

PART V
METHOD

253

CHAPTER XII

WAGE STATISTICS IN THE UNITED STATES

The peculiar shortcomings of any inquiry into wages or earnings by census methods have made it necessary, in order to arrive at an approximate estimate of real earnings, to supplement the census material forming the foundation of this monograph with data from other official sources and, to some extent also, from certain authoritative private agencies. This varied assortment of sources relied upon in working out our results makes it desirable briefly to discuss the different agencies whose reports are utilized, in order to throw light upon the methods of collecting the original data, the scope and limitations of the figures reported and the differences between the various bodies of data. In addition to the Bureau of the Census, the following agencies have been drawn upon for supplementary data: United States Bureau of Labor Statistics, the New York State Department of Labor, the Massachusetts Department of Labor and Industry, the Illinois State Bureau of Labor Statistics, the Wisconsin Industrial Commission, the New Jersey Bureau of Labor Statistics, the Federal Reserve Board, and the Federal Reserve Bank of New York. The private agencies whose statistics have been utilized are: The National Bureau of Economic Research and the National Industrial Conference Board.¹

BUREAU OF THE CENSUS

In the case of the Census Bureau, it is naturally necessary to examine somewhat more thoroughly the development of the statistics of wages which it has produced, as well as to characterize its present methods and point out certain limitations upon its data.²

It was just a little more than 100 years ago that the Census Bureau first included in its schedules for manufacturing establishments inquiries dealing with numbers of persons employed and amounts paid in wages. The first census of manufactures, taken in 1810, appears to have made no mention whatever of wages or wage earners. In the census of 1820 there were questions as to the number of men, women, and boys and girls, and an inquiry as to the amount annually

¹ For a list of sources used and cited in this monograph, see Appendix IV.

² In addition to the regular census publications, the writer has consulted and utilized in the preparation of this chapter the typewritten manuscript on Census Wage Statistics prepared for the Bureau of the Census by Mr. M. O. Lorenz.

paid in wages. No explanation is given as to whether the number of persons related to the average number, the greatest number, or the number on a certain date. The amount paid in wages is not given separately for sex and age groups. No census of manufactures was taken in 1830, but in 1840 the schedule asked for "the number of men employed" in various industries; there was, however, no inquiry in regard to wages.

It was in the census of 1850 that a definite effort seems first to have been made to ascertain the average earnings of persons engaged in manufacturing industries. The inquiry for this census called for "the average number of hands employed (males and females separately), the average monthly cost of male labor, and the average monthly cost of female labor." It is evident that there was no inquiry on the schedule as to the total amount of wages paid, although it seems likely that the returns in answer to the request for average monthly cost of labor was used as a basis for estimating the total annual amount of wages paid. The schedules contained the following stipulation: "The average number of hands and the average monthly wages are to be returned so that by dividing the latter by the former the result will show the average earnings of individuals." It was further stipulated that "In all cases where the employer boards the hands, the usual charge for board is to be added to the wages."³

The inquiries relating to employees and wages at the census of 1860 were virtually the same as those of 1850. In the published tabulation, wages are reported as "annual cost of labor," so that, as was the case in 1850, the average monthly cost items appear to have been aggregated to make an annual labor cost item.

A report of the total amount paid in wages during the year was requested for the first time in the Ninth Census (1870) and was repeated in the Tenth Census (1880). In 1870, as in the two preceding censuses, inquiry was made as to the average number of hands employed, and this inquiry was subdivided in order to get reports as to the average number of "males above 16 years; females above 15 years; and children and youth." In 1870 an inquiry was included, apparently for the first time, asking for the number of months in active operation.

In the text of the general report on the census of manufactures in 1880, there is nothing said about average wages or rates of wages. In the statistical tabulation, however, the total amount paid in wages is presented for all classes combined and the average number of hands employed is shown separately for men and for women and children, as in preceding census years. In connection with the

³ The report on manufactures of the census of 1850 was published in March, 1859, as Sen. Ex. Doc., 35th Cong., 2d sess., No. 39.

census of 1880, a special investigation of wages was made, the results of which were compiled and described in a separate report by Mr. Joseph D. Weeks, special agent of the Census Bureau.⁴

The Weeks' report was limited to a presentation of the rates of wages of the most important classes of employees in 627 establishments in 53 of the more important manufacturing, mechanical, and mining industries. The report included in addition some further information bearing on intervals of payment, hours of labor, and regularity of employment. The original schedules used in this inquiry provided for a report as to the rates of wages over a series of years ending with 1880, and in some cases such rates were secured for a period of 30 years. The tables of the report show rates of wages by occupation, the rate prevailing in each occupation in each year reported, and the time unit of payment. In a number of cases the names of the operating companies are given.

In 1890 more attention was paid to the subject of wages than at any preceding census. Calculation of so-called "average wages"⁵ was facilitated by publishing the number of wage earners and the total amount paid in wages in adjoining columns. The amounts of wages paid to men, women, and children are shown separately. This separation of amounts paid in wages by sex and age groups was continued in 1899 and in 1904; with the latter year, however, the practice was discontinued, and since then the amount paid in wages is not subdivided in respect to the sex and age of the wage earners to whom it is paid. This omission is of no little importance in connection with the present analysis, for the reason that if it had been possible to utilize for the period 1899 to 1925 the separate amounts paid to men, women, and children, respectively, it would have been more easily possible accurately to estimate the amounts of per capita earnings of women and children. Lacking this separation by sex and age groups, it becomes necessary to rely upon the assumption that the changes in the wages of women correspond closely to changes in the wages of men, and, resting on that assumption, to utilize as points of departure the amounts paid to men, women, and children separately in 1904 and reported in the special report on earnings of wage earners in Census Bulletin 93.

The census of 1890 (the Eleventh Census) was the occasion of an attempt to make a new departure in the method of reporting statistics of wages. An effort was made to ascertain by means of classified wage tables the actual distribution of wages among men, women, and children. This table called for the number of employees in each establishment who were paid specified weekly rates of wages running

⁴ Report on the Statistics of Wages in the Manufacturing Industries. 1886. (571 pp.)

⁵ Computed by dividing the amount paid in wages by the number of wage earners. (See initial paragraph, Ch. XIII, p. 269.)

from under \$5 up to \$25 and over, per week, and grouped in dollar intervals. The form of inquiry was as follows:

WEEKLY RATES OF WAGES PAID AND AVERAGE NUMBER OF HANDS EMPLOYED AT EACH RATE (NOT INCLUDING THOSE EMPLOYED ON PIECEWORK): 1890

RATES PER WEEK	Males above 16 years	Females above 16 years	Children
Under \$5.....			
\$5 and over, but under \$6.....			
\$6 and over, but under \$7.....			
\$7 and over, but under \$8.....			
\$8 and over, but under \$9.....			
\$9 and over, but under \$10.....			
\$10 and over, but under \$12.....			
\$12 and over, but under \$15.....			
\$15 and over, but under \$20.....			
\$20 and over, but under \$25.....			
\$25 and over.....			

The following comment upon this attempt to report wages in the form of classified frequency distributions is given in the summary and analysis of results appearing in the report of the Twelfth Census:⁶

This is an ideal treatment of the wage question according to the matured statistical experience and experiment of many years in many bureaus and many countries. If it could have been successfully carried out it would have shown the actual number of employees in each wage group, and would have presented reliable approximations instead of the vague and meaningless average obtained by dividing the number of employees into the total amount of wages paid.

Unfortunately this effort was anything but a complete success. As stated in the report, "This classified method involved a statistical inquiry of such magnitude that it broke down of its own weight when the attempt was made to apply it to such an enormous volume of returns secured through the methods which the census must employ. Comparatively few of the enumerators in making their returns gave the necessary amount of time and attention to answering the complicated questions. The mass of returns was so defective in that respect that the Census Bureau abandoned any attempt to tabulate them for the country as a whole."⁷

A synopsis covering the period 1820 to 1890 and published in the reports of the manufactures census of 1905 is reproduced here as Table 127. It indicates the character of the inquiries made regarding employees and wages in all of the censuses from 1820 to 1890. The census periods since 1890 are all included within the scope of this present analysis, and for that reason they are given a somewhat different and more detailed description in another place. At this point it is only necessary to emphasize the fact that in respect to the

⁶ Twelfth Census (1900), Vol. VII, Manufactures, Pt. I, p. cxii to cxiii.

⁷ Returns from this inquiry were published, however, for the cities withdrawn from the enumerators, and appear with the statistics of cities in Pt. II of the report on manufactures of the Eleventh Census.

inquiries concerning the number of wage earners and the amount paid in wages, the census of 1899 (commonly referred to as the census of 1900) marks the beginning of a period which has now run to more than a quarter of a century, during which time it may truthfully be said that for the first time the statistics are strictly comparable as

TABLE 127.—PERSONS EMPLOYED, SALARIES AND WAGES: QUESTIONS USED ON THE GENERAL SCHEDULE AT CENSUSES OF 1820, 1840, AND ALL SUBSEQUENT CENSUSES UP TO 1890¹

[The "X" following the question and placed under the year signifies that the question was asked that year]

QUESTIONS ON SCHEDULE	1820	1840	1850	1860	1870	1880	1890
Amount paid annually in wages.....	X						
Average day's wages for an ordinary laborer.....						X	
Average day's wages for a skilled mechanic.....						X	
Average monthly cost of female labor.....			X	X			
Average monthly cost of male labor.....			X	X			
Average number of hands employed: Male and female.....			X	X			
Average number of hands employed: Males above 16 years; females above 15 years; children and youth.....					X	X	
Clerks or salesmen: Males above 16 years; females above 15 years; children; average number employed during the year; total amount paid in wages during the year.....							X
Greatest number of hands employed at any one time during the year.....						X	
Number of men employed.....		X					
Number of persons employed: Men, women, boys, and girls.....	X						
Officers and firm members: Males; females; average number employed during the year; total amount paid in wages during the year.....							X
Operatives, engineers and other skilled workmen, overseers and foremen, or superintendents (not general superintendents or managers); Males above 16 years; females above 15 years; children; average number employed during the year; total amount paid in wages during the year.....							X
Piecework (not included in the foregoing statement): Males above 16 years; females above 15 years; children.....							X
Total amount paid in wages during the year.....					X	X	
Watchmen, laborers, teamsters, and other unskilled workmen: Males above 16 years; females above 15 years; children; average number employed during the year; total amount paid in wages during the year.....							X
Weekly rates of wages paid and average number of hands employed at each rate (not including those employed on piecework) [from under \$5 by gradations to \$25 and over]; Males above 16 years; females above 15 years; children.....							X

¹ Census, Manufactures, 1905, Pt. I, p. lxxxiii. Special reports of the Census Bureau.

² The "foregoing statement" included operatives, engineers, and other skilled workmen, overseers and foremen, or superintendents (not general superintendents or managers); watchmen, laborers, teamsters, and other unskilled workmen.

between all of the different census years within the period. Throughout the 27-year period since the census of 1899, the wage item has been reported in exactly the same way, namely, as the total amount paid in wages.³

The number of employees has been reported, during the period 1899-1925, in a form which, although superficially not quite as uni-

³ Since 1904, however, it has not been reported separately for different sex and age groups.

form as in the case of the wage-payment items, is substantially on a uniform footing for the whole period. The only important difference is that in the first two censuses of the quarter century under review, namely, those of 1899 and 1904, the average number of wage earners was based upon reports from the different establishments in response to a request for "the average number of wage earners, including pieceworkers, employed during each month," whereas in 1909 and each following manufactures census year, the numbers reported each month were not the average number employed during the month, but the actual "number as per pay rolls or time records on the 15th day of each month * * * " As is indicated in another place, it is not believed that this difference materially affects the resulting annual average numbers of wage earners. Under the method of return used in 1899 and 1904, and under the style followed in 1909 and following census years as well, the monthly returns have been treated in the same uniform fashion, namely, the monthly numbers added together and divided by 12, and the resulting quotient published in the census returns under the heading "Wage earners (average number)." ⁹

During the period covered by this analysis, there have been two special inquiries relating to employees and wages. The first of these two reports, known as "The Dewey Report," published in 1903, made a wage comparison between censuses of 1889 and 1899.¹⁰ The second report utilized the inquiry made in connection with the first quinquennial census of manufactures in 1905 and was published in 1908.¹¹

THE DEWEY REPORT

The Dewey report is based on an investigation distinctly selective in its character. Returns were secured from 33 of the more important manufacturing industries, and within these 33 industries only a small proportion of the establishments were reported. The industries and establishments which were covered, however, were reported in an extraordinarily careful and detailed fashion. The statistics are primarily of weekly rates of wages, weekly earnings being shown in only a few special cases. The data are quite minutely classified by occupations and are presented in the form of frequency distributions, in which the weekly rates are shown in 50-cent classes. Cumulative percentages are thrown alongside the frequency distributions. Parallel arrays of both absolute and cumulative percentages are given for 1890 and 1900. Not only are the statistics presented in a form

⁹ Copies of the inquiries pertaining to wage earners and wages in each census year from 1899 to 1925, inclusive, are printed in the Appendix.

¹⁰ Employees and Wages, by Davis R. Dewey, expert special agent. Special reports of the Twelfth Census. U. S. Census Bureau, 1903.

¹¹ Earnings of Wage Earners, Census of Manufactures, 1905, Bull. 93, U. S. Census Bureau. The data refer to the year 1904.

highly classified according to occupations, within each of the 33 industries shown, but they are also quite well subdivided in respect to geographic location, although regional classification is not carried as far as occupational.

The frequency distributions and cumulative percentage arrays for the different occupational groups make up the bulk of the large volume containing the Dewey report. These large tables, however, are condensed into summary form by utilizing the cumulative percentages to locate the median and quartile groups of wages and these median and quartile groups, for rates of wages per week, earnings per week, or rates per hour, are made up into summary tables showing each of the different industries classified by occupations.

It is significant that Mr. Dewey did not see fit to make any consolidation of his results for the different industries. Not only did he feel, apparently, that he was not warranted in consolidating the 33 industries to show a final frequency distribution for all industries combined and for the United States as a whole, but he did not even consolidate all occupations, sex and age groups, within the different industries. His nearest approach to consolidation is his grouping of all occupations of a given sex or age group in a given industry; that is to say, he shows, for example, all males 16 years and over in the agricultural-implement industry in all regions, and presents the frequency distribution of those male wage earners and cumulative percentages corresponding to that distribution.

On the whole, the Dewey report was probably the most important and most reliable report on wages which had, up to that time, been published in the United States. Although it relied upon samples, those samples were in most cases sufficiently large. The industries were carefully selected to cover every important kind of manufacturing and to include also a sufficiently large number of wage earners to make the returns representative. Another outstanding merit of the report is that the data are presented in practically their original form. A serious defect of the Dewey report is that, as a result of the frequency distribution method, the report assumes a quite voluminous and unwieldy form. A second and more important defect is one which is somewhat related to the first, namely, that it nowhere presents any final or summary results of the investigation as a whole. The wage earners in each industry are assigned to their particular occupational group, these groups assembled by geographic regions, and finally a total is presented for each sex and age group for the entire industry, but as already remarked, there is no consolidation of the industries to show what was the general drift of wages during the decade covered, or to give any idea, even the roughest, of the average rate of wages.

Since the Dewey report was published, however, two useful summaries of it have appeared. The first one was made by Henry L. Moore, and the second by A. E. James.¹² Both of these writers have based their discussions very largely, if not entirely, upon their own consolidation of the industries reported by Mr. Dewey, with the object in each case of showing in a final summary the distribution of wage earners and wage groups in all the industries for the whole country. The two summary tables presented by Messrs. Moore and James are practically identical, except that Mr. James presents not only columns of absolute percentages, but also the cumulative percentages, which are not introduced by Mr. Moore.

The use which has been made of the Dewey report in this present analysis is only a minor and incidental one, because so far as the main part of this monograph is concerned, it has been necessary to work in the somewhat foggy atmosphere of census averages. The material of the Dewey report has not been at all pertinent except in Chapters X and XI, which present the results of a special treatment of the original establishment schedules, with the idea of attempting to show something about the degree of variation in wages.

In connection with the study of variability, then, certain parts of the Dewey report have been utilized; since even in this subsidiary section of our monograph we are still dealing with earnings, not rates, only such industries as reported wages in the form of earnings, for the Dewey report, are utilized. In Chapter XI an effort was made to compare, on the basis of constant purchasing power, the distribution of earnings shown for 1890 and 1899 in the Dewey report, with a similar distribution of earnings worked out for the census year 1919 by transcribing selected establishment records for that year.¹³

CENSUS BULLETIN 93

In the first quinquennial census of manufactures in 1905, the schedules used were practically the same as those used in 1900, but, in addition, a statement was asked for from each establishment giving the number of persons employed at various classified earnings for the week of maximum employment during that census year—1904. The answers to this special inquiry were in many cases imperfect, and for this reason the results were not included in the published general tables covering all establishments, but a separate bulletin was published covering 123,703 establishments, which

¹² Moore, H. L. "The variability of wages," 22 *Political Science Quarterly*, 61-73 (March, 1907).

James, A. E. "The Dewey report on wages in manufacturing industries in the United States," in the *Publications of the American Statistical Association*, September, 1907, pp. 319-344.

¹³ Similar comparison is made between the 1919 frequency distribution of earnings and the 1904 distribution in Census Bull. 93.

constituted 62.9 per cent of the whole number of establishments reported in the 1904 census.¹⁴

This report is much smaller in volume and much larger in scope; that is to say, much more of a *census* of earnings, than was the Dewey report. It presents the results in the form of frequency tables of weekly earnings for not less than 333 industries, and similar frequency tables are given in somewhat greater detail for 25 selected industries, and in still further detail for 5 selected industries. The report also presents average weekly earnings computed from the frequency tables. Summary tables are presented showing the median groups of earnings and alongside the median are the corresponding average weekly earnings. Census Bulletin 93 reports average weekly earnings, classified frequency distribution of earnings, and median groups of earnings not only by elaborate industry divisions, but also by geographic divisions and States.

It is this comprehensive and systematic subdivision of data geographically and industrially, together with the fact that average weekly earnings are presented for different sex and age groups in the different industries and regions, and the fact that it dealt with weekly earnings rather than weekly rates, that have made Census Bulletin 93 seem to be the most satisfactory census report on wages for the purposes of this present analysis. Accordingly, systematic use has been made of it in the preparation of the estimates herein presented of the amounts of annual earnings. In so far as the present analysis deals with changes in average earnings, rather than the absolute amounts of those averages, it has made no use whatever of Census Bulletin 93. In other words, the only section of this monograph which rests in any degree upon the returns published in Census Bulletin 93 is Part II, which deals with estimated amounts of per capita annual earnings. In that section of the monograph, Census Bulletin 93 is used as the point of departure for arriving at estimates of the amounts of annual earnings in the year 1904, and by application of estimated degrees of change in the census averages from one year to another, the corresponding amounts for earlier and later periods have been worked out. It is true, that in so far as the amounts of average weekly earnings showing in Census Bulletin 93 are in error, to just that same degree, at least, the estimated amounts shown in this monograph must also be in error. It would indeed be fortunate if it could be believed that the value of the present estimates of amounts of earnings rested entirely upon the results shown in Census Bulletin 93. Unfortunately there are other items entering into the present calculations of amounts of earnings which are probably less safe than the average weekly earnings data of 1904.¹⁵

¹⁴ Bull. 93. U. S. Census, Manufactures, 1905 (1904), Earnings of Wage Earners (179 pp.).

