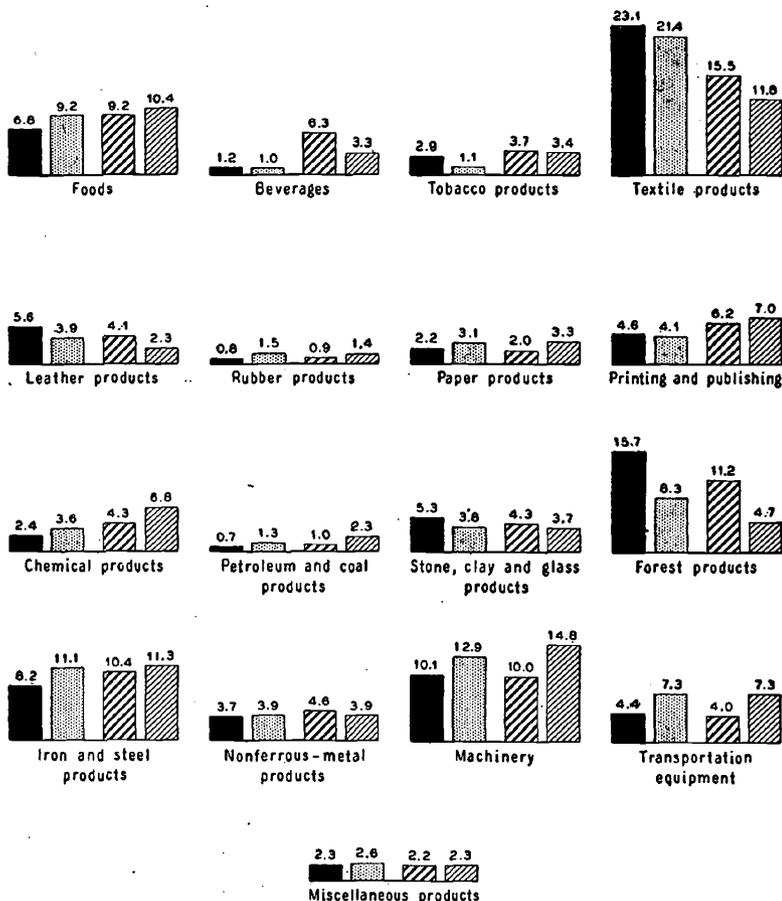
MAJOR GROUPS OF MANUFACTURING INDUSTRIES
Relative Contributions to Wage-Earner Employment and
Value Added for All Manufacturing Industries Combined,
1899 and 1937

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

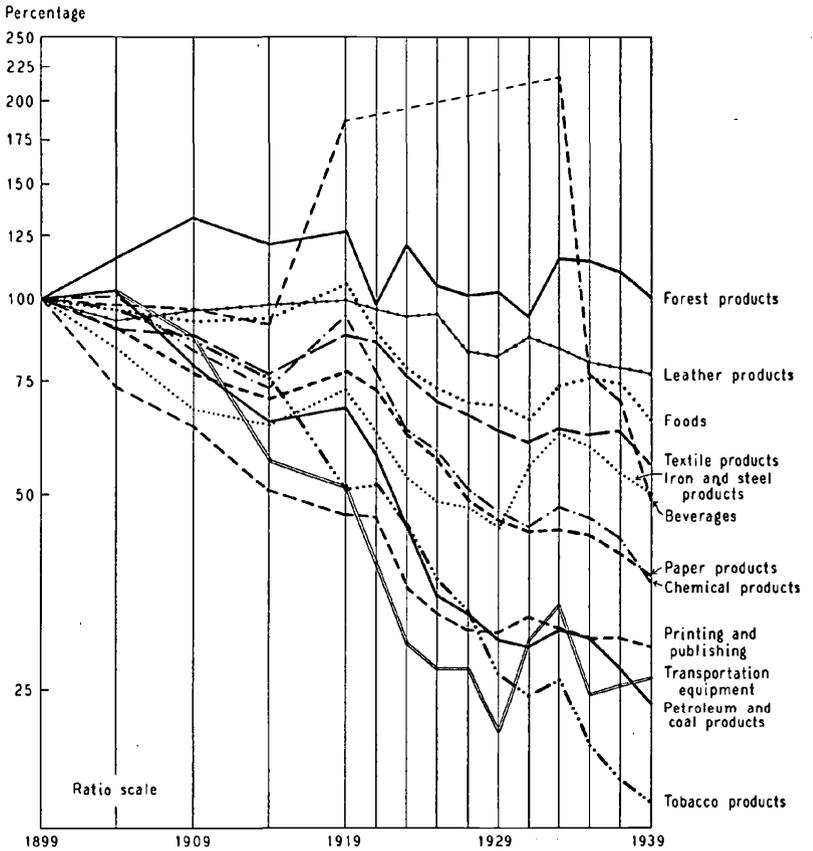
From 1899 onward, the number of workers employed in making a unit of product declined in all but one group for which we have information (Chart 8).⁵ That group was forest products, which showed a slightly rising trend.