¹⁵ The following summary table from Census Bull. 93 (p. 11), indicates the form in which the statistics are presented.

UNITED STATES—SUMMARY OF ALL WAGE EARNERS, BY CLASSIFIED WEEKLY EARNINGS, WITH PERCENTAGES AT EACH AMOUNT: 1905

WEEKLY EARNINGS	Number of wage earners	Per centage in the group	Cumulative per centage	WEEKLY EARNINGS	Number of wage earners	Per centage in the group	Cumulative per centage
Total.....	3,297,819	100.0		\$8-\$9.....	255,458	7.7	93.2
Less than \$3.....	132,094	4.0	100.0	\$9-\$10.....	378,090	11.5	55.5
\$3-\$4.....	150,403	4.6	96.0	\$10-\$12.....	430,208	13.3	44.0
\$4-\$5.....	194,301	5.9	91.4	\$12-\$15.....	404,875	14.1	30.7
\$5-\$6.....	206,163	6.2	85.5	\$15-\$20.....	390,867	11.8	18.0
\$6-\$7.....	262,531	8.0	79.3	\$20-\$25.....	190,700	3.2	4.8
\$7-\$8.....	206,012	8.1	71.3	\$25 and over.....	51,728	1.6	1.6

Total earnings for the specified week, \$33,185,791; average per wage earner, \$10.00.

CENSUS METHOD OF COLLECTING AND TABULATING RETURNS

Since the creation of the permanent Census Bureau, censuses of manufactures have been taken in five-year intervals only since 1900.¹⁶ The report in each case covers the operations of the preceding calendar year, so that in this monograph the census years covered are 1899, 1904, 1909, 1914, 1919, 1921, 1923, and, in a preliminary form, 1925. Section 32 of the "The act to provide for the fourteenth and subsequent decennial censuses," approved March 13, 1919, provided that thereafter statistics of the products of manufacturing industries should be secured in each even year relating to products manufactured during the odd year; that is, 1919, 1921, and 1923, etc. We have, consequently, 3 biennial census years included in the period under review, the years 1921, 1923, and 1925, which with the year 1919, give us 3 intervals of 2 years following upon the 4 intervals of 5 years each, which latter make up the bulk of the 27-year period. The manufactures census covers some 356 industrial groups of which 41 of the most important (comprehending 68 per cent of all manufacturing wage earners in 1919) are included in the present study.

The schedules in the manufactures census are filled out either by field agents of the Census Bureau or by the firm, subject to the supervision of the enumerator. In so far as consistent with correct returns, the Census Bureau has endeavored to obtain reports by mail directly from the establishments; in any case, however, the figures are certified to by the owner or responsible official of the establishment to which the schedule relates. When completed the schedules are returned to the Bureau of the Census at Washington, where they are edited by the division of manufactures. Whenever an entry appears to be in doubt, it is verified by communication with the establishment from which the schedule was received. The material is then tabulated by States, industries, sex and age groups, etc., and, after verification, published.

¹⁶ From 1919 these censuses have been biennial.

THE ALDRICH REPORT

Before discussing the wage statistics of other governmental agencies, mention should perhaps be made of the Aldrich report on wages. In connection with the preparation of the report of the Senate Committee on Finance on wholesale prices, wages, and transportation, Mr. R. P. Faulkner, acting as statistician for the committee, prepared the tables of wages which appeared therein and in the construction of them use was made for the first time in connection with wage statistics of the device of index numbers.¹⁷ The use of relatives, or index numbers, to show the rise or fall in wages over periods of time, constitutes one of the very few great improvements that have been made in methods of dealing with wage statistics. Another, and perhaps the only other, being the use of classified (frequency) wage tables. In the Aldrich report daily rates of wages for each year from 1840 to 1891 were obtained from actual pay rolls in 22 industries, of which 21 were shown in the final tables. The number of distinct series of quotations, or wage rates, from 1860 to 1891 was 543, many of these covering the same occupation in different establishments of the same industry. The daily wages paid in January, 1860, were taken as the base or standard of each wage series presented and an index number calculated for each year backward to 1840 and forward to 1891. The daily wage rate for each occupation was obtained by averaging the reported daily wage rate for each different employee in that occupation. From the rates for occupations arrived at in this fashion, index numbers, or relatives, were calculated with the year 1860 as base.

THE UNITED STATES BUREAU OF LABOR STATISTICS

The United States Bureau of Labor Statistics is the only important agency of the Federal Government, besides the Census Bureau, which has produced any considerable body of wage statistics for manufacturing industries. Its first series of wage statistics followed, in a general way, the method of Mr. Faulkner in the Aldrich report. The bureau, however, improved upon the Faulkner model and very considerably increased the scope of the data. The information collected and published by the Bureau of Labor Statistics concerning wages and hours of labor are divided into two general classes: Union scales of wages and hours of labor, for which the data are obtained from labor union officials; and statistics of wages (in the form of rates or earnings) and hours, for which the data are obtained from pay roll records, through employers and without regard to whether the employee is a union member or not. We are primarily concerned with the statistics of the latter type. They have been collected more or

¹⁷ Wholesale Prices, Wages, and Transportation, Senate Report No. 1394, by Mr. Aldrich, Senate Committee on Finance, Mar. 3, 1893.

less continuously since 1890, with the exception that for certain industries data are not collected as often as once a year, but biennially or, in a few cases, even less often.

From the data secured from pay rolls the following items of wage statistics are developed: Average hourly wage rates; average scheduled (or full-time) hours of labor per week, or other pay-roll period; average hours actually worked per pay-roll period; average full-time earnings of employees per pay-roll period; and average actual earnings of employees per week or other pay-roll period. The averages given in the published reports are for representative weekly, monthly, or other pay-roll periods during the year, and comparable averages are given, when available, for corresponding periods in previous years. Index numbers are utilized for making these time comparisons.¹⁸ In making the present analysis, however, we are less concerned with the Bureau of Labor Statistics' figures on wages and hours of labor than we are with a certain statistical by-product of its series of figures on the volume of employment which has been reported monthly since the year 1915.

In connection with this inquiry into the volume of employment, the bureaus published monthly the total number of employees and total amount of pay rolls in a large number of establishments in manufacturing industries of the United States. Recently this work has been greatly enlarged, until it now covers 4,000 establishments in 54 selected industries, employing over 3,000,000 persons. The industries included coincide very closely with the 41 selected industries used in this monograph. Data are secured for the pay-roll period ending nearest the 15th of each month. In its periodic reports published monthly in the *Labor Review*, the bureau now shows a "comparison of per capita earnings" in each month with per capita earnings in the preceding month for each of the 54 industries. These comparisons are put in the form of month-to-month percentages of change, up or down, as the case may be, and arrived at by first dividing the amount of pay roll (which is the amount paid in wages) by the number of employees on the pay roll for that pay period and ascertaining the ratio of increase or decrease between the quotient so obtained and quotient which had already been obtained, in similar fashion, for the preceding month. The quotients themselves, that is to say, the amounts of per capita earnings, as they might be called, are not published by the bureau. As has already been intimated, there would seem to be quite as much justification for the publication of such figures as representing average earnings as there is for the States of Massachusetts and New York to publish such quotients as "average earnings," and as there is for the

¹⁸ See U. S. Bureau of Labor Statistics Bull. 326, "Methods of procuring and computing statistical information of the U. S. Bureau of Labor Statistics."

Census Bureau to divide the annual amount paid in wages by its average number of employees and to call the result "average earnings." At all events, the month-to-month percentages of change in per capita earnings, issued by the Bureau of Labor Statistics, has been utilized, as explained in Chapter XIX, to interpolate for the intercensal years amounts corresponding to the average wage item of the census year, derived directly from the census records.

In connection with the process of converting money earnings into real (or commodity) earnings, large use is made in this monograph of the retail price cost of living indices published by the United States Bureau of Labor Statistics.

STATE BUREAUS OF LABOR STATISTICS

Brief mention should perhaps be made of the small handful of States which, through their bureaus of labor statistics, publish statistics of per capita earnings, or issue their wage statistics in such form as to make it easily possible to derive per capita earnings from their published figures. The States which deserve special mention, for this reason, are New York, Massachusetts, Illinois, and Wisconsin. It should be made clear that, in the interpolation of the intercensal years for the analysis contained herein, the Bureau of Labor Statistics per capita earnings ratios were not relied upon alone, but were consolidated with similar per capita earnings figures from the States of New York, Massachusetts, Illinois, and Wisconsin. The interpolation of intercensal years for those 12 of our 41 industries which the United States Bureau of Labor Statistics has been covering since 1915 has been made for the period from 1914 to 1925 by use of the Bureau of Labor Statistics' data alone, on account of the fact that the industrial classification used by the different States mentioned was not sufficiently uniform to admit of consolidation along industrial lines. For the period 1899 to 1914, State materials alone have been relied upon. In addition to the States already mentioned, the volume of employment figures of New Jersey were utilized in a supplementary way in the computation of an index of employment by the least squares method. The New Jersey Series of employment figures has now been discontinued.

NONGOVERNMENTAL AGENCIES

Only one nongovernmental source of statistical material has been relied upon to any considerable extent in this monograph. That agency is the National Bureau of Economic Research. The report published by that bureau on Employment, Hours, and Earnings in Prosperity and Depression, has seemed to furnish the most reliable

material for constructing a bench mark from which to measure the actual amount of unemployment at different points along the employment curve. Even this report is semiofficial inasmuch as it embodies "the results of an inquiry conducted by the National Bureau of Economic Research, with the help of the Bureau of Markets and Crop Estimates and the Bureau of the Census for the President's Conference on Unemployment."¹⁹ The National Bureau's results have also been utilized in one or two other ways, as will appear in the context where its work is referred to. Its classification of the country into 3 geographic regions and into 6 industrial divisions, has also been combined with the census classification into 14 industrial groups and 9 geographic divisions.

One table published by the National Industrial Conference Board has been included to throw some light upon the degree of parallelism in the changes which take place in earnings as between male and female and skilled and semiskilled workers.

¹⁹ W. I. King, *Employment, Hours, and Earnings in Prosperity and Depression, United States, 1920-1922*. New York National Bureau of Economic Research, 1923.

CHAPTER XIII

THE CENSUS AVERAGE WAGE

In entering upon the discussion that occupies this chapter, it can not be too sharply emphasized that the expression "census average wage" does not refer to any statistical term actually published by the Bureau of the Census; it is used throughout this monograph to identify the quotient obtained by dividing the amount paid in wages by the average number of wage earners, both these latter terms being regularly published by the Census Bureau.

FORM OF ORIGINAL INQUIRY

The information regarding employees and wages asked for on the original schedules sent out by the manufactures division of the Census Office has been practically uniform throughout the period covered by this analysis. In each manufactures census year the schedule has asked employers to report under Item 5: "Wage earners, including pieceworkers; number as per pay rolls or time records on 15th day of each month of period covered by this report, if data are available for that day. If data are not available for the 15th of the month they are to be reported for the nearest representative day." This is the wording which appears in the 1919 and 1914 census schedules. This item takes practically the same form also in the censuses of 1899, 1904, and 1909. In the manufactures census schedule of 1921 the item reads "Wage earners, including pieceworkers employed on the 15th day of each month, or nearest representative day, in the establishment here reported * * *." The wording for the 1923 and 1925 census schedules is practically the same.

The second and only other important item with which we have to deal in this book is No. 6, which asks for the total amount paid in salaries and wages during the year covered by the report. The subdivision of this item with which we are especially concerned is the one reading "wage earners, including pieceworkers." Again the quotation is from the general schedule of the census of manufactures for 1919. The wording on the 1914 schedule is identical and on all earlier schedules for the period in which we are interested the language is almost exactly the same. On the 1921 and 1923 schedules the corresponding item is No. 3, marked "salaries or wage payments," and the subdivision of this item in which we are interested in subdivision "b"—"total amount of wages for period covered by this report."

The only other schedule items with which we are at all concerned (and we are interested in them only in a very incidental way) are Inquiries 3 and 7, which ask, respectively, for the number of salaried employees of each sex, including a separate report for "clerks, stenographers, salesmen, etc.," on the pay roll on December 15, or nearest representative day, of the manufactures census year, and for the time the establishment was in operation in days per year and the number of hours normally worked by wage earners per shift and per week. Of the two schedule inquiries with which we are here chiefly concerned, the wage-payment inquiry and the one concerning the number of wage earners, the former only can be answered by entry of a single amount. The other inquiry, regarding the number of wage earners, asks for 12 separate items, giving the number as per pay roll on the 15th day of each month of the census year. These figures are reported in the original monthly form in certain parts of the published reports of the census of manufactures, but we are not concerned with them in that form. Since the amount paid in wages is not reported monthly but only for the year as a whole, it becomes necessary to convert the monthly number of wage earners into some sort of yearly average. The census computes this average in the following fashion:

The number of employees, both male and female combined, on the pay rolls for each month are added together and the aggregate of these items is divided by 12. This procedure is followed whether or not the establishment operated throughout the year. If the establishment operated only six months of the year, the established procedure has involved the summation of the numbers of employees on the pay rolls in each of the six months during which the plant was in operation and the division of that aggregate by 12. The effect of this particular method of arriving at an annual average number of wage earners is discussed in another place in some detail. (See p. 277 et seq.) It suffices here to call attention to the fact that an average so calculated would on the face of it seem to represent an average number of full-year workers and produce, therefore, when divided into the total amount paid in wages, an average amount of full-time earnings. In the report of the Census Bureau this mean number, so derived, is called the "average number of wage earners."

In undertaking, then, to find out from census material something about the per capita amounts of earnings received by wage earners, or something about the changes which have taken place in those amounts, there are at hand for different geographic jurisdictions and different industries, the two items reported by the census as "wage earners, average number" and "wages" (i. e., the amount paid in wages). Practically nothing else is available. Certain other items, such as the number of days in operation during the year and to a less extent

the monthly fluctuation in the numbers of wage earners employed, may be brought in, in an auxiliary way, to help with the adjustment and interpretation of the results obtained by use of the two main items referred to. Fortunately, in making the present analysis the writer has not been confined to the census material. This material has constituted the foundation and point of departure, but auxiliary use has been made of other official statistics published by the Government and, to a slight extent, also, of unofficial data issued from authoritative private agencies.

THE CENSUS AVERAGE WAGE¹

It would seem that the first and most obvious thing to be done with the two items (wages and wage earners) is to divide one by the other.

The quotient obtained by dividing the amount paid in wages by the census average number of employees (referred to hereafter as the "census average wage") would at first blush seem to represent a legitimate average wage or average amount of earnings. Further examination, however, reveals the fact that largely because of the peculiar way in which the average number of employees is computed, this quotient is by no means all that it appears to be. It is, of course, to be expected that such an average would have the usual shortcomings of an average; and it does have them. What is worse, it has the additional defect that it not only does what all averages do, conceal variations which may be extremely wide, but it also fails to indicate what even as a mere average it would naturally be expected to indicate: It does not measure the amounts of earnings with even an approximate accuracy. It will be seen that it does measure, with what is believed to be a very close approximation to accuracy, the changes in full-time earnings as distinguished from actual earnings, and this feature is utilized to the fullest extent in applying the average wage figures to the purposes of this inquiry.

In the census years 1880, 1890, and 1900 the Bureau of the Census did divide the amount paid in wages by the average number of employees and the results of these divisions for these census years, classified by States and Territories and by industries, are published in the printed report of the Twelfth Census.² The division was also made in the manufactures census of 1904. Since 1904 there has been no attempt made to divide amounts paid in wages by the number of wage earners, and there have been no figures published that purport to show annual earnings.

¹ See initial paragraph of this chapter, p. 269.

² Twelfth Census, Manufactures, Pt. I, pp. cxv to cxvii. They are published in connection with a "Summary and Analysis of Results" and are accompanied by a rather emphatic textual criticism, chiefly directed against such so-called average earnings.

The difficulty, as already indicated, results largely from the method of computing the average number of employees. The Census Bureau in 1900 was perfectly aware of the anomalous character of this average. In the analysis of the results in the report of the Twelfth Census, referred to above, there occurs the following comment upon this average:

On account of the varying numbers of employees in a manufacturing establishment during a given year, due to change of employment and to seasonal trade conditions, it is becoming more and more difficult to establish a statistical term which will accurately represent the number of wage earners to be used as a divisor into the total amount of wages paid in order to derive a quotient to serve as a wage average. The average number of persons stated in the schedule as employed by months during the census year is a variable and, to some extent, an arbitrary figure, not properly comparable with the total amount paid in wages during the same periods, which amount is a fixed sum paid, not to the average number of persons employed, but to all persons employed, many of them for a few weeks or days only.

The tables of the Twelfth Census showing "average annual earnings" indicate, for all sex and age groups for all industries and for all geographic regions combined, that the average annual earnings in 1880 were \$346.91 and the corresponding earnings for 1890 were \$444.83. The report of the Eleventh Census in commenting upon these two figures, says that "owing to the differences in form and scope of the inquiry in 1890, as compared with that of 1880, previously referred to, neither of these average annual earnings (amounts) for 1890 should be accepted as the exact increase during the decade."³ In the discussion of these figures in the analysis of results in the Report on Manufactures of the Twelfth Census, it is stated that "those who are familiar with the conditions of industry at the two periods above referred to (1880 and 1890) are quite aware that neither the stated increase of average earnings, amounting to about 28 per cent, nor any increase approximating thereto occurred." The report of the Twelfth Census states finally that "for the purpose of any such comparison the figures were worthless, owing to the general conditions under which such figures must always be obtained for a census, the radically different phraseology of the two schedules and the different methods of computing the results."⁴

Then, after presenting comparative figures for average annual earnings in 1880, 1890, and 1900, the Twelfth Census report (1900) concludes that "considerations of this character justified the Census Bureau in affirming with all possible emphasis that the attempt to obtain the average earnings from the census figures, or to establish an average wage in the several census periods through the use of these statistics, is a false use of them and is not justified under any

³ Eleventh Census, Manufactures, Pt. I, p. 19.

⁴ Twelfth Census, Manufactures, Pt. I, p. cxlii.

circumstances."⁵ The official strictures above quoted made by the Census Bureau upon its own data and upon the process of dividing wage payment by average wage earners, were, in the opinion of the present writer, fully justified at the time. Similar strictures, however, can be applied with less force to the period since 1900.

The problem of computation of average annual earnings received some further discussion and criticism, in the report of the 1904 census of manufactures, the latter being in this case somewhat more favorable.⁶ Special emphasis was laid upon a defect in the quotient of wages divided by workers which is necessarily inherent in any average, especially when the items averaged are statistical conglomerates. The census of 1904 reports wages paid and the number of wage earners by industries, without making the division of one by the other.

The census makes no distinction, in the matter of wages paid, between male, female, and juvenile employees, and in none of its published figures does it make any separation of the different kinds of labor, marking off highly skilled from semiskilled and unskilled. There is no distinction made between the different qualities of labor which are reflected in different occupations. In the language used in the discussion of the subject in the 1905 census of manufactures—"it must never be assumed that the result (of dividing wages by wage earners) shows the average annual earnings of a machinist or of a weaver, or of a laborer, or of a wage earner in any other occupation; or that it is the earnings of the average person working a whole year, or those of a group employed six months, or a month, or any other period of time."⁷ In the same place the official commentator goes on to say that the census average wage is simply * * * the annual earnings in each case of a complex average unit or artificial person." He continues: "This average unit is the average of wage earners of heterogeneous occupations and rates of pay, working for varying lengths of time, in each industry, each State, and the United States, respectively. But it gives a quantitative statement of average annual earnings, which is the only statement easily grasped; presents a general idea regarding wage earners as a whole; and furnishes results by which, character of elements and methods of computation being clearly stated and understood, complex conditions can be interpreted."⁸ This discussion in the report of the 1905 census concludes that, with this distinct appreciation of the limitations within which this average is to be used and interpreted, it "has a practical value." The important requisites, it is pointed out in the same place, are "that from census to census, methods should remain

⁵ Twelfth Census, Manufactures, Pt. I, p. cxvii.

⁶ Special reports of the census of manufactures, Pt. I, pp. lxxxix to xviii.

⁷ Census, Manufactures, 1905, Pt. I, p. lxxxix.

Report, Manufactures, 1905, loc. cit., p. xc.

the same and that the average number be obtained with all accuracy." Admission finally is made that efforts to attain these conditions had not at any time proved wholly successful.

In the report of the Thirteenth Census (1910), after stating that no attempt had been made to calculate an average wage, and that "such a broad average would have very little significance," the following comment was made:

* * * such a calculated average would not in any case show the average annual earnings of wage earners, since the average number of wage earners from which it would have to be calculated does not represent the *actual number* of different persons engaged in manufacturing industries, but represents the number who would be required to perform the work accomplished if all were continuously employed.⁹

In the report of the Fourteenth Census (1920) the following statement is made:

The Census Bureau has not undertaken to calculate the average earnings of either salaried employees or wage earners. Such averages would possess little real value, because they would be based on the earnings of employees of both sexes, of all ages and of widely varying degrees of skill. Furthermore, so far as wage earners are concerned, it would be impossible to calculate accurately even so simple an average as this, since the number of wage earners fluctuates from month to month, in every industry, in some cases to a very great extent. The Census Bureau's figures for wage earners * * * are averages based on the number employed on the 15th of each month, and while representing the number to whom, according to the pay rolls, wages were paid on that date, no doubt represent a *larger* number in any industry than would be required to perform the work if all were continuously employed during the year.¹⁰

The statement in the Thirteenth Census does not seem to have made sufficient allowance for the pay-roll padding which results from labor turnover;¹¹ the Fourteenth Census statement is more accurate. The census figure for wage earners is unquestionably too large accurately to stand for the equivalent number of full-time workers. When divided into the amount paid in wages, therefore, it gives an average-earnings figure which is too small accurately to reflect *full-time* earnings. Moreover, as is explained elsewhere, it usually is either too large or too small to reflect actual earnings.

It seems to the present writer that in some respects the interpretation given the census average wage¹ in the discussion of it in the 1905 report is distinctly favorable; it also seems to him that the earlier discussion in the report of the Twelfth Census was in some respects unduly cautious. The writer does not believe that the census aver-

¹ See initial paragraph of this chapter, p. 269.

⁹ Thirteenth Census. Vol. VIII. *Manufactures*, p. 28.

¹⁰ Fourteenth Census. Vol. VIII. *Manufactures*, p. 10. Essentially the same statement as is contained in the last sentence of this excerpt is made in the reports of the manufactures censuses of 1921 and 1923. (Biennial Census of Manufactures, 1921, p. 8; Biennial Census of Manufactures, 1923, p. 7.)

¹¹ In the Biennial Census of Manufactures, 1923, there is explicit recognition of the effect of labor turnover upon the census statistics of wage earners: "The pay rolls in many cases contained the names of part-time employees, of employees who have been laid off temporarily, or of persons whose services had terminated a few days prior to the pay-roll date" (p. 6).

age wage, as it now can be figured on the basis of original data available since 1899, can be characterized by the language used in his report on wages for the Tenth Census by Mr. Joseph D. Weeks in reference to the census average wage of that earlier period. He declared that it really "represents nothing but the result of the division of one number by another."¹² The present writer does not believe that the official criticism, above cited, of the census average wage, on the basis on which it then had to be worked out, has nearly so much force in reference to the period since 1899.

The chief reason for the criticisms in the earlier period was the lack of uniformity in the form in which the original information was returned. But since 1899, uniformity has been established and the two items which are to be divided, one by the other, have been reported in essentially identical form.

DEFECTS OF THE CENSUS AVERAGE¹

In other respects, however, we are forced to conclude that certain of the defects pointed out above remain inherent in the average wage payment item up to the present time. Among these is the fact that no adequate separation is made in the amount paid in wages so as to make possible the allocation of parts of it to different kinds of labor, such as skilled labor, unskilled labor, etc. The other factor in the census average—that is, the number of wage earners—is (somewhat less seriously) deficient in the same way. It is classified by sex and age groups, but not by occupation or by any other criterion that might separate different kinds of labor. The necessary result of this weakness in both terms which enter into the average wage is to make it an average of somewhat doubtful character. It is not surprising that since 1899 the Census Bureau has refrained from publishing it.

The character of the two factors entering into the average wage payment makes it something similar to what we would have if we reported in our price statistics the single average price for any given year of butter, eggs, and cheese. We have in the census average almost as much of a "catch-all" mean, when we report that the average earnings during a given year of the laborers, semiskilled operatives, and highly skilled mechanics in a textile mill, for example, is a certain sum. This defect is with us yet and any interpretation of the resulting figures must reckon with it. Further, it seems evident that we must confirm the earlier strictures upon the value of the census average wage, in so far as those strictures question the value of the average as showing the amounts of earnings at the different periods. The present writer does not believe that even

¹ See initial paragraph of this chapter, p. 269.

¹² Report of the Tenth Census. Vol. II, p. 6.

now, with uniform census methods for securing the original information, this census average wage correctly shows amounts of earnings—either full-time or actual. What it does seem correctly to measure, and what it appears to have measured very faithfully during the last quarter century, is the degree of change in full-time earnings. The use made of it in this monograph, therefore, is that of an indicator of such ratios of change. Other expedients, which in themselves are not too satisfactory, but which are believed to be superior to the method of reliance on the census average, are utilized for the purposes of estimating the amounts of earnings at different periods.

It has been stated that, from and including the census of 1899, the two items which are really important, namely, the amount paid in wages and the average number of wage earners, have been collected in the field in a form which has been virtually uniform throughout the period. To this statement one qualification should be made. In the two manufactures census years 1899 and 1904, the establishment schedule asked employers to return "average number of wage earners, including pieceworkers, employed during each month," instead of requesting, as has been the case since then, the number of wage earners shown by the pay rolls to have been employed on the 15th of each month. It may be noted also that in these first two census years of the period covered in this monograph, the average number of wage earners employed during each month was shown separately for men and women 16 years of age and over, and for children under 16 years. For the census years from 1909 to 1919 the numbers of wage earners on the 15th of the month were shown only under the two headings, male and female, and since 1919 no sex distribution has been made. It is very unlikely that this change in the method of reporting the number of employees each month makes any appreciable difference in the census average wage calculated from monthly figures derived by the two different methods. It seems quite possible, as Mr. M. O. Lorenz has pointed out,¹³ that the method adopted in the 1909 census and followed thereafter would lead to somewhat greater care on the part of the employer in filling out this part of the schedule. Employers are now asked for a specific number on a specific day and doubtless are more likely to report the information from actual records. When the average number during the month is called for there is possibly some temptation to make rough estimates, and these "guesses" are likely to be too large rather than too small. It is not believed that this difference materially affects the comparability of the two earlier census periods with the later ones. Throughout the whole 27-year period there has been, nevertheless, a constant tendency to produce a larger

¹³ Typewritten manuscript in the files of the Census Bureau on "Numbers of persons employed," dated June, 1919, p. 9.

average number of wage earners than the facts warrant, and thus to produce, in turn, when that number is divided into the amount paid in wages, a census average wage which, while inaccurate as an absolute sum, is (fortunately for our purposes) in error by a margin which throughout our period is probably quite uniform.

AVERAGE NUMBER OF WAGE EARNERS

The true character of the census average wage¹ will perhaps best be comprehended by the use of one or two illustrations based upon hypothetical establishment situations. First of all, it may be well to examine somewhat more carefully the census average number of wage earners, which enters so largely into the calculation of the census average.

Imagine two establishments, A and B, the first of which operates for six months during the census year and the latter for the full year. Assume that the earnings of the employees in each case are uniform for each of the months worked. Assume more specifically that in plant A, during each of the six months it was in operation, there were 10 men employed and each of the 10 men got a total of \$50 in his pay envelope during each of the six months. In the other plant assume that the same number of men were employed during the whole year and that during this time their earnings were \$50 per month per man. In the case of the plant in operation only one-half of the year, the average number of employees computed by the census method would be 10 multiplied by 6 divided by 12, or 5. In the case of the plant in operation the full year, the average number of wage earners would be 10 multiplied by 12 divided by 12, or 10. In the latter case an average of 10 employees per month is the number one would naturally say represented the size of the standard work force of the plant. In the case of the plant operating 6 months of the year, we would be inclined to say that the average number must also be 10. The Census Bureau calls it 5, and that figure obviously represents an average equivalent to the average which would be obtained by spreading the employment, which was actually concentrated into 6 months, over the whole year. That is to say, 10 men working 6 months, other things being equal, put in the same amount of labor time as 5 men working for a full year. The census average, therefore, in the case of both full and part time operation, represents, in so far as the number of actively employed wage earners reported is accurate, the average number of full-year workers.

Turning to the earnings of these 2 groups of 10 men in the 2 factories mentioned, it is evident that the total wage bill in Factory A will be \$3,000 and in Factory B \$6,000. In the case of these two

¹ See initial paragraph of this chapter, p. 269.

factories, the census average wage would be computed in the first instance by dividing \$3,000 by the average number of wage earners, in this case 5, and in the second case by dividing \$6,000 by the average number of wage earners, in this case 10. The quotient in each case is the same, \$600, so that Factory A and Factory B, one of which was in operation twice as long as the other and gave each of its wage earners twice as much employment, at the same rate, as the other plant, appear in the census records as having made the same average wage payment, \$600. This number, then, very distinctly does not represent the average actual earnings; it represents something which bears a definite relation, from one census period to another, to average full-time earnings. For reasons already discussed it can not be taken to represent the amount of full-time earnings, although it can be accepted as running from census year to census year at a uniformly definite point below the true amount of full-time earnings.¹⁴

A further illustration may be made in which the hypothetical plant is one in which the conditions are somewhat more representative of actual conditions than in the two plants just now discussed. Let us suppose that, on one of the original establishment schedules, the amount paid in wages during the year was reported as \$157,248, and that the number of employees on the pay roll on the 15th of each month was as follows:

January-----	40	July-----	400
February-----	300	August-----	100
March-----	300	September-----	0
April-----	340	October-----	0
May-----	600	November-----	0
June-----	300	December-----	0

The census average number of wage earners, obtained by adding the above numbers to a total of 2,380 man-months¹⁵ and dividing by 12, is 198.3.

It may be assumed that the total wage payment of \$157,248, above mentioned, was distributed as follows:

\$8,000 to 20 employees who worked 8 months at \$600 a year.
 \$6,666 to 20 employees who worked 8 months at \$500 a year.
 \$117,000 to 260 employees who worked 6 months at \$900 a year.
 \$5,333 to 40 employees who worked 4 months at \$400 a year.
 \$750 to 10 employees who worked 3 months at \$300 a year.
 \$1,750 to 10 employees who worked 3 months at \$700 a year.
 \$5,333 to 40 employees who worked 2 months at \$800 a year.
 \$4,666 to 100 employees who worked 1 month at \$560 a year.
 \$7,750 to 100 employees who worked 1 month at \$930 a year.

¹⁴ The writer is indebted for the form and much of the content of this illustration to Mr. M. O. Lorenz, who used it in the first instance in his manuscript on Census Wage Statistics, p. 7.

¹⁵ This number represents man-months on the assumption that each employee at work on the 15th worked for the full month.

This statement of distribution of wage payments is intended to represent the actual time worked by each one of the employees in this hypothetical establishment and the rate of pay each received. It will be seen also that the sum of the products of the number of employees by the number of months worked will give the same number of man-months that is obtained by adding the number of employees at work on the 15th of each month; that is to say, 2,380 man-months. The census average wage in the case of this factory would be obtained by dividing \$157,248 by 198.3, the resulting average being \$794. Since none of the employees worked more than eight months, and most of them considerably less than that, it would seem that the actual earnings would be considerably below two-thirds of \$794. The earnings actually received by each employee in this establishment, on the basis of the distribution assumed above, would be as follows:

20 employees who worked 8 months at \$600 a year received \$400 each.
20 employees who worked 8 months at \$500 a year received \$333 each.
260 employees who worked 6 months at \$900 a year received \$450 each.
40 employees who worked 4 months at \$400 a year received \$133 each.
10 employees who worked 3 months at \$300 a year received \$75 each.
10 employees who worked 3 months at \$700 a year received \$175 each.
40 employees who worked 2 months at \$800 a year received \$133 each.
100 employees who worked 1 month at \$560 a year received \$47 each.
100 employees who worked 1 month at \$930 a year received \$78 each.

The amounts in the last column represent the actual earnings of the 600 employees who were in the work force of this hypothetical factory for some period of time. The weighted average obtained by multiplying these amounts received in earnings by the number of employees receiving them and dividing the sum of the products by the total number of employees is \$262. Now this true weighted average of actual earnings received by employees during their employment in this hypothetical factory seems to be, and is, a far cry from the average which would be obtained by dividing annual wage payments by the census average number of wage earners. Yet it would be a mistake to conclude from this that the census average wage is as far off from the true average of actual earnings received as this would seem to imply.

We have already seen that the census average wage¹ usually is either too high or too low to represent actual earnings and that the margin by which it exceeds actual earnings is sometimes quite wide, being wider, apparently, in periods of depression than in periods of prosperity, as is indicated in the figures in Table 20 and in other tables in preceding chapters. We do not believe that this margin of difference is likely to be as large as would appear from the hypothetical illustra-

¹ See initial paragraph of this chapter, p. 269.

tion just presented. The case taken undoubtedly represents an extreme situation; certainly the great bulk of the factories in the United States operate more than 8 months out of the 12. The census figures on time in operation indicate that the average time in operation for all establishments in all industries in the census year 1904 was 262 days, which is 86 per cent of a full year of 307 days. The typical factory, then, is in operation a much larger proportion of the year than the factory used in the above illustration. At the best, however, it is pretty clear that the census average does not accurately indicate amounts of earnings.

We must conclude, then, that there is only the remotest likelihood that the census average wage approximates at all closely the amounts of annual earnings actually received by the typical, or "average," wage earner. Indeed such fragmentary pieces of evidence as have come to hand indicate rather definitely that it does not represent such sums at all, even approximately.¹⁶ No more does it reflect the amounts of theoretical full-time earnings of the average full-time worker, although it does appear to reflect the changes in those full-time earnings. The analysis, so far as it deals with estimated amounts of earnings, bases those estimates, as explained in the following chapter, on a foundation entirely different from the census average wage. However, as indicated above, this census average is used as a basis for determining *the degree of change* in full-time earnings per capita. The way in which it is used for this purpose is more fully explained below. Meanwhile, let us return to the statement just made, that the census average wage does not reflect the amounts of full-time earnings.

It fails to do this primarily because pay-roll figures do not represent the number of employees actually at work. Pay-roll numbers are always, or nearly always, larger than numbers representing the number of employees actually at work. This results from the practice of carrying names of wage earners on the pay roll after those persons have left. So it will not do to assume that every name on the pay roll on the 15th day of the month, say, represents the employment of one man for one month. In practice, some of the wage earners will be found to have been employed only a part of the time, and if these short-service wage earners have their respective fragments of time pieced together so as to indicate the number of full man-months of employment represented in any period, that number would be found to be smaller than the number of employees reported to the Census Bureau for that month. When this too-large item, then, is divided into the amount paid in wages, it results in a sum which is

¹⁶ Compare Table 20 and fig. 4.

too low to represent full-time earnings.¹⁷ How far the census average wage falls short of representing the amount of full-time earnings it is very difficult to say. Some conception of the margin may be had by an inspection of Table 20.

Not only does the census average wage fail to reflect at all accurately the amounts of full-time earnings per capita; it also, in the writer's opinion, fails, by more uneven, if not by wider, margins to measure actual earnings. This necessarily follows, in the first place, from the method by which the average number of wage earners is obtained; namely, by dividing the sum of the monthly numbers on pay rolls by 12. This division produces an average number which logically ought to represent (and which were it not for the padded pay-roll difficulty just mentioned would represent) fairly closely the average number of full-time wage earners. Therefore, when the average number of full-year wage earners is divided into the amount paid in wages, the result can not by any stretch of the imagination be conceived to represent actual earnings per capita. It perhaps would represent full-time earnings per capita if the monthly numbers on pay rolls really corresponded exactly with the numbers of wage earners at work, but we have just seen that this monthly number does not correspond with the actual number at work. If the manufactures census reported the number of equivalent full-month workers in each of the 12 months and then if that number were divided into the amount paid in wages during the year, the result, one would suspect, would be very close to per capita full-time earnings. But this is academic. Taking the statistical items actually published by the Census Bureau, the result of the division of the census average number of wage earners into the annual amount paid in wages is an "average wage" that represents neither amounts of full-time nor amounts or changes in actual earnings. This interpretation would seem to lead us to a confirmation instead of dissent from the remark quoted from Mr. Joseph B. Weeks, "that the average wage means nothing except the division of one number by another," and that is the logical conclusion from what we have just said, so far as amounts of wages are concerned. But actually in respect to the *degree of change* in earnings it does mean something besides a division of one number by another. This belief that there is warrant for the inference that the ratios between average wage figures for successive census years measure the degree of change in full-time earnings per capita rests upon the fact that although the census average is too low to represent the amount of full-time earnings, the margins by which it falls short of full-time earnings does not fluctuate greatly. This is, of course, due to the fact that the pay-roll inflation which makes it too low seems to produce a fairly uniform

¹⁷ Cognizance is taken of this situation in the report of the Biennial Census of Manufactures for 1923. See citation therefrom on p. 6.

expansion in the "wage earners" factor and hence a fairly uniform reduction in the average wage. The result is that the degree of change between the successive smaller amounts is approximately the same as it would be between the larger and more accurate amounts of full-time earnings, which would be obtained if the numbers reported monthly were the numbers of equivalent man-months put in by the work force.