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)



Based on Table F-1

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

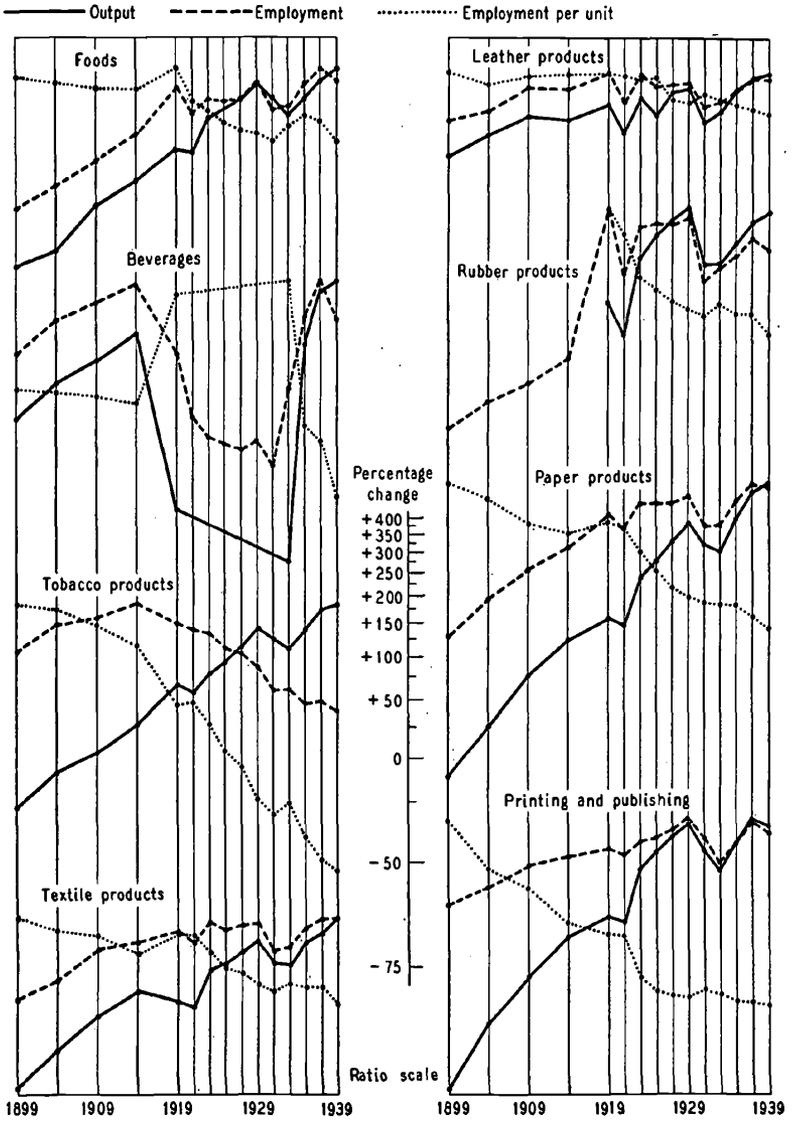
The addition of a series on employment per unit of product, when set beside those for output and number of workers, brings out another set of relationships among the major industrial groups. Though they are less easy to describe in a simple statement than the positive correlation between rising output 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