CORRESPONDENCE BETWEEN FLUCTUATIONS IN CENSUS AVERAGE WAGE¹ AND FULL-TIME EARNINGS

The figures in Table 128 tend to confirm what has been said. The figures in the first column are census average wage figures for each of the census years. Those in the second column are estimated full-time earnings per capita worked out as a result of the analysis

TABLE 128.—COMPARISON OF AMOUNTS OF CENSUS AVERAGE WAGES WITH DOLLAR AMOUNTS OF FULL-TIME EARNINGS AND ACTUAL EARNINGS, PER CAPITA, FOR CENSUS YEARS: 1899-1923

YEAR	Census average wage	ESTIMATED YEARLY EARNINGS PER CAPITA	
		Full-time	Actual
1899	\$426	\$525	\$446
1904	477	590	483
1909	518	643	557
1914	580	719	576
1919	1,158	1,433	1,212
1921	1,180	1,462	1,047
1923	1,267	1,566	1,317

described in the following pages. It will be noted that in every case the average wage figures fall short of the estimated full-time earnings figures by wide margins. The margin by which they fall short of them, however, is constant. It will be noticed, further, that there seems to be no constant relation whatever between the average wage figures and the figures in the last column of the table, which are estimated actual yearly earnings. In fact, the census average figures, although usually lower even than the actual yearly earnings figures, in two instances at least are higher than the latter figures. It is perhaps significant that the two census years (1914 and 1921) in which the average wage figures exceed estimated actual earnings figures are years of business depression; in the year 1904, too, which was rather a poor year, the average wage approached nearer to the estimated actual money earnings than in the census years which happened to come at times when business was prosperous.

It may be said that the figures in Table 128 constitute no proof at all but, after a fashion, beg the question, because the estimated

¹ See initial paragraph of this chapter, p. 269.

figures in the second and third columns are worked out on the assumption that certain things are wrong with the census average and then used to prove that these things are wrong with the census average. This is hardly true, however, since the primary foundation for the figures in the second and third columns is not the census average at all, but entirely independent earnings items originating in a special census investigation covering the year 1904.

Additional evidence relevant to this question is to be found in the report of an inquiry made by a special committee appointed by the Director of the Census, January 15, 1906, "to investigate this question [of the method of obtaining the average number of wage earners and of computing average wages] with such celerity as is compatible with thoroughness and report their conclusions in writing." Upon the recommendation of this committee a limited field inquiry was made to check up and make comparisons with the regular census returns for the average number of wage earners and their average annual earnings. The results of this special inquiry, thrown alongside of the corresponding figures from the regular census returns, are presented in Table 129.

It is evident from the results shown in this table that the "average annual earnings" reported by the special committee were higher by 24.8 per cent than the census average wage, that is, the average shown under the box heading "Census schedule." The former figure was \$618; the latter \$495. Unfortunately the returns from the special committee's field inquiry cover only a very small sample of the field (seven establishments) and one's conclusion from them probably should be heavily discounted on that score. For the same reason, it is impossible to make any comparison between the results of the special committee's inquiry and the estimates worked out in this monograph for the industries which are represented by the seven establishments in Table 129.

One final check upon the statement that the average wage item not only falls far short of measuring the actual amount of full-time earnings but also that it runs first above and then below the amount of actual money earnings, may be had in a comparison of the figures of columns A and E in Table 17, page 48, where the census average wage is compared with estimates of per capita money earnings made by the National Bureau of Economic Research. The national bureau's data, there given, show average actual annual earnings for factory wage earners for 1909 and 1910 of \$499 for the earlier and \$548 for the later year.¹⁸ The census average wage figures for those

¹⁸ The figures published by the national bureau include clerical and office employees. The figures given here are exclusive of clerical labor and have been courteously placed at the disposal of the writer in advance of publication. The corresponding figures in the bureau's published report (Income in the United States, Vol. I, p. 102) are: 1909, \$571; 1910, \$620.

two years (the estimate for 1910 being interpolated) are, respectively, \$518 and \$529. It appears that the census average wage item misses by wide margins the amounts estimated by the National Bureau of Economic Research as the average actual earnings for manufacturing wage earners.

As a result of these considerations, the census average wage item has been discarded entirely except in so far as it can be used to show

TABLE 129.—THE AVERAGE NUMBER OF WAGE EARNERS, TOTAL AMOUNT PAID TO WAGE EARNERS, AND THE ANNUAL AVERAGE EARNINGS FOR SEVEN ESTABLISHMENTS AS COMPUTED FROM THE CENSUS RETURNS FOR 1904, AND THE SPECIAL WAGE INVESTIGATION RETURNS, SHOWING THE DIFFERENCE IN EACH CASE (+ OR - THE CENSUS SCHEDULE) AND THE PER CENT OF DIFFERENCE BETWEEN THEM, ASSUMING THE RETURNS UPON THE SPECIAL SCHEDULE TO BE CORRECT¹

Establishment	KIND OF PRODUCT	AVERAGE NUMBER OF WAGE EARNERS			TOTAL AMOUNT PAID TO WAGE EARNERS		
		Census sched-ule	Special sched-ule	Difference (+ or - census sched-ule)	Census schedule	Special schedule	Difference (+ or - census schedule)
	Average.....	196	161	-35	\$112,505	\$108,206	-\$4,299
1	Ingrain carpet.....	80	45	-35	21,156	22,525	+1,369
2	Art squares.....	96	77	-19	49,374	44,255	-5,119
3	Foundry and machine-shop products...	333	330	-3	221,631	220,094	-1,537
4	Foundry and machine-shop products...	485	433	-52	330,395	316,231	-14,164
5	Furniture (fine cabinetwork).....	128	103	-25	88,500	72,718	-15,782
6	Glass (bottles and jars).....	114	70	-44	55,876	55,876	-----
7	Sewing-silk thread and machine twist...	83	73	-10	20,607	25,745	+5,138

Establishment	KIND OF PRODUCT	ANNUAL AVERAGE EARNINGS			PER CENT OF DIFFERENCE		
		Census sched-ule	Special sched-ule	Difference (+ or - census sched-ule)	Average number wage earners	Total amount paid to wage earners	Average earnings
	Average.....	\$495	\$618	+\$123	-17.9	-3.8	+24.8
1	Ingrain carpet.....	264	500	+236	-43.7	+6.5	+39.4
2	Art squares.....	514	574	+60	-19.8	-10.4	+11.7
3	Foundry and machine-shop products...	578	666	+88	-13.8	-0.7	+15.2
4	Foundry and machine-shop products...	681	730	+49	-10.7	-4.3	+7.2
5	Furniture (fine cabinetwork).....	691	706	+15	-19.5	-17.8	+2.2
6	Glass (bottles and jars).....	490	798	+308	-38.6	-----	+62.9
7	Sewing-silk thread and machine twist...	248	352	+104	-12.0	+24.9	+41.9

¹ Special reports of the Census Bureau, Manufactures, Pt. I, 1905, p. xc.

² The special agent did not obtain the total amount of wages paid by this establishment, and the amount reported on the census schedule has been accepted for purposes of comparison.

the degree of change in full-time earnings. It would be fortunate, for our purpose, if the census average could be shown to reflect changes in actual earnings, because these latter constitute our chief objective. Since it does not do so, we seem forced to rely upon a somewhat circuitous procedure in order to arrive at (1) the degree of change in actual earnings; and (2) the amounts, both of actual and (hypothetical) full-time earnings, the latter emerging as an

incidental by-product of this procedure (without our having much use for them). The way in which the census average wage¹ is converted into an index number of full-time annual earnings per capita and the method by which to this series of index numbers is tied to an estimated *amount* of full-time yearly earnings for the year 1904, from which, in turn, estimated amounts of full-time yearly earnings for all census years are derived by application of this series of index numbers, are described in the chapter following.

Before undertaking that detailed explanation, it should be pointed out that wherever a figure appears in the census average wage column for the year 1925, it should be understood that that figure is not derived from the census records, but is estimated on the basis of the changes in per capita earnings between 1923 and 1925 reported for all industries combined and for a few single industries by the United States Bureau of Labor Statistics and the State Bureaus of Labor Statistics of New York, Massachusetts, and Wisconsin. This special estimate is more fully explained in Chapter XIX. It is used only in connection with figures for all industries combined and for 12 of the 41 selected industries covered in this monograph. In other words, the census average wage item for 1925 is on a footing with average wage items estimated for intercensal years, rather than on a footing with those items for the census years. The method of estimating the average wage item for the intercensal years is described in Chapter XIX.

FORMULA FOR THE CENSUS METHOD

The census method for computing the average number of wage earners may be put in the shape of a formula:

Let

n = Census average number of wage earners.

t = Time in operation in months.

and w_1 ----- t = the number of wage earners on the pay roll each month.

Then the census procedure is:

$$n = \frac{\Sigma(w_1 \text{-----} t)}{12}$$

Similarly, the method of computing the census average wage¹ may be expressed as follows:

Let

x = Census average wage.

t = Time in operation in months.

w_1 ----- t = Number of wage earners on the pay roll each month.

p = Total wage payment.

and n = Census average number of wage earners.

¹ See initial paragraph of this chapter, p. 260.

Then the procedure is:

$$x = \frac{p}{n}$$

or

$$x = \frac{p}{\frac{\Sigma(w_1 \text{-----} t)}{12}}$$

$$x = p \cdot \frac{12}{\Sigma(w_1 \text{-----} t)}$$

$$x = \frac{p}{\Sigma(w_1 \text{-----} t)} \cdot 12$$

That is to say, the total wages divided by the aggregate of the numbers of wage earners on the mid-month pay rolls for the months of actual operation gives the average monthly earnings of each man employed. This latter monthly average multiplied by 12 gives the amount he would earn if and when he is employed throughout the year—and this is the census average wage.¹

¹ See initial paragraph of this chapter, p. 260.

CHAPTER XIV

ESTIMATION OF FULL-TIME MONEY EARNINGS AND OF THE DEGREE OF CHANGE THEREIN

It would appear from the appraisal of the census average wage¹ made in the last chapter that its chief merit lies in the fact that, when a series of such average wage items, extending over a number of census years, is converted into relatives, these relatives measure quite accurately the changes in per capita, full-time, annual earnings. In this chapter an effort is made to explain how, by resort to the use of such relatives in connection with a special investigation of the earnings of wage earners made by the Census Bureau in 1904, it has been possible to arrive at estimates of the amounts of full-time money earnings.

CENSUS BUREAU'S INVESTIGATION OF WEEKLY EARNINGS IN 1904

The special investigation referred to was made under the supervision of W. M. Steuart, the present Director of the Bureau of the Census, and at that time chief statistician for manufactures. The inquiry covered manufacturing operations of the census year 1904. Schedules were submitted to each establishment that was in operation during any portion of the calendar year. According to the published report of the investigation, returns from the individual establishments "were prepared from an actual record of pay rolls or from information furnished by the proprietor or someone in authority who was familiar with actual earnings. Verbal statements were accepted only when there were less than 10 wage earners reported by the establishment * * *"²

The reports of this investigation covered the busiest week, or a representative week, in the year 1904. In securing original data the agents of the Census Bureau were given the following instructions:

This information is required for the three classes of employees—men 16 years and over, women 16 years and over, and children under 16 years of age—and is merely a transcript of the pay roll for the week in which the largest number was employed during the year, arranged so as to show the number of men, women, and children, respectively, at the specified earnings for the week. The distribution of the employees must be made according to actual earnings, not rates of pay. For instance, if an employee is rated at \$6 per week and works only three days during the week selected, he should be included in the group "\$3 and over, but under \$4." By consulting the pay roll for the week selected the number receiving

¹ See initial paragraph of Ch. XIII, p. 289.

² Earnings of Wage Earners, Bull. 93, Bureau of the Census, p. 10.

each amount can be tallied in the schedule so as to obtain the desired result. In some instances it may be necessary to supplement the information on the pay roll by inquiry concerning the number of women and children, respectively, employed, but any person familiar with the personnel of the employees can supply the number for each group. The answer to the inquiry must be for the period of one week. If the pay roll is for any other period, it must be reduced to a weekly basis before the figures are entered. If the establishment has no pay roll, secure and enter an estimate of the number at each weekly group. Give also the total amount paid as wages to men, women, and children separately for the week selected. The total wages for the week should not be less than the minimum or greater than the maximum as computed from the weekly earnings. It is essential that the segregation of the employees be made from a pay roll. In order that the office may be fully advised as to the source of the information the agent must, in every instance, write on the margin of the schedule, opposite this inquiry, "Obtained from a pay roll," or, if the answer is estimated, the word "Estimated."³

It is evident from the above instructions that what was done in this special investigation was to secure, for a representative week of full operation in the industry concerned, a record of actual earnings received by the wage earners of each establishment. These earnings were reported in the form of frequency distributions, showing the numbers of wage earners receiving earnings within classified groups. The reports for the different establishments, of course, were not all for the same week, since a representative week in one industry or locality is necessarily likely to come at a different season of the year from the representative week in another industry or locality.

The statistics published in the report, then, are a compilation of the returns for the different weeks selected for the individual establishments. In those cases where it was difficult to obtain for any plant a report for a week during which the largest number of wage earners was employed, the report was prepared for a "representative week."

SCOPE OF THE 1904 INVESTIGATION

The representativeness of the returns in the 1904 inquiry is indicated in some detail in Table 130. Additional information on the same point is given above in Table 14. In Table 130 we have, by industry, the number of establishments covered in the special inquiry reported in Census Bulletin 93, the number of wage earners employed in those establishments in the week for which earnings were reported and the percentage this number bears to the greatest number employed at any one time during that year in all the factories covered by the regular census of manufactures. It will be seen that, for "all industries" the factories reporting earnings had in their employ (during the week for which the earnings were reported) 47 per cent of the maximum number of wage earners employed during the year in all of the factories throughout the country. Among 41 industries,

³ Census, of Manufactures, 1905, Pt. IV, p. 643.

which are selected for the analysis made in this book, the percentage ranges from 27.1 in women's clothing to 85.6 in steam-railroad car construction.

It may be remarked, also, that the wage earners in the establishments covered by the special investigation of 1904, constituted, in the specified week for which the figures were taken in the different establishments, 60.3 per cent of the average number of wage earners

TABLE 130.—NUMBER OF WAGE EARNERS IN SELECTED ESTABLISHMENTS IN WEEK OF 1904 FOR WHICH EARNINGS WERE REPORTED AND CORRESPONDING NUMBER OF ESTABLISHMENTS, BY SELECTED INDUSTRIES

INDUSTRY	Number of establishments reporting weekly earnings	WAGE EARNERS IN SPECIFIED WEEK, SELECTED ESTABLISHMENTS ¹		INDUSTRY	Number of establishments reporting weekly earnings	WAGE EARNERS IN SPECIFIED WEEK, SELECTED ESTABLISHMENTS ¹	
		Number	Per cent of maximum ²			Number	Per cent of maximum ²
All industries.....	123, 703	3,207,819	47.0	Lumber and planing-mill products.....	2, 866	50, 787	41.8
Bread and other bakery products.....	13, 493	59, 079	65.0	Paper and wood pulp.....	381	38, 204	50.6
Flour and grist mill products.....	7, 382	30, 931	63.8	Printing and publishing, book and job.....	4, 802	52, 016	49.6
Slaughtering and meat packing.....	617	35, 818	39.6	Printing and publishing, newspapers and periodicals.....	10, 860	64, 551	57.9
Confectionery and ice cream.....	816	20, 455	42.7	Chemicals.....	155	11, 396	50.8
Liquors, malt.....	918	28, 446	51.9	Petroleum refining.....	58	15, 278	77.9
Mineral and soda waters.....	2, 542	9, 552	65.2	Brick, and tile, pottery, terra-cotta, and fire-clay products.....	2, 473	65, 045	37.1
Tobacco, cigars and cigarettes.....	9, 033	84, 292	51.4	Glass.....	171	30, 308	41.5
Carpets and rugs, other than rag.....	36	10, 512	29.0	Iron and steel, blast furnaces.....	82	23, 839	50.3
Clothing, men's.....	1, 697	47, 344	29.9	Iron and steel, steel works and rolling mills.....	192	119, 069	46.5
Clothing, women's.....	1, 072	40, 312	27.1	Foundry and machine-shop products.....	5, 359	246, 177	57.8
Cotton goods.....	525	202, 211	57.5	Smelting and refining.....	44	13, 391	41.5
Dyeing and finishing textiles.....	179	20, 195	50.5	Automobile bodies and parts.....	31	890	29.7
Knit goods.....	416	45, 347	38.8	Automobiles.....	86	10, 849	74.4
Silk goods.....	205	30, 480	33.6	Cars, steam-railroad.....	46	47, 249	85.6
Woolen and worsted goods.....	474	89, 684	63.0	Railroad repair shops—electric.....	43	6, 752	53.7
Shirts.....	242	16, 765	39.0	Railroad repair shops—steam.....	713	132, 042	66.8
Boots and shoes, not including rubber boots and shoes.....	745	92, 002	52.7	Agricultural implements.....	362	31, 016	49.2
Leather, tanned, curried, and finished.....	621	40, 259	58.8	Electrical machinery, apparatus, and supplies.....	443	36, 875	47.1
Furniture.....	1, 257	56, 918	44.3	Rubber and elastic goods.....	9	10, 211	65.7
Lumber and timber products.....	8, 394	177, 022	27.6	Shipbuilding, steel.....	28	22, 552	46.7

¹ Establishments from which average weekly earnings are reported.

² The greatest number employed at any one time. Census Bull. 93; pp. 17, 98.

in all establishments covered by the regular manufactures census of 1904. The average number of wage earners in the establishments included in the special inquiry, constituted in 1904, 49.1 per cent of the average number of wage earners in all establishments covered by the regular census of 1904. The special inquiry, moreover, included an average number of male wage earners equal to exactly 50 per cent of the total number of men 16 years of age and over,

covered by the regular census of 1904. It included 45.9 per cent of women and 46.2 per cent of children covered by the regular census.

An important feature of this 1904 investigation was that it reported earnings separately by sex and age groups, as well as by industrial and geographic divisions. Advantage has been taken of this fact to attempt the construction of estimates of the amounts of earnings received in the different census years by women and by children, as well as by male wage earners.

The data collected in the special investigation are reported primarily in the form of frequency tables of earnings. The class intervals of weekly earnings in the frequency distribution are \$1 to \$3, \$3 to \$4, and then widening after the \$9-\$10 interval, to a \$2, then to a \$3 and finally to a \$5, interval, being completed with the class "\$25 and over." The average weekly earnings reported in the special investigation of 1904 have been used in this monograph as a fixed starting point from which corresponding sums of average weekly earnings for preceding and later census years, and in some cases intercensal years, have been calculated.

Since our purpose in connection with the earnings investigation of 1904 is from its reports of actual earnings in a busy week, to derive estimates of actual yearly earnings it will be worth while perhaps to compare the ranking of the States on the basis of (1) the average weekly earnings as given in the published report of the 1904 inquiry and (2) the census average wage for that year. This comparison is made in Table 131. It is evident that while the ranking is not exactly the same in the two series, yet there is very little difference between them.

The amount, in dollars, of the average weekly earnings reported in Census Bulletin 93 for the busiest week of that year has been taken as representing not full-time earnings but what they are stipulated to be in the report, actual earnings received in a representative week. Of course, in a great many instances earnings in the busiest week do approximate full-time earnings; in some instances they equal or exceed full-time earnings, but it seems to be true that even in the busiest week the extent of employment falls appreciably short of the volume of employment represented by the condition of full-time employment of all wage earners attached to industry. The phrase "full employment" is here used, it should be remembered, in the sense of complete employment at full time (and yet without overtime) of all wage earners attached to any given industry. The available employment statistics indicate that for industry generally, even the periods of maximum prosperity reflect a degree of employment appreciably less than such full employment. In some industries, to be sure, there is so much overtime worked in periods of prosperity by employees on the pay roll, as entirely to make up (or even

more than make up) for the idleness of wage earners attached to the industry but not employed even in this period of prosperity.

These considerations seem to indicate rather definitely that the money sums reported as average weekly earnings in 1904 are generally somewhat less than full-time earnings. Now, the index numbers of census average wage relatives show changes in full-time earnings and not in actual earnings. It is necessary to change the figures of Bulletin 93 in such a way as to show as nearly as possible full-time weekly (and then, yearly) earnings. Next, because our final objec-

TABLE 131.—COMPARISON OF RANK OF STATES (AND ALASKA) FOR AVERAGE WEEKLY EARNINGS AND AVERAGE YEARLY EARNINGS: 1904

STATE	CENSUS BULLETIN 93, 1904		REGULAR 1904 MANUFACTURES CENSUS		STATE	CENSUS BULLETIN 93, 1904		REGULAR 1904 MANUFACTURES CENSUS	
	Average weekly earnings ¹	Rank	Census average wage	Rank		Average weekly earnings ¹	Rank	Census average wage	Rank
Montana.....	\$18.19	1	900	1	Connecticut.....	\$10.34	27	484	26
Nevada.....	17.70	2	865	2	Oklahoma.....	10.30	28	513	19
Arizona.....	16.15	3	828	3	Wisconsin.....	10.12	29	472	31
Wyoming.....	15.75	4	888	4	Indiana.....	10.10	30	467	32
Idaho.....	14.81	5	873	5	Michigan.....	9.92	31	464	34
Colorado.....	14.14	6	892	6	Massachusetts.....	9.68	32	476	30
Washington.....	13.84	7	866	7	Iowa.....	9.67	33	465	33
Alaska.....	13.83	8	565	15	Texas.....	9.51	34	499	25
California.....	13.24	9	844	8	Maine.....	9.39	35	436	40
Oregon.....	12.68	10	818	11	Delaware.....	9.27	36	442	38
New Mexico.....	12.18	11	819	10	Vermont.....	9.24	37	459	35
Utah.....	11.93	12	641	9	Rhode Island.....	9.19	38	443	37
North Dakota.....	11.81	13	888	12	Louisiana.....	9.16	39	453	36
South Dakota.....	11.69	14	870	14	Florida.....	9.04	40	375	45
Illinois.....	11.55	15	849	16	New Hampshire.....	9.04	41	424	41
Dist. of Columbia.....	11.16	16	881	13	Maryland.....	8.60	42	384	43
Minnesota.....	11.01	17	815	20	Kentucky.....	8.38	43	409	42
Nebraska.....	10.89	18	844	17	Arkansas.....	7.95	44	440	39
Indian Territory.....	10.82	19	807	21	Mississippi.....	7.70	45	383	44
Ohio.....	10.63	20	801	22	Virginia.....	7.69	46	348	48
Kansas.....	10.62	21	831	18	Alabama.....	7.65	47	352	47
West Virginia.....	10.58	22	483	27	Tennessee.....	7.51	48	377	46
Pennsylvania.....	10.51	23	482	28	Georgia.....	6.10	49	295	49
New Jersey.....	10.41	24	481	29	North Carolina.....	4.90	50	250	50
New York.....	10.40	25	802	23	South Carolina.....	4.68	51	233	51
Missouri.....	10.39	26	800	24					

¹ Earnings of wage earners Census Bull. 93, p. 36.

tive is to arrive at, not full-time, but actual yearly earnings, the expanded (full-time) yearly earnings, derived from the 1904 investigation, must be deflated again to actual earnings by resort to unemployment ratios. This circuitous procedure is made necessary because of the nature of the census average wage.⁴ The actual weekly earnings of 1904 have to be made full-time earnings in order to apply to them the index numbers of census average wages. This application of indices of census average wages to the estimated full-time yearly earnings for 1904, derived from weekly earnings for that year, makes

⁴ See initial paragraph of Ch. XIII, p. 269.

it possible to present estimates of the full-time yearly earnings in each of the other census years. But let it be repeated these latter estimates of full-time annual earnings are not what we seek. In that form they represent, very roughly, annual rates; that is to say, they represent the "salaries" which wage earners would get if they worked continuously throughout the year. It is necessary, therefore, to deflate these sums in order to secure estimates of *actual* earnings for each of the census years. What has been gained by this roundabout procedure is the estimation, on an annual basis, of amounts of earnings for other census years, as well as 1904.

EXPANSION OF ACTUAL TO FULL-TIME WEEKLY EARNINGS

It is necessary to consider now the procedure for the expansion of the average weekly earnings in 1904 to estimated full-time weekly earnings in the same year. The expansion coefficients are derived from New York State figures reporting the per cent of trade unionists unemployed in 1904. The method of derivation of the coefficients is indicated in Table 132. The figures are taken from the reports of the New York Department of Labor for 1904.⁵ In column B are given for those New York industries which are identical with or very closely resemble the 41 selected industries which we are including in this monograph, the per cent of trade unionists unemployed in the month when the highest average number of wage earners were employed in New York State. The months to which the percentages refer are listed in column A. In column C are given the complements of figures in column B; they represent, of course, employment ratios as distinguished from the unemployment ratios of the preceding column. Since there would undoubtedly be some considerable error involved in attempting to apply the New York employment ratios, shown in column C to our average weekly earnings in 1904, an effort was made to ascertain the probable relation in 1904 between the extent of employment in New York in different industries and the corresponding extent of employment in those same industries in the United States as a whole. To get at this relation the writer has made use of the unemployment figures published by the census as a part of its population statistics in 1890 and 1900.

For all industries combined, the derivation of this New York-United States correction ratios rests upon a comparison of census figures for 1890 and 1900. The figures for "all industries" are shown in Table 133. The ratios in the last column represent the relation between the United States and New York in respect to the number who were unemployed during some part of the year. Figures are given separately for males and females. Corresponding ratios for

⁵ Report of the New York Bureau of Labor Statistics, 1904—Appendix Table F.

separate industry groups are shown in Table 138. The ratios for these industries, however, are based upon the census unemployment figures for 1900 only. In the case of the figures for separate industries, the original census figures for unemployment are not for industries, as such, but for occupations. Thus, in Table 138, the ratios are shown for bakers, millers, confectioners, brewers, tobacco-factory operatives, etc. It has been assumed that these ratios indicate the relative extent of unemployment among bakers, millers, etc., in the United States as compared with New York, and, further, that without serious error they can be assumed to represent the ratio between the degrees of employment, for the cognate industries, between the United States and New York State.

Returning now to Table 132 and the United States correction ratios introduced in column D, these latter ratios are multiplied by the New York trade unionist employment ratios in column C to produce the "estimated ratios actual to full employment in the indicated month in the United States," shown in column E. These are the ratios which are utilized to expand the average weekly earnings in the busiest week in 1904 to estimates of full-time earnings for that week. The New York employment ratios used are for the busiest month and it is presumed that this busiest month is the month containing the busiest week which is reported in Census Bulletin 93. This assumption unquestionably involves some error, but it seems to represent the most accurate method of correction that is possible with the available data.

It should be explained that the data in column A in Table 132, showing the month of highest average of number of wage earners employed, were taken from the manufactures census of 1904, in which are reported the average number of employees on the pay rolls in each month during the census year. These monthly averages are given separately for men and women. In the construction of Table 132, therefore, for all sex and age groups combined and for women separately, the month of maximum employment was listed for all industries and for each separate industry. Opposite this month, in column B, was entered the per cent of trade unionists shown as unemployed in that month. The New York figures are not separately classified according to sex and, for that reason, there is probably very little to be gained by making separate reports for women. It was thought desirable to do so, however, in view of the fact that not only the census employment figures, but also the figures underlying the ratios between New York and United States unemployment in 1900 are separately reported by sex. In all cases where data for earnings are given for women separately, the estimated ratios for women from Table 132 are used. In other cases, that is to say, where men wage earners alone are reported, and where

EARNINGS OF FACTORY WORKERS

TABLE 132.—COMPOSITION OF ESTIMATE FOR EXPANDING ACTUAL WEEKLY EARNINGS TO FULL-TIME EARNINGS: 1904

INDUSTRY	ALL SEX AND AGE GROUPS					WOMEN				
	A	B	C	D	E	A	B	C	D	E
	Month in which highest average number of wage earners were employed 1	Per cent of New York trade unionists unemployed that month 2	New York trade unionists employ-ment ratio 3	United States correction ratio 4	Estimated ratio, actual to full em-ployment in indicated month: United States	Month in which highest average number of wage earners were employed 1	Per cent of New York trade unionists unemployed that month 2	New York trade unionists employ-ment ratio 3	United States correction ratio 4	Estimated ratio, actual to full em-ployment in indicated month: United States
All industries 1	October 4	10.8	0.892	0.975	0.870	October	10.8	0.892	0.975	0.870
Bread and other bakery products	July	10.7	.883	1.010	.901	June	11.3	.887	1.010	.887
Confectionery and ice cream	November	16.7	.833	.984	.820	November	16.7	.833	.984	.820
Flour-mill and gristmill products 3	October	20.0	.710	.980	.870	October	20.0	.710	.980	.870
Mineral and soda waters	July	2.5	.975	.984	.959	July	2.5	.975	.984	.959
Slaughtering and meat packing 4	December	17.1	.829	.975	.868	December	17.1	.829	.975	.868
Slaughtering, wholesale	November	16.7	.833	.975	.812	July	2.5	.956	.975	.975
Liquors, malt	July	2.5	.975	.981	.956	July	2.5	.975	.981	.956
Tobacco, cigars and cigarettes 5	November	2.8	.972	1.036	1.007	November	2.8	.972	1.036	1.007
Carpets and rugs, other than rag 10	February	25.6	.744	.915	.870	March	0.0	1.000	.915	1.000
Clothing, men's 12	October	16.2	.838	.945	13.838	March	34.3	.838	.945	13.838
Clothing, women's 12	October	16.2	.838	.981	.931	March	34.3	.838	.981	.931
Cotton goods 10	January	24.4	.756	1.012	.765	January	24.4	.756	1.012	.765
Dyeing and finishing textiles, exclusive of that done in textile mills. 10	December	14.5	.855	.981	13.855	February	25.6	.855	.981	13.855
Knit goods 10	October	7.2	.928	.965	.923	October	7.2	.928	.965	.923
Shirts 12	February	22.7	.773	1.013	11.870	March	34.3	.773	1.013	11.870
Silk goods, including throwsters 10	December	14.1	.855	1.021	.873	December	14.5	.855	1.021	.873
Woolen goods 10	March	15.0	1.000	.949	.849	November	18.5	1.000	.949	.849
Boots and shoes, not including rubber boots and shoes 14	March	15.8	.842	.934	.833	March	18.8	.842	.934	.833
Leather, tanned, curried, and finished	March	10.6	.894	.945	13.894	October	13.7	.894	.945	13.894
Furniture 15	November	18.5	.815	.975	.795	November	18.5	.815	.975	.795
Lumber and timber products 14	May	26.3	.737	.966	11.870	May	26.3	.737	.966	11.870
Lumber, planing-mill products, not including planing mills connected with sawmills. 14	September	25.2	.748	.966	11.870	March	34.4	.748	.966	11.870
Paper and wood pulp	October	0.0	1.000	.984	.984	June	0.0	1.000	.984	.984
Printing and publishing, book and job 16	December	9.4	.906	.994	.901	November	9.8	.906	.994	.901

Printing and publishing, newspapers and periodicals ¹¹	December.....	904	901	904	908
Chemicals ¹²	June.....	902	893	15.9	841
Petroleum refining ¹³	June.....	1,025	893	11.1	889
Glass.....	April.....	975	882	3.2	988
Iron and steel, blast furnaces.....	December.....	989	881		
Iron and steel, steel works and rolling mills.....	May.....	980	858	10.1	889
Foundry and machine-shop products ¹⁴	April.....	989	749	3.5	955
Smelting and refining ¹⁵	December.....	975	841		
Automobile bodies and parts ¹⁶	June.....	1,088	939	23.8	742
Automobiles ¹⁷	June.....	863	939		
Cars, steam-railroad, not including operations of railroad repair shops ¹⁸	August.....	900	824	13.7	863
Railroad repair shops—electric ¹⁹	April.....	897	794		
Railroad repair shops—steam ²⁰	December.....	912	835	8.8	912
Agricultural implements ²¹	March.....	870	848	13.0	870
Rubber goods ²²	December.....	894	784	11.1	889
Shipbuilding, steel.....	April.....	926	903		
Electrical machinery, apparatus, and supplies ²³	January.....	863	841	8.8	912

¹ From data showing "average number of wage earners employed during each month," Manufactures census, 1905, Pt. I, pp. Ixxix, 30-67.

² Reports of New York Bureau of Labor Statistics. The figures are for all sexes and all ages combined.

³ Compulsions of figures for each State.

⁴ For all industries combined, the ratio for "men" and "children" are 884 and 880, respectively.

⁵ Average number employed this month 5,677,732. Greatest number employed at any one time during year 7,017,138.

⁶ Basis: Corrected (a col. B) are for "Food preparations."

⁷ New York figures are for "Tobacco."

⁸ New York figures are for "Textiles."

⁹ Ratio for "All industries."

¹⁰ Unadjusted New York ratio.

¹¹ New York figures are for "Boots, shoes, and gloves."

¹² New York figures are for "Wood working and furniture."

¹³ New York figures are for "Printing, binding, etc."

¹⁴ New York figures are for "All industries combined" (p. 49 U. S. Bureau of Labor Statistics Bul. 310)

¹⁵ New York figures are for "Other metals (metals, machinery, and shipbuilding group)."

¹⁶ New York figures are for "Metals, machinery, shipbuilding (recapitulation)."

See Table 133.

there is no separation of sex, the United States correction ratios, shown in Table 132, have been utilized.

The method of applying the estimated ratios of actual to full employment for the busiest month of 1904, to the average weekly earnings in the busiest week in that year, is indicated in Table 134. The average weekly earnings in 1904 are divided by the ratios in column CX, taken from Table 132, the result being the estimated full-

TABLE 133.—COMPARISON OF EXTENT OF UNEMPLOYMENT IN NEW YORK AND THE UNITED STATES FOR MEN AND WOMEN AND FOR BOTH SEXES COMBINED: 1890 AND 1900¹

AREA AND SEX	PERSONS 10 YEARS OF AGE AND OVER IN GAINFUL OCCUPATIONS			Percentage employed	Ratio, United States to New York ²
	Total	Unemployed during some part of year			
		Number	Per cent		
1890					
United States:					
Male.....	4,034,061	900,672	22.16	77.8	97.0
Female.....	1,027,242	167,832	16.34	83.7	100.4
Total.....	5,061,293	1,068,404	21.0	79.0	97.7
New York:					
Male.....	634,430	125,795	19.8	80.2	100.0
Female.....	193,786	32,264	16.6	83.4	100.0
Total.....	828,216	158,059	19.1	80.0	100.0
1900					
United States:					
Male.....	5,772,641	1,631,057	28.3	71.7	96.6
Female.....	1,312,668	294,346	22.4	77.6	101.5
Total.....	7,085,309	1,925,403	27.2	72.8	97.3
New York:					
Male.....	788,317	203,130	25.8	74.2	100.0
Female.....	246,240	57,682	23.4	76.6	100.0
Total.....	1,034,557	260,821	25.2	74.8	100.0

¹ Figures are for gainfully employed persons in the continental United States in manufacturing and mechanical industries and are taken from the Occupations Census. Figures for 1890, U. S. census 1890: Population, Pt. II. Figures for 1900, U. S. census 1900, special reports: Occupations.

² The averages of 1890 and 1900 ratios are, for males, 96.9; females, 100.2; and total, 97.5.

time weekly wages for the year 1904 shown in column D. The corresponding estimated full-time weekly wages for the other census years are then obtained by multiplying the 1904 amount by the relatives shown in column B. Thus 11.56 multiplied by 0.89 gives 10.29, the estimated full-time weekly wages for 1899. The estimated full-time yearly earnings in column I are then calculated by multiplying weekly figures in preceding columns by 51, it being assumed that 51 weeks constitute a full year.⁶

⁶ The selection of 51 weeks as representing a full-time year was made only after very careful consideration of the alternatives. Obviously, any period short of 51 weeks would hardly represent full-time operation; yet, even in continuous industries it is not uncommon, even in years of good business, for factories to shut down entirely for a week. At any rate, in view of the handful of holidays in which factories customarily shut down, it has seemed unwise to take 52 weeks as the full-time year. The Census Bureau, furthermore, considers 307 days (51 six-day weeks) a full-time year. In industrial accidents statistics 300 days are generally taken to represent a full-time year. (Bureau of Labor Statistics Bull. 276, p. 69.)

Since the process of expansion (which in a few cases of much over-time, is one of contraction) of the average weekly earnings reported in Census Bulletin 93, to estimated full-time weekly earnings for the same year, is of considerable importance, the figures used in making the adjustment for the different industrial and regional groups are given in Tables 135 and 137 and in Tables 139 and 140 at the end of this chapter.