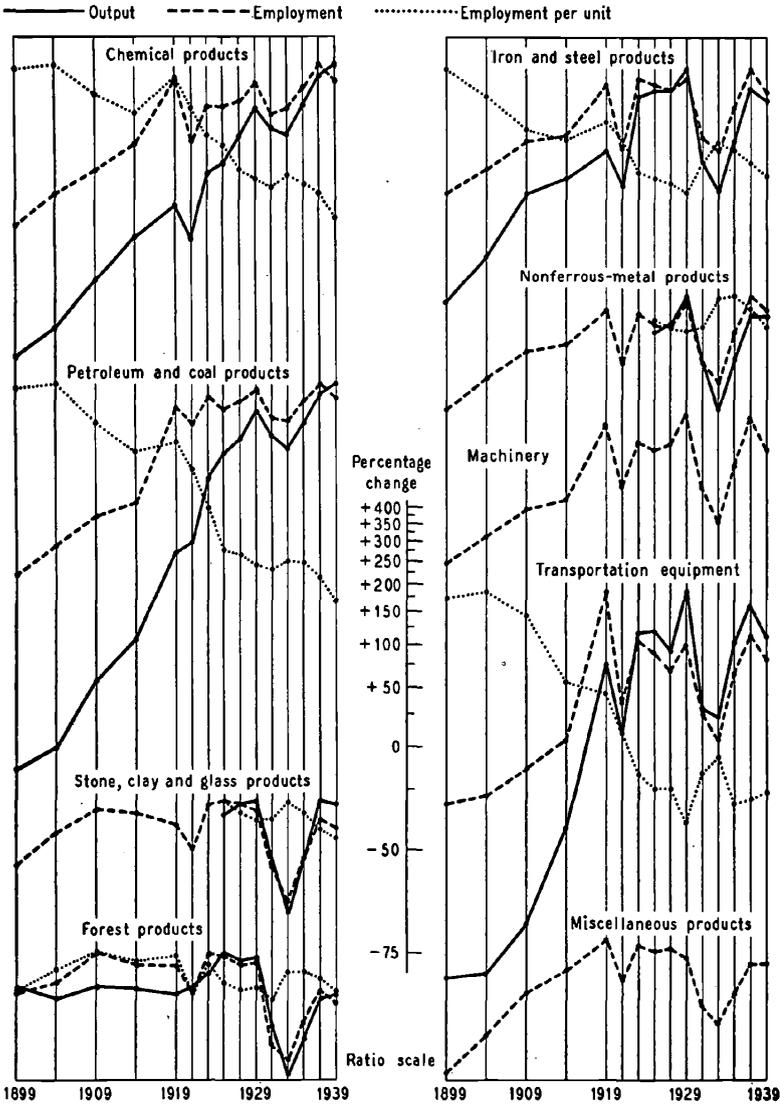
MAJOR GROUPS OF MANUFACTURING INDUSTRIES
Wage-Earner Employment, Physical Output, and Number of
Wage Earners Employed per Unit of Product



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

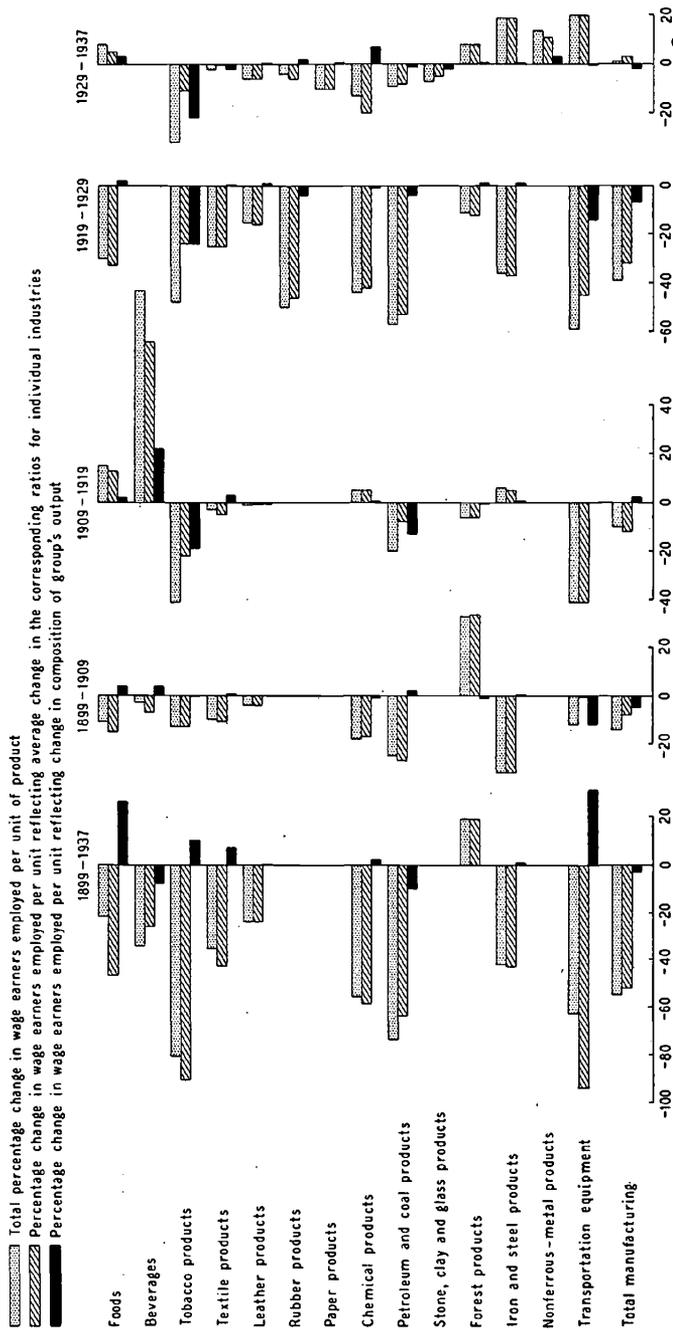
Each of the major groups consists of several industries which differ from one another not only as to the character of the final product, but also as to the number of workers they employ per unit of product. Because of variation in the latter respect, a change merely in the composition of the output of 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



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.