TABLE 134.—CENSUS AVERAGE WAGE, AVERAGE WEEKLY MONEY EARNINGS IN 1904, ESTIMATED FULL-TIME WEEKLY EARNINGS, AND ESTIMATED FULL-TIME YEARLY EARNINGS, ALL INDUSTRIES COMBINED, BY SEX AND AGE GROUP: 1899-1923

YEAR	Average wage	Relatives 1904=100	Average weekly (money) earnings in 1904	Estimated ratio, actual to full employment for month of 1904 involved in column C	Estimated full-time (money) weekly wages	Estimated full-time yearly earnings
	A	B	C	CX	D	I
United States:						
1899.....	\$426	\$0.89			\$10.29	\$525
1904.....	477	1.00	\$10.06	0.870	11.50	590
1909.....	518	1.09			12.60	643
1914.....	580	1.22			14.10	710
1919.....	1,158	2.43			23.09	1,433
1921.....	1,180	2.48			23.67	1,402
1923.....	1,207	2.63			30.35	1,560
Men:						
1899.....	426	.89			11.50	587
1904.....	477	1.00	11.16	.864	12.92	659
1909.....	518	1.09			14.08	729
1914.....	580	1.22			15.70	804
1919.....	1,158	2.43			31.40	1,601
1921.....	1,180	2.48			32.04	1,634
1923.....	1,207	2.63			33.85	1,726
Women:						
1899.....	426	.89			6.18	314
1904.....	477	1.00	6.17	.892	6.92	353
1909.....	518	1.09			7.54	391
1914.....	580	1.22			8.44	430
1919.....	1,158	2.43			16.82	858
1921.....	1,180	2.48			17.16	875
1923.....	1,207	2.63			18.13	925
Children:						
1899.....	426	.89			3.50	170
1904.....	477	1.00	3.40	.830	3.93	222
1909.....	518	1.09			4.28	202
1914.....	580	1.22			4.70	244
1919.....	1,158	2.43			9.55	457
1921.....	1,180	2.48			9.75	497
1923.....	1,207	2.63			10.30	525

The details of the expansion process, with the estimated full-time weekly earnings for the year (1904) are given by selected industry in Table 135. The figures in the first column come from Census Bulletin 93; those in the second from (or by the method shown in) Table 132; those in the third from a source entirely separate and by a method quite distinct⁷ from the source and method utilized in this

⁷ These figures, introduced in Tables 135, 137, 139, and 140, for purposes of comparison merely, were worked out (as explained in Chs. XV and XVI) for the purpose of reducing "full-time yearly earnings" to actual yearly earnings. The ratios are given for each of the selected industries and for all census years in Table 152.

chapter; those in the fifth and last column from a simple division of the figure in the first column by that in the second.

TABLE 135.—AVERAGE WEEKLY EARNINGS REPORTED FOR 1904 IN CENSUS BULLETIN 93, AND ESTIMATED RATIOS OF ACTUAL TO FULL EMPLOYMENT IN THAT YEAR, BY INDUSTRIES

INDUSTRY	Sex	Average weekly earnings reported in Census Bulletin 93	ESTIMATED RATIO, ACTUAL TO FULL EMPLOYMENT		Estimated full-time weekly earnings, 1904
			For month of 1904 covered in Census Bulletin 93	For year 1904 ¹ (male and female)	
All industries.....	Total.....	\$10.00	0.870	0.819	\$11.86
	Men.....	11.16	.804		12.92
	Women.....	6.17	.892		6.92
	Children.....	3.40	.830		3.93
Bread and other bakery products.....	Male.....	11.77	.901	.821	13.06
	Female.....	5.46	.837		6.15
Flour and gristmill products.....	Male.....	10.03	.870	.821	11.53
Confectionery.....	Male.....	10.27	.820	.759	12.52
	Female.....	4.83	.833		5.80
Slaughtering and meat packing.....	Male.....	11.27	.844	.844	13.35
Liquors, malt.....	Male.....	14.37	.956	.890	15.03
Mineral and soda waters.....	Male.....	9.86	.959	.888	10.28
	Female.....	5.09	.975		5.22
Tobacco, cigars and cigarettes.....	Male.....	11.14	1.007	.829	11.06
	Female.....	5.97	.972		6.14
Carpets and rugs, other than rag.....	Male.....	9.93	.870	.815	11.41
	Female.....	7.31	1.000		7.31
Shirts.....	Male.....	10.20	.870	.815	11.72
	Female.....	5.69	.892		6.38
Clothing, men's.....	Male.....	12.23	.838	.815	14.59
	Female.....	6.07	.892		6.80
Clothing, women's.....	Male.....	13.52	.931	.815	14.52
	Female.....	6.85	.892		7.67
Cotton manufactures.....	Male.....	7.71	.870	.840	8.86
	Female.....	6.03	.870		6.93
Dyeing and finishing textiles.....	Male.....	9.51	.855	.815	11.12
	Female.....	5.99	.892		6.72
Knit goods.....	Male.....	8.90	.923	.815	9.04
	Female.....	6.01	.928		6.47
Silk goods.....	Male.....	10.57	.873	.815	12.11
	Female.....	6.11	.855		7.15
Woolen and worsted goods.....	Male.....	9.52	.949	.765	10.03
	Female.....	6.33	.949		7.20
Boots and shoes, not including rubber boots and shoes.....	Male.....	11.88	.870	.856	13.66
	Female.....	7.00	.870		8.74
Leather, tanned, curried, and finished.....	Male.....	9.90	.894	.802	11.07
Furniture.....	Male.....	10.16	.802	.802	12.67
Lumber, timber products.....	Male.....	9.25	.870	.802	10.63
Lumber, planing-mill products, not including planing mills connected with sawmills.....	Male.....	11.15	.870	.802	12.82
Paper and wood pulp.....	Male.....	10.64	.984	.917	10.81
Printing and publishing, book and job.....	Male.....	12.94	.901	.873	14.36
	Female.....	6.54	.902		7.26
Printing and publishing, newspapers and periodicals.....	Male.....	13.13	.901	.873	14.57
	Female.....	5.95	.906		6.57
Chemicals.....	Male.....	10.91	.946	.884	11.53
Petroleum refining.....	Male.....	12.31	.939	.876	13.11
Brick and tile, terra-cotta, and fire-clay products.....	Male.....	9.82	.883	.878	11.12
Glass.....	Male.....	14.10	.877	.848	16.36
	Female.....	5.09	.968		5.25
Iron and steel, blast furnaces.....	Male.....	11.71	.881	.748	13.29
Iron and steel, steel works and rolling mills.....	Male.....	12.56	.856	.748	14.07
Foundry and machine-shop products.....	Male.....	11.88	.749	.745	15.86
Smelting and refining.....	Male.....	13.82	.941	.789	14.69
Automobile bodies and parts.....	Male.....	11.05	.939	.701	11.77

¹ From Table 152. The derivation of these employment ratios for the whole year 1904 is worked out entirely independently of the ratios for the peak month in 1904 and for use in expanding the earnings data of Census Bull. 93. These ratios are for all sex and age groups combined. They are inserted in the table merely for purposes of comparison.

TABLE 135.—AVERAGE WEEKLY EARNINGS REPORTED FOR 1904 IN CENSUS BULLETIN 93, AND ESTIMATED RATIOS OF ACTUAL TO FULL EMPLOYMENT IN THAT YEAR, BY INDUSTRIES—Continued

INDUSTRY	Sex	Average weekly earnings reported in Census Bulletin 93	ESTIMATED RATIO, ACTUAL TO FULL EMPLOYMENT		Estimated full-time weekly earnings, 1904
			For month of 1904 covered in Census Bulletin 93	For year 1904 (male and female)	
Automobiles.....	Male.....	\$13.07	0.939	0.701	\$13.02
Cars, steam-railroad.....	Male.....	11.21	.824	.560	13.60
Railroad repair shops—electric.....	Male.....	12.55	.794	.732	15.81
Railroad repair shops—steam.....	Male.....	12.47	.835	.732	14.93
Agricultural implements.....	Male.....	10.97	.848	.658	12.94
Rubber goods.....	Male.....	11.25	.804	.658	13.99
Shipbuilding, steel.....	Male.....	11.32	.903	.658	12.54
Electrical machinery, apparatus, and supplies.....	Male.....	10.85	.841	.658	12.90
	Female..	6.37	.912	6.98

The same construction shown in Table 135 is given for geographic regions and divisions in Table 137. The method of constructing this latter table is indicated in Table 136. The first two columns of the latter table show the total population in the different regions in 1900 and the proportions of that population unemployed at some time in that year. The third column (by use of complementary percentages) shows the proportions employed in 1900. The fourth column, derived from the one preceding, gives the ratio of each region to the United States. These regional ratios, finally, are multiplied by the United States ratio, 0.870 (calculated as shown in Table 132) to produce corresponding regional ratios, which are used in computing the results presented in Parts II and III of this monograph, on the assumption that they represent for each geographic division the ratio of actual

TABLE 136.—DERIVATION OF RATIOS, ACTUAL TO FULL EMPLOYMENT, FOR REPRESENTATIVE WEEK OF 1904, BY GEOGRAPHIC REGIONS AND DIVISIONS

REGION	Number unemployed, 1900 ¹	Per cent of total	Per cent employed	Ratio of region to United States	Ratio of actual to full employment ²
UNITED STATES.....	1,925,403	27.2	72.8	100.0	0.870
North Atlantic.....	865,858	25.7	74.3	102.1	.886
South Atlantic.....	157,924	25.2	74.8	102.7	.892
North Central.....	698,776	29.5	70.5	96.8	.841
South Central.....	130,108	28.6	71.4	98.1	.852
Western.....	123,617	28.1	71.9	98.0	.857
Northeast ³867
South ³875
West.....					.857

¹ At some time during the year, in manufacturing and mechanical pursuits, U. S. census, 1900. Special reports: Occupations, p. cxxxv.

² Assumed to apply to 1904 and used for expansion of weekly earnings data in Census Bull. 93. Computed by geographic divisions by multiplying 0.870, ratio for United States (all industries), by index in preceding column.

³ Weighted average from above fivefold regional division, weight being number of wage earners in 1904.

TABLE 138.—PROPORTION OF GAINFULLY EMPLOYED IN MANUFACTURING AND MECHANICAL PURSUITS WHO WERE UNEMPLOYED SOME PART OF THE YEAR 1900, SHOWING THE UNITED STATES TOTAL AND NEW YORK AS A TOTAL AND BY SEX—Continued

OCCUPATION, AREA, AND SEX	Aggregate number in the occupation	UNEMPLOYED			Total unemployed	Per cent number unemployed is of aggregate in occupation	Per cent employed	Ratio, United States to New York, New York=100
		1-3 months	4-6 months	7-12 months				
Confectioners.....	31,242				3,995	12.8	87.2	98.4
New York.....	6,105	390	221	52	693	11.4	88.6	
Male.....	4,302	233	148	55				
Female.....	1,803	157	73	27				
Brewers and maltsters.....	20,984				2,552	12.2	87.8	98.1
New York.....	4,319	226	134	95	455	10.5	89.5	
Male.....	4,319	226	134	95				
Female.....								
Bottles and soda-water makers.....	10,546				1,298	12.3	87.7	98.4
New York.....	2,230	127	88	27	242	10.9	89.1	
Male.....	2,230	127	88	27				
Female.....								
Tobacco and cigar factory operatives.....	131,464				37,496	28.5	71.5	103.6
New York.....	26,269	4,902	2,582	567	8,141	31.0	69.0	
Male.....	17,292	2,845	1,476	409				
Female.....	8,977	2,147	1,106	158				
Carpet factory operatives.....	19,372				4,791	24.7	75.3	91.5
New York.....	5,910	756	194	98	1,048	17.7	82.3	
Male.....	2,517	270	105	40				
Female.....	3,393	486	89	58				
Tailors (and tailoresses).....	230,277				61,602	26.8	73.2	116.0
New York.....	88,762	18,946	12,013	1,818	32,777	36.9	63.1	
Male.....	65,180	14,362	9,400	1,251				
Female.....	23,582	4,584	2,604	567				
Seamstresses.....	151,379				37,025	24.5	75.5	106.2
New York.....	27,770	4,830	2,589	602	8,030	28.9	71.1	
Male.....	2,990	738	383	43				
Female.....	24,780	4,101	2,206	559				
Cotton-mill operatives.....	246,391				34,396	14.0	86.0	101.2
New York.....	5,105	440	198	128	760	15.0	85.0	
Male.....	2,428	104	98	56				
Female.....	2,677	246	100	72				
Bleachery and dyeworks operatives.....	22,289				4,261	19.1	80.9	98.1
New York.....	2,084	188	131	46	365	17.5	82.5	
Male.....	1,872	172	115	40				
Female.....	212	16	16	6				
Hosiery and knitting-mill operatives.....	47,120				9,444	20.0	80.0	99.5
New York.....	11,386	1,319	584	326	2,229	19.6	80.4	
Male.....	3,935	489	227	120				
Female.....	7,451	830	357	206				
Shirt, collar, and cuff makers.....	39,432				8,840	22.4	77.6	101.3
New York.....	19,542	2,922	1,244	410	4,582	23.4	76.6	
Male.....	4,002	748	310	67				
Female.....	15,540	2,174	934	349				
Silk-mill operatives.....	54,460				14,823	27.2	72.8	102.1
New York.....	6,153	1,026	521	216	1,763	28.7	71.3	
Male.....	2,532	426	268	98				
Female.....	3,621	600	253	118				
Woolen-mill operatives.....	73,196				14,777	20.2	79.8	94.9
New York.....	6,072	526	278	164	968	15.9	84.1	
Male.....	3,333	305	154	91				
Female.....	2,739	221	124	73				

TABLE 138.—PROPORTION OF GAINFULLY EMPLOYED IN MANUFACTURING AND MECHANICAL PURSUITS WHO WERE UNEMPLOYED SOME PART OF THE YEAR 1900, SHOWING THE UNITED STATES TOTAL AND NEW YORK AS A TOTAL AND BY SEX—Continued

OCCUPATION, AREA, AND SEX	Aggregate number in the occupation	UNEMPLOYED			Total unemployed	Per cent number unemployed is of aggregate in occupation	Per cent employed	Ratio, United States to New York, New York=100
		1-3 months	4-6 months	7-12 months				
Boot and shoe makers and repairers.....	209,047				70,435	33.7	60.3	87.1
New York.....	27,539	3,730	1,090	874	6,594	23.9	70.1	
Male.....	23,374	2,817	1,030	753				
Female.....	4,165	913	360	121				
Leather curriers and tanners.....	42,684				10,533	24.7	75.3	94.5
New York.....	6,408	783	351	178	1,312	20.3	79.7	
Male.....	6,105	740	332	177				
Female.....	303	37	19	1				
Saw and planing mill employees.....	161,687				56,638	35.1	64.9	96.6
New York.....	6,686	1,062	956	174	2,192	32.8	67.2	
Male.....	6,686	1,062	956	174				
Female.....								
Paper and pulp mill operatives.....	36,326				6,538	18.0	82.0	98.4
New York.....	6,048	708	320	134	1,162	16.7	83.3	
Male.....	5,778	606	241	111				
Female.....	1,170	102	79	23				
Printers, lithographers, and pressmen.....	155,333				23,548	15.2	84.8	90.4
New York.....	31,822	2,504	1,434	755	4,693	14.7	85.3	
Male.....	29,724	2,371	1,342	698				
Female.....	2,098	133	92	57				
"Other chemical workers," chemical works employees.....	14,723				2,794	19.0	81.0	90.3
New York.....	1,994	111	59	36	206	10.3	89.7	
Male.....	1,807	96	47	33				
Female.....	187	15	12	3				
Oil-well and oil-works employees.....	24,626				5,632	22.9	77.1	103.5
New York.....	1,218	186	103	21	310	25.5	74.5	
Male.....	1,218	186	103	21				
Female.....								
Brick and tile makers, etc.....	49,934				24,004	48.2	51.8	213.6
New York.....	7,848	1,041	4,711	236	5,988	76.3	23.7	
Male.....	7,848	1,041	4,711	236				
Female.....								
Glassworkers.....	49,999				20,501	50.2	40.8	66.4
New York.....	4,704	1,171	433	233	1,837	38.6	61.4	
Male.....	4,551	1,133	424	226				
Female.....	213	38	9	7				
Iron and steel workers.....	290,724				81,456	28.0	72.0	98.0
New York.....	31,540	5,176	2,277	903	8,356	26.5	73.5	
Male.....	31,252	5,148	2,248	898				
Female.....	288	28	29	5				
Machinists.....	283,432				37,902	13.4	86.6	98.9
New York.....	40,699	2,921	1,350	776	5,047	12.4	87.6	
Male.....	40,699	2,921	1,350	776				
Female.....								
Brass workers.....	26,760				5,263	19.7	80.3	103.3
New York.....	5,037	714	284	124	1,122	22.3	77.7	
Male.....	5,037	714	284	124				
Female.....								
Rubber factory operatives.....	21,866				7,411	33.9	66.1	82.8
New York.....	1,476	163	66	39	298	20.2	79.8	
Male.....	1,053	120	66	29				
Female.....	423	43	30	10				

ESTIMATION OF FULL-TIME MONEY EARNINGS 303

TABLE 139.—AVERAGE WEEKLY EARNINGS REPORTED FOR 1904 IN CENSUS BULLETIN 93, ESTIMATED RATIOS, ACTUAL TO FULL EMPLOYMENT, AND ESTIMATED FULL-TIME WEEKLY EARNINGS, BY GEOGRAPHIC REGIONS, DIVISIONS, AND STATES, ALL SEX AND AGE GROUPS COMBINED: 1904

REGION	Average weekly earnings reported in Census Bulletin 93	ESTIMATED RATIO, ACTUAL TO FULL EMPLOYMENT FOR—		Estimated full-time weekly earnings, 1904
		Month of 1904 covered in Census Bulletin 93	Year 1904 ¹	
UNITED STATES.....	\$10.06	0.870	0.819	\$11.56
NORTHEAST.....	10.34	.867	.817	11.93
NEW ENGLAND.....	9.67	.886	.817	10.91
Maine.....	9.39	.886	.817	10.60
New Hampshire.....	9.04	.886	.817	10.20
Vermont.....	9.24	.886	.817	10.43
Massachusetts.....	9.68	.870	.817	10.93
Rhode Island.....	9.19	.886	.817	10.37
Connecticut.....	10.34	.886	.817	11.67
MIDDLE ATLANTIC.....	10.45	.886	.817	11.70
New York.....	10.40	.886	.817	11.74
New Jersey.....	10.41	.886	.817	11.75
Pennsylvania.....	10.51	.886	.817	11.86
EAST NORTH CENTRAL.....	10.66	.841	.817	12.68
Ohio.....	10.63	.841	.817	12.64
Indiana.....	10.10	.841	.817	12.01
Illinois.....	11.55	.841	.817	13.73
Michigan.....	9.92	.841	.817	11.80
Wisconsin.....	10.12	.841	.817	12.03
WEST NORTH CENTRAL.....	10.47	.841	.817	12.45
Minnesota.....	11.01	.841	.817	13.09
Iowa.....	9.67	.841	.817	11.50
Missouri.....	10.39	.841	.817	12.35
North Dakota.....	11.81	.841	.817	14.04
South Dakota.....	11.69	.841	.817	13.90
Nebraska.....	10.89	.841	.817	12.95
Kansas.....	10.58	.841	.817	12.58
SOUTH.....	7.67	.875	.799	8.77
SOUTH ATLANTIC.....	7.31	.892	.799	8.20
Delaware.....	9.27	.892	.817	10.39
Maryland.....	8.60	.892	.817	9.64
District of Columbia.....	11.16	.892	.799	12.51
Virginia.....	7.69	.892	.799	8.62
West Virginia.....	10.52	.892	.799	11.70
North Carolina.....	4.90	.892	.799	5.56
South Carolina.....	4.68	.892	.799	5.25
Georgia.....	6.10	.892	.799	6.84
Florida.....	9.04	.892	.799	10.13
EAST SOUTH CENTRAL.....	7.86	.852	.799	9.23
Kentucky.....	8.38	.852	.799	9.92
Tennessee.....	7.51	.852	.799	8.89
Alabama.....	7.65	.852	.799	9.06
Mississippi.....	7.79	.852	.799	9.22
WEST SOUTH CENTRAL.....	9.07	.852	.799	10.65
Arkansas.....	7.95	.852	.799	9.41
Louisiana.....	9.16	.852	.799	10.84
Oklahoma.....	10.30	.852	.799	12.19
Texas.....	9.51	.852	.799	11.26
WEST.....	13.68	.857	.848	15.96
MOUNTAIN.....	14.84	.857	.848	17.32
Montana.....	13.19	.856	.848	21.25
Idaho.....	14.81	.856	.848	17.30
Wyoming.....	15.75	.856	.848	18.40
Colorado.....	14.14	.856	.848	16.52
New Mexico.....	12.13	.856	.848	14.23
Arizona.....	16.15	.856	.848	18.87
Utah.....	11.93	.856	.848	13.94
Nevada.....	17.76	.856	.848	20.75
PACIFIC.....	13.29	.857	.848	15.51
Washington.....	13.84	.856	.848	16.17
Oregon.....	12.58	.856	.848	14.70
California.....	13.24	.856	.848	15.47

¹ See footnote to Table 135.

week. This average was calculated for the various industrial and regional classifications for each census year from 1909 to 1921, inclusive. Prior to 1909 the Census Bureau did not publish frequency tables of the prevailing hours worked per week, and for the two census years prior to 1909 it was necessary, therefore, to fall back upon another method of working out the necessary averages, to be described presently.

CALCULATIONS OF AVERAGES OF PREVAILING HOURS OF WORK

The method of calculating the prevailing hours averages from the census tables follows the usual procedure for calculating weighted averages from frequency tables; that is to say, the number of employees listed in each hours bracket (between 48 and 54, 54 and 60, etc.) was multiplied by the number of hours taken as the midpoint of the hours group, it being assumed for the purpose of computing the average, that every employee in any hours group worked the number of hours represented by the assumed midpoint. The resulting products were then added and the sum of the products divided by the total number of employees shown in the frequency table, the result of this division being the required weighted average of prevailing hours worked per week.

The calculation of prevailing hours averages for the years 1899 and 1904 has been made with the aid of the data on full-time hours per week published by the United States Bureau of Labor Statistics for 15 industries. For the most part, the Bureau of Labor Statistics' relatives utilized here are not taken directly from the published statement of the Bureau of Labor Statistics, but from the more condensed arrangement of them published in Mr. I. M. Rubinow's article on "The recent trend of real wages."³ The Bureau of Labor Statistics' relatives as reported by Mr. Rubinow are upon the original base used by the bureau (average, 1890-1899 = 100). For our present purposes, his series of relatives has been shifted to the base 1909 = 100. When this shift has been made, we have for all industries combined and for the separate industries a series of index numbers of full-time hours per week for each census year from 1899 to 1914, inclusive. We have also the above-mentioned series of weighted averages of prevailing hours worked per week for each of the census years from and including 1909. It will be evident, as is indicated by the figures in Table 166, that this gives us an overlap for the two census years 1909 and 1914. The United States Bureau of Labor Statistics' index number for 1914 on the 1909 base is 96; the index of the weighted census average for 1914 on the same base is 97. This close correspondence seems to indicate that the United States Bureau of Labor Statistics' index

³ 4 American Economic Review 810 (December, 1914).

numbers for the earlier period may safely be relied upon as the basis for projecting backward to 1899 the series of weighted averages derived from the census reports. This, accordingly, has been done. The year 1909 being taken as 100, it follows that the probable weighted average for 1904 will be the number of hours which bears the same relation to the known census average as the Bureau of Labor Statistics' relative, 102, bears to its base. In Table J, on page 405, the detailed results are shown for the different selected industries. In this table the names of the selected industries covered in this monograph and the most nearly cognate of the United States Bureau of Labor Statistics' relatives (which are used in splicing) are listed in parallel columns.

TABLE 163.—CALCULATION OF COMPLETE SERIES OF AVERAGES OF PREVAILING HOURS WORKED PER WEEK, ALL INDUSTRIES COMBINED: 1899-1921

YEAR	INDUSTRY CLASSIFICATION		U. S. BUREAU OF LABOR STATISTICS' RELATIVES OF FULL-TIME HOURS PER WEEK		Spliced series of prevailing hour averages ²
	Selected industries used in this book	U. S. Bureau of Labor Statistics series used	(Average, 1890-1899=100) ¹	(1909=100)	
1899.....	All industries.....	15 industries combined.....	99.2	105	59.83
1904.....			98.0	102	57.93
1909.....			94.4	100	56.80
1914.....			90.1	96	55.10
1919.....					50.80
1921.....					50.30

¹ U. S. Bureau of Labor Statistics' indices, as reported by I. M. Rubinow.

² Figures for 1909-1921, inclusive, are weighted averages computed from census data; figures for 1899-1914 are calculated on the basis of the series of indices on the 1909 base.

³ Relatives for 1914 are taken from a more recent article, which has brought more nearly down to date the analysis of the U. S. Bureau of Labor Statistics' data originally made by Mr. Rubinow ("The Movement of Real Wages, 1890-1918" (Paul H. Douglas and Francis Lamberson, 11 American Economic Review 413, September, 1921)).

It is all too evident that the industry classifications do not match as well as might be desired. For a number of our selected industries, indeed, there is no cognate series of the United States Bureau of Labor Statistics' indexes and for such industries we have had to fall back upon the United States Bureau of Labor Statistics' relatives for all of the 15 industries combined, as reported by Mr. Rubinow. For some of the selected industries exactly the same United States Bureau of Labor Statistics' series could be used. In one case, namely, that of bread and other bakery products, the United States Bureau of Labor Statistics' relatives for bakers has been used. This, however, is apparently the only instance where an occupational series has been used in connection with an industrial series. In the all too numerous instances where the United States Bureau of Labor Statistics' series for all industries has had to be used, it is probably true that in the final series of prevailing hour averages, the items for 1899 and 1904 are really not industrial series at all but more in the nature

of general series representing all industries. This would be the situation in all of the instances where the United States Bureau of Labor Statistics' relatives for all industries are used, were it not that at the point where the splicing is done, in 1909, it has been possible to introduce separate weighted census averages for each of the selected industries. The relative changes back from those averages to 1904 and on back to 1899 are exactly the same except where the special United States Bureau of Labor Statistics' indexes are used for the industries involved. The result, however, is a slightly different series for practically all of the selected industries, and this result, of course, is a compromise between the use of the single "all industries" series for separate industry groups and the other alternative, which is the ideal but here quite impossible one, of having a separate series of relatives definitely representing each one of the selected industries.

Prevailing hour averages for geographic divisions for the census years 1909 to 1919, inclusive, were computed from the census frequency tables in the same fashion as already described for industry groups. No frequency data are available for the 1921 census for geographic divisions. Consequently, in each geographic division, the prevailing hour average has been assumed to have diminished from the year 1919 in the same proportion as it definitely has been shown to have diminished in the United States as a whole. The averages, for 1899 and 1904, for the separate geographic divisions, were estimated by making, with the aid of the United States Bureau of Labor Statistics' indexes, a backward projection similar to that already described for the selected industries. In Table 167 (p. 360) the resulting complete series of prevailing hour averages for the nine geographic divisions are shown.

TABLE 164.—PREVAILING HOUR AVERAGES (WEIGHTED), BY GEOGRAPHIC DIVISIONS, ALL INDUSTRIES COMBINED

DIVISION	1899 ¹	1904 ¹	1909	1914	1919	1921 ²
United States.....	59.6	57.9	56.8	55.1	50.8	50.3
New England.....	58.5	56.8	55.7	54.1	49.6	49.1
Middle Atlantic.....	59.0	57.3	56.2	54.3	49.6	49.1
East North Central.....	59.5	57.8	56.8	54.8	51.3	50.8
West North Central.....	59.3	57.6	56.5	55.2	51.5	51.0
South Atlantic.....	61.8	60.1	58.9	57.7	53.5	53.0
East South Atlantic.....	62.4	60.6	59.4	57.9	55.3	54.7
West South Central.....	62.8	61.0	59.8	58.5	54.0	54.4
Mountain.....	60.1	58.3	57.2	55.5	52.0	51.5
Pacific.....	59.2	57.5	56.4	54.9	47.5	47.0

¹ The 1899 and 1904 figures for the separate geographic divisions are estimated by making a projection back through those years on the basis of U. S. Bureau of Labor Statistics' index numbers for all industries combined.

² No census data available for geographic divisions. In each geographic division the prevailing hour average has been assumed to have diminished in the same proportion that it decreased in the United States as a whole.

The way in which the average full-time hours per week, which we have now obtained, are applied in conjunction with full-time weekly earnings to arrive at estimated earnings per hour, is shown in Table 168, in which are used, for illustration, the figures for all industries combined.

TABLE 165.—DERIVATION OF ESTIMATED AMOUNTS OF HOURLY EARNINGS, PER CAPITA, ALL INDUSTRIES COMBINED

CENSUS YEAR	Average full-time hours per week	Estimated full-time weekly earnings per capita	Estimated amount of hourly earnings per capita
1899.....	59.63	\$10.20	\$0.1726
1904.....	57.98	11.56	.1996
1909.....	56.79	12.00	.2219
1914.....	55.07	14.10	.2660
1919.....	50.80	28.00	.5530
1921.....	50.30	28.67	.5700

CHAPTER XIX

THE INTERPOLATION OF INTERCENSAL YEARS

The average annual earnings and changes therein which have been estimated and reported in preceding pages are for the most part for those years in which the United States census of manufactures was taken. They are, within the period of this study, 1899, 1904, 1909, 1914, 1919, 1921, 1923, and 1925. It will be noticed, however, that some results are given for each year of the 27-year period—they include, that is to say, intercensal as well as census years. The inclusion of these series in complete annual form has been made possible by resort to the supplementary use of the figures on average per capita earnings reported by the United States Bureau of Labor Statistics and by the States of New York, Massachusetts, and Wisconsin.

There is, undoubtedly, some inconsistency involved in resorting to index numbers of (*actual*) per capita earnings to fill in the intercensal interstices of a series of average wages, which, as we have emphasized in an earlier chapter, show changes in *full-time* and not in actual earnings. And, no doubt, the interstitial index numbers, resulting from this illogical procedure are less accurate than would be results derived from appropriate (but nonexistent) relatives of full-time earnings. Data for actual weekly earnings have been relied upon because, so far as we know, there are no other data available. The United States Bureau of Labor Statistics published, in its bulletins on wages and hours, some fragmentary figures on full-time earnings, but they are not annual and they do not represent manufacturing industry as a whole.

It would, of course, be foolish to claim a high degree of accuracy for the estimates of amounts of per capita earnings, or even of changes in earnings, finally arrived at through interpolation, but comparisons (such as are made in Part I) with results reached by such agencies as the National Bureau of Economic Research tend to confirm the belief that the present results, in respect, at least, to *changes* in earnings, are not seriously in error.¹

The results that we have been able to report in annual form as a result of interpolation are for the United States as a whole, all industries combined, and for each of the 12 of our 41 selected industries which also happen to be reported for per capita earnings for the period 1915 to 1925 by the United States Bureau of Labor Statistics. It

¹ See Table 17, p. 48.

has not been possible to report earnings in annual form for any of the other selected industries or industry groups, nor has it been possible to report them separately in this form for any geographic subdivision of the United States. The annual figures for all industries combined and for each of the 12 selected industries cover the whole of our period of 1899 to 1925.

The procedure followed in arriving at the annual series of amounts of, and changes in, earnings is indicated in Table 166 and Table 167.

SOURCE MATERIALS FOR INTERCENSAL INTERPOLATIONS

The necessary starting point is the estimation of the intercensal counterparts of the index numbers of census average earnings, or what may be called "intercensal mean-wage payments." It is not necessary, of course, actually to get a dollar sum representing for the intercensal years the same metaphysical something that is represented for the census years, by the census average wage.² It is necessary only to get a series of relatives for the years intervening between census years, which shall indicate the size of the average wages in those years relative to the amount of the census average wage for census year. The development of these relatives, in the case of all industries combined, rests upon the utilization of a spliced series containing for the period 1899 to 1913, inclusive, the Massachusetts figures for average yearly earnings, and for the remainder of the period per capita earnings figures obtained by striking a simple average of the relatives (1) the per capita weekly earnings reported for the United States by the United States Bureau of Labor Statistics and for two of the States by the New York State Department of Labor and the Wisconsin Industrial Commission and (2) the average yearly earnings reported by the Massachusetts Department of Labor and Industries. The Massachusetts figures, which constitute the sole ingredient for the first part of our period, are shown in the first column of Table 166. The figures are those published in the annual reports on the Statistics of Manufactures by the Massachusetts Department of Labor and Industries. The figures are described in the report as "average yearly earnings"; they are computed in the same way that the Census Bureau calculates its "average wages." The data for the latter part of the period, including the single Federal series and the three State series, are based in the case of Massachusetts directly upon index numbers. Consequently, the splicing of the two periods is not done until the Massachusetts absolute amounts have been converted into index numbers. The computation of the averages for the last part of the period is outlined in Table 167. The index numbers shown in that table for the United States are

² See initial paragraph, Ch. XIII, p. 269.

TABLE 166.—BASIS FOR COMPUTING INTERCENSAL RELATIVES OF AVERAGE WAGES FOR THE PURPOSE OF CONSTRUCTING A YEARLY INDEX OF ANNUAL EARNINGS PER CAPITA

YEAR	Massachusetts average yearly earnings ¹	Relatives (preceding census year, 100)	Spliced series (preceding census year, 100) ²	YEAR	Massachusetts average yearly earnings ¹	Relatives (preceding census year, 100)	Relatives of per capita earnings, United States Bureau of Labor Statistics, as computed by Federal Reserve Bank of New York. ³		Spliced series (preceding census year, 100) ²
							December, 1914, base	Yearly, 1914, base ⁴	
1899	\$427.60	1.000	1.000	1914	\$562.87	1.000	⁵ 1.000	1.000	⁶ 1.000
1900	441.61	1.032	1.032	1915	580.61	1.031	1.020	1.080	⁶ 1.021
1901	449.69	1.050	1.050	1916	656.23	1.107	1.210	1.140	⁶ 1.170
1902	459.98	1.074	1.074	1917	753.23	1.349	1.430	1.350	⁶ 1.367
1903	471.52	1.102	1.102	1918	944.05	1.680	1.551	1.747	⁶ 1.791
1904	467.44	1.000	1.000	1919	1,073.95	1.000	2.171	2.048	⁶ 1.000
1905	477.07	1.020	1.020	1920	1,280.74	1.192	2.601	2.458	⁶ 1.203
1906	494.96	1.000	1.000	1921			2.240	2.120	⁶ 1.000
1907	515.18	1.102	1.102	1922			2.127	2.030	⁶ .976
1908	510.71	1.091	1.091	1923			2.356	2.220	⁶ 1.000
1909	515.21	1.000	1.000	1924			2.330	2.200	⁶ .990
1910	526.92	1.021	1.021	1925				2.280	⁶ 1.040
1911	532.76	1.034	1.034						
1912	551.86	1.070	1.070						
1913	569.43	1.112	1.112						

¹ Annual Statistics of Manufactures, Massachusetts.

² 1899-1913 based on Massachusetts relatives; 1915-1923 based on average of relatives (of per capita earnings) from U. S. Bureau of Labor Statistics (13 industries, United States) New York, Massachusetts, and Wisconsin.

³ Chain relatives computed by Federal Reserve Bank of New York, from U. S. Bureau of Labor Statistics month-to-month link relatives. Average weekly earnings of factory workers in New York State and in the United States, Statistics Department, Federal Reserve Bank of New York, Nov. 4, 1921, and correspondence from Carl Snyder. The bank gives monthly chain relatives. These have been averaged for the above annual figures.

⁴ Base shifted to year 1914 by dividing relatives of preceding column by 1.06 ratio obtained by dividing average number of wage earners (census 1914) employed in 1914 by number employed in December, 1914. This assumes that for this short period rates were not appreciably changed and that money earnings varied as employment.

⁵ For December, 1914.

⁶ Figures for these years not from col. D but from last column of Table 167.

⁷ Index number for New York State as reported by Federal Reserve Bank of New York; no data from U. S. Bureau of Labor Statistics.

not taken directly from the official report of the United States Bureau of Labor Statistics, since the bureau does not publish chain relatives of per capita earnings.³ The Federal Reserve Bank of New York City has chained the Bureau's published link relatives for each of the 13 industries which the Bureau of Labor Statistics has reported since 1915, and for all of them combined. We are not, just now, concerned with the Federal reserve bank's chain relatives for the separate industries. The relatives are reported by the bank on the base—December, 1914=100. The bank presents the figures, moreover, by months. These monthly figures have been averaged to obtain annual relatives and the base shifted from December, 1914, to the year 1914.

³ They are reported in the *Labor Review* in the form of "month to month percentages of change in per capita earnings."

This shift has been made by dividing the annual relatives, derived from the bank's monthly relatives, by 1.06: The latter figure is the ratio obtained by dividing the average number of wage earners shown by the census of 1914 to have been employed in that year by the number employed in December, 1914. The use of this division in shifting the base naturally rests upon the assumption that for this short period money earnings vary as employment.⁴

The data of Table 167, for New York, Massachusetts, and Wisconsin, are taken, for the most part, from the *Survey of Current*

TABLE 167.—CONSTRUCTION OF CONSOLIDATED SERIES OF RELATIVES OF PER CAPITA EARNINGS: 1914-1925

YEAR	AVERAGE PER CAPITA EARNINGS RELATIVES ON 1914 BASE ¹				UNWEIGHTED AVERAGE	
	United States ²	New York ³	Massachusetts ³	Wisconsin ³	1914=1.000	Preceding census year =1.000
1914.....	1.000	1.00	1.000	1.00	1.000	1.000
1915.....	1.960	1.03	1.032	1.06	1.021	1.021
1916.....	1.140	1.16	1.166	1.25	1.179	1.179
1917.....	1.350	1.31	1.347	1.40	1.367	1.367
1918.....	1.747	1.88	1.678	1.86	1.791	1.791
1919.....	2.048	1.88	1.908	2.00	1.982	1.000
1920.....	2.458	2.26	2.276	2.54	2.384	1.203
1921.....	2.120	2.06	1.968	2.02	2.042	1.000
1922.....	2.030	2.01	1.966	1.96	1.992	.976
1923.....	2.220	2.18	2.238	2.18	2.205	1.000
1924.....	2.200	2.22	2.107	2.23	2.190	.990
1925.....	2.280	2.27	-----	2.33	2.293	1.040

¹ Massachusetts figures through 1922, based on average yearly earnings. (For construction of 1922 and 1923 indices, see *Survey of Current Business*, May, 1924, p. 169, note 3.)

² As reported by Federal Reserve Bank of New York, United States indices for 1924 and 1925 computed by dividing U. S. Bureau of Labor Statistics annual index of pay-roll totals by its index of employment. *Monthly Labor Review*, January, 1926, p. 157.

³ *Survey of Current Business*, May, 1924, p. 169, and February, 1925, p. 117.

⁴ First quarter of 1915=100 and 1914 assumed as 100.

⁵ Federal reserve bank uses New York data for this year.

⁶ Based on first 11 months of the year.

Business for May, 1924 (p. 169). The figures in the Massachusetts series through 1922 are based upon identical plants as reported through a yearly census. The figures for 1923 and 1924, according to the explanation in the *Survey of Current Business*, are connected to the series by the chain-relative method, representing at least 40 per cent of the firms included in the yearly figures. The United States figures, although described by the Federal Reserve Bank of New York as "average weekly earnings," are not, of course, precisely

⁴ The Federal reserve bank's relatives were taken from the mimeographed report issued on Nov. 4, 1921, by the bank's statistics department under the title "Average Weekly Earnings of Factory Workers in New York State and the United States." This mimeographed report carries the figures only to the end of the year 1921. Figures for the years 1922, 1923, and 1924 were kindly furnished to the writer by Mr. Carl Snyder, of the Federal reserve bank. For 1925 the relatives were derived from the reports of the United States Bureau of Labor Statistics. They are the quotients of the bureau's indexes of pay roll divided by its indexes of employment. The December, 1925, figure was assumed to be the same as November. (*Labor Review*, January, 1926.)

what that phrase might imply. The Bureau of Labor Statistics computes its month to month percentages of change in per capita earnings by dividing the amount paid in wages during some pay-roll period of each month by the number of wage earners on the pay-roll for that same day period. The result, expressed only on a relative basis, is taken by the bureau to indicate, when compared with some preceding or following month, month to month changes in per capita earnings for the period covered. This period, it is to be noted, in some cases is one week and in some cases two weeks, so that the designation used by the United States Bureau of Labor Statistics—"per capita changes in earnings"—is more accurate. The figures for New York and Wisconsin are average weekly earnings computed by dividing the total weekly pay roll by the number of employees on the pay roll. It would be, of course, logically impossible to combine average yearly earnings in Massachusetts with average weekly earnings in other States, if those earnings were expressed in dollar sums. The figures in Table 167, however, are all on a relative basis and there seems to be no reason why the relatives derived from per capita yearly earnings and per capita weekly earnings should not be averaged as they have been in this instance.

The next step is to calculate the intercensal relatives from the money sums reported in the first part of the period and from the single-base relatives reported in latter part of the period. This is done in each case by taking the item for the census year as 1.00 and dividing the absolute sum or index number for each of the years within each intercensal period by the money sum or relative for the preceding census year. The results of these calculations are shown in columns B and E of Table 166 and the last column of Table 167. The last column of Table 166 shows the complete spliced series ready for application to the known amounts of census average wages¹ directly calculated from census data for census years.

ESTIMATION OF AMOUNTS OF INTERCENSAL AVERAGE EARNINGS

The estimation of intercensal mean wage payment amounts is now a simple matter. The census average wage for 1899, for example, for the United States, all industries combined, is \$426; this sum, multiplied by the ratios which have been derived as explained in preceding paragraphs and which are shown in the last column of Table 166, produces corresponding money sums for intercensal years which may be taken as representing the most probable intercensal values corresponding to the amount of the census average wage¹ for census years. From this point on the procedure is in no way different from that which has been explained in preceding chapters. The first

¹ See initial paragraph of Chap. XIII, p. 269.

step being as before the calculation, now for *each year*, of intercensal index numbers upon the 1904 base. The procedure followed is illustrated in Appendix II.

It should be noted that the average wage figure in Appendix II for 1927, although it is for a census year, is not derived from census data as are corresponding earlier figures for census years. The reason is that, at the time of writing, census data are not yet available for the year 1927. The mean-wage-payment estimate for 1927 has been reached, therefore, by applying to the corresponding known sum for 1925 (\$1,280) the ratio of increase shown (by the series of indexes of average wages in the first column) between average per capita earnings for 1925 and 1927. The same procedure, naturally, was followed in estimating corresponding 1927 items for each of the 12 selected industries for which annual series are reported.

INTERCENSAL INTERPOLATIONS FOR 12 SELECTED INDUSTRIES

In the case of the annual series shown for each of the 12 selected industries, the process of interpolating the intercensal values has followed the same general lines as those marked out in the preceding paragraph. Because of the lack of correspondence in the industrial classifications used by the United States Bureau of Labor Statistics and the States of New York, Massachusetts, and Wisconsin, it was decided to let the interpolation of intercensal years, for these industries, for the period 1914-1927 rest entirely upon per capita changes in earnings reported for the 12 industries by the United States Bureau of Labor Statistics. Instead, however, of taking the month to month percentages of change in per capita earnings, reported in the *Monthly Labor Review*, again in this case use has been made of the corresponding chain relatives which the Federal Reserve Bank of New York has calculated from the bureau's link relatives. The Federal reserve bank's chain relatives are shown, by months, on the December, 1914, base. These figures were averaged for annual relatives and the base shifted to the year 1914 in the same manner as described above for all industries combined. The resulting figures are taken as relatives of per capita earnings in the United States for the industries involved. They are then shifted from the single base 1914 and put in the form of intercensal relatives having as base, in the case each year of any given intercensal group, the preceding census year as 1.000. These intercensal indexes are then multiplied by the known "census average wages," already calculated from census data, to form corresponding interpolated "average wages." Relatives are then calculated as before upon the 1914 base and the same procedure followed as in the case of the census year items. The procedure is illustrated by figures of Table 168 which shows for woolen goods the manner of applying the

Federal reserve bank's chain relatives for the interpolation of intercensal "mean-wage payment" sums.

TABLE 168.—ILLUSTRATION OF METHOD OF INTERPOLATION OF INTERCENSAL YEARS, FOR SEPARATE INDUSTRIES

(Woolen and worsted goods)

YEAR	U. S. Bureau of Labor Statistics relatives of per capita earnings, as compiled by Federal Reserve Bank of New York	Inter-censal relatives	Census average wage (inter-censal years interpolated)	Relatives of per capita full-time earnings (1904=100)	Estimated full-time weekly earnings
1904.....			\$388	1.00	\$10.03
1914.....	1.00	1.00	479	1.23	12.33
1915.....	.96	.96	460	1.19	11.94
1918.....	1.20	1.20	575	1.48	14.84
1917.....	1.49	1.49	714	1.84	18.40
1918.....	1.85	1.85	886	2.28	22.87
1919.....	2.08	1.00	1,008	2.60	26.08
1920.....	2.64	1.27	1,280	3.30	33.10
1921.....	2.43	1.00	1,077	2.78	27.88
1922.....	2.35	.97	1,045	2.69	26.98
1923.....	2.64	1.00	1,170	3.02	30.29

The interpolation of intercensal data for the 12 industries for the period 1899-1914 rests entirely upon State data on average yearly earnings. The States whose statistics were drawn upon for this purpose were Massachusetts, Pennsylvania, Connecticut, New Jersey, and Iowa. Not all of these States contributed to each of the 12 industries, and not all of the States are represented by data for the whole 15-year period. It is evident that this part of the intercensal interpolation rests upon a very fragmentary statistical foundation. However, it has seemed adequate for the indication of the most probable intercensal values. The detailed procedure need not be recited, since it is essentially the same as that already described for all industries combined.

CHAPTER XX

THE ESTABLISHMENT AVERAGE WAGE AND THE ESTIMATION OF VARIABILITY

The great bulk of the statistical material presented in the preceding chapters is based in the last analysis upon a single statistical item, which has been called the "census average wage."¹ This average has been discussed elsewhere and the reminder need only be made at this point that it is struck by dividing aggregate wage pay-roll amounts by corresponding aggregates of the average number of wage earners. These aggregates, of course, represent varying numbers of establishments in different industry groups, as well as in different cities, States, and other regional jurisdictions. The fact is to be emphasized that the census average wage¹ is calculated by the process of division above described separately applied to each classification for which it is desired. Take, for example, two establishments in the iron and steel industry in a given city: Each one reports the total amount paid during the year to its wage earners. It also reports the average number of wage earners, an average which is obtained, as heretofore explained, by dividing the number of wage earners on the pay rolls, on or near the 15th of each month, by 12, regardless of the time the plant was in operation. The sum paid to wage earners in establishment A is added to the sum paid to wage earners in establishment B; also the average number of wage earners in establishment A is added to the average number of wage earners in establishment B. If these two were the only concerns in the iron and steel industry in the given city, the census average wage¹ for that industry in that city would be represented by the quotient obtained by dividing the first of the two aggregates, just mentioned, by the second. Evidently, then, it ought to be possible by consulting the original establishment schedules in the archives of the Census Bureau to compute for each one of any group of establishments in any census year the corresponding census average, which may be called an establishment mean-wage payment or an establishment average wage. This item would have for single establishments a significance very similar to that of the corresponding census average wage¹ computed by division of the aggregates shown in the published reports of the Census Bureau.

¹ See initial paragraph of Ch. XIII, p. 269.

THE ESTABLISHMENT AVERAGE WAGE

It is this establishment average wage item upon which we fall back in order to get some idea of certain facts about earnings which are not revealed by the estimated amounts and relatives which constitute the main result of this analysis of the census wage data. These estimated amounts and the corresponding index numbers of changes in those amounts are all derived, as just pointed out, from a single average wage.

The census average wage,¹ in addition to the defects due to the method by which it is calculated, has the shortcomings of any average. Obviously, an average wage or an average amount of earnings is an amount which may not be received by any single person in the group whose wages are averaged. For example, take a concern so small as to be unrepresentative, but which has at least the merit of making the illustration simple: It employs five wage earners whose annual earnings are \$1,000, \$1,400, \$800, \$700, and \$1,040, respectively. The average wage of these five wage earners is \$988. No single one of the five wage earners received \$988, yet the sum \$988 probably gives as faithful an idea as any other single amount would give of the per capita earnings prevailing in this group. Ideally, we would be able to get the most realistic picture of what wage earners actually get by making a complete census in which each wage earner would report the amount he received in earnings during the year, or in which there were taken off from the books of the employer the sums paid to each individual wage earner. Such a task on a census basis would, of course, be impossible. It would require more time and money than the Census Bureau could possibly command. But if such a complete census of individual earnings could be made, it would be possible to construct frequency tables showing the number of wage earners in different groups who received earnings within specified limits. We must content ourselves, however, with the data which are available on the census schedules.

The special inquiry into variability was made in the belief that the establishment average wage derived from the returns on the original establishment schedule might be made the basis for an estimate of the distribution of earnings above and below the average. Obviously, it is very important to know not only what the average wage is, but also, if possible, to get some notion as to what proportion of the wage earners received earnings closely approximating that average and how many wage earners, on the other hand, received earnings vastly higher or lower than that average. In the case cited above, it is evident that the average, \$988, conceals individual earnings ranging from \$700, received by the man who earned the least, up to \$1,400, received by the man who earned the most.

Obviously, the same average might cover a much more complex situation.

Unfortunately, in attempting to make use of original establishment data, in order to get some notion of the range of earnings above and below the average, we still find ourselves obliged to depend upon an average, the same census average wage¹ already referred to so often. At first blush, it would seem that this fact would completely nullify any attempts to get behind the average.

The results attained must certainly be taken with much more caution than if those results had been arrived at by an examination of the sums received by individual wage earners in the different establishments. Despite misgivings, however, the experiment has been made, and it is believed that the results are not without significance. It is further felt that the results probably reflect, with some considerable degree of faithfulness, the degree of concentration of earnings in different industries in the year 1919 and make possible some significant comparisons with earlier estimates of variability.

PROCEDURE IN ANALYSIS OF VARIABILITY

The results are set forth in Chapters X and XI. Their meaning and validity will be more evident, perhaps, after some explanation of the procedure. In the variability inquiry, made primarily for the census year 1919, only the resulting earnings shown for that year are adjusted also to the purchasing power basis appropriate for comparison, respectively, with variability data for 1899 and 1904. The first step in the work was to decide upon geographic and industrial limits for the analysis. The very large number of establishments in the United States seemed to make it inadvisable to try to include all industries or all regions of the country. There were selected, therefore, 20 of the more important of the 41 industries selected for treatment in other parts of this monograph and 8 of the larger cities of the United States; that is to say, only the schedules from establishments in these 20 industries were used, and within these 20 industries, only such establishment schedules were used as came from one or another of the 8 cities. The cities covered in the inquiry are Pittsburgh, Detroit, Cleveland, Chicago,² San Francisco, New York, Boston, and St. Louis; and the selected industries are as follows:

Slaughtering, wholesale, excluding meat packing.	Printing and publishing.
Iron and steel, steel works and rolling mills.	Foundry and machine-shop products.
Automobiles.	Brass, bronze, and copper products.
Cars and general shop construction and repairs for steam railroads.	Furniture.
	Mineral and soda waters.
	Clothing, women's.
	Boots and shoes.

¹ See initial paragraph, Ch. XIII, p. 269.

² The 20 industries were not analyzed separately for Chicago.

Tobacco, cigars and cigarettes.	Lumber and timber.
Glass.	Flour-mill and gristmill products.
Petroleum refining.	Rubber tires and inner tubes.
Agricultural implements.	Cotton goods.
Paper and wood pulp.	

There are in these 20 industries in these 8 cities slightly more than 15,000 establishments and over 523,000 wage earners. We have, therefore, in this sample, about 10 per cent of the establishments and 11 per cent of the employees in the 20 industries in the whole United States and 20 per cent of the establishments and 30 per cent of the employees in all industries in these cities; and about 4 per cent of the establishments and nearly 6 per cent of the employees in all industries in the whole of the United States.

TREATMENT OF THE ESTABLISHMENT SCHEDULE

In the case of each establishment schedule, the following items were drawn off on establishment cards: (1) Days in operation, (2) amount paid to wage earners, and (3) average number of wage earners. A copy of the form of card used for transcribing this information is reproduced below.

<u>City</u>	<u>NEW YORK</u>	<u>Industry No. 255c</u>
(a) Days in operation (Inquiry 7) ^a		
(b) Per cent (a) is of 307.....		
(c) Amount paid wage earners (Inquiry 6) ^a		
(d) Average number of wage earners (Inquiry 5) ^a		
(e) Average full-time earnings (c) ÷ (d).....		
(f) Average actual earnings (b) × (e).....		

^aNumbers of the inquiries in the General Schedules, Census of Manufactures, 1919.

No schedule was used where any of these three items was missing. Because of omissions, not quite all of the establishments in the selected cities and industries, which reported to this census, were included in this analysis. Items *a*, *c*, and *d* are copied from the schedule. The items which constitute the unit in the classified tables and percentile arrays in Part V, and from which the ratios of variation are calculated, are those on lines *e* and *f* of the card. These items represent, respectively, the mean full-time per capita money earnings and the mean actual per capita money earnings for the establishment represented by the card. Item *e*, representing per capita full-time earnings, is obtained by dividing the average number of wage earners (*d*) into the total amount which their employer paid out to them in wages during the year (item *c*). These full-time earnings are deflated in the case of those establishments which worked less than 307 days during the year by multiplying full-time earnings, shown on line *e*,

by the percentage reported on line *b*, it being assumed that 307 days of operation represents full-time employment and that the ratio of actual to full employment is roughly represented by the ratio of the number of days in actual operation to 307.³

After cards were filled in for the 15,000 establishments, which are included in the analysis, the cards for each industry and the city cards for all industries combined were arrayed in the order of increasing amounts of actual earnings. In other words, all of the cards for the women's clothing industry, for example, were sorted with the card showing the least amount of earnings at the top of the pile and with the card representing the establishment, the average wage of which was next larger, next in the pile and so on to the last card in the pack, which represented the establishment in which the amount of average actual earnings per capita was the highest of all establishments in that industry. With the cards thus sorted the item for which they were arrayed, that is to say, the average actual earnings (item *f*) on the card, was transferred to tally sheets and along with this item, and opposite to it, was listed in another column the average number of wage earners in the establishment for which average actual earnings were shown. The same procedure followed for full-time earnings. A sample of the tally sheet used in this analysis is shown in Table 169. The particular tally sheet shown is taken from an array of all of the cards from the automobile industry in the seven cities⁴ in the order of increasing full-time (and, also, actual) earnings. The tally sheet, as indicated in the illustration, contains two sets of arrays, one of which is for average full-time and the other for average actual earnings, the former being obtained in the same way as actual earnings, by arranging the cards according to increasing or decreasing items of average full-time earnings (item *e* on the card), and placing opposite the average full-time earnings item, for each establishment, the average number of wage earners in that establishment. For each of the two sorts of arrays, the one on the left and the one on the right hand side of the tally sheet, two additional columns are provided—one for the number of establishments and one for cumulative percentages of employees. The column headed "Number of establishments" has not been utilized on the tally sheets, each line represents one establishment and there are, therefore, as many establishments as there are lines on the tally sheet or used portion thereof. The cumulative percentages are calculated in the usual fashion, in this case beginning at the bottom of the tally sheet with the highest

³ Both of these assumptions are subject to appreciable margins of error. It is realized also that they are somewhat inconsistent with the theory on which rests the bulk of the analysis in this book. The malpractice, if there is any, is chiefly in connection with this present analysis of variability. Such possible malpractice, however, affects mainly, it is believed, the decil and percentil *amounts* of earnings reported. There seems no ground for believing that it seriously affects the percentage distribution tables showing concentration or the derived ratios of variation.

⁴ Chicago having been omitted.

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AVERAGE WAGE AND VARIABILITY

TABLE 169.—SAMPLE TALLY SHEET (AUTOMOBILE INDUSTRY)

Estab- lishment No.	Decil points in number of wage earners	Average number of wage earners	Cumula- tive per- centage	Average full-time earnings	Estab- lishment No.	Decil points in number of wage earners	Average number of wage earners	Cumula- tive per- centage	Average full-time earnings
1		16.0	100.0	\$635	33	10	149.3	100.0	\$628
2		4.8	100.0	720	1		10.0	99.7	635
3	10	635.0	100.0	818	8		51.6	99.7	678
4		150.0	98.6	833	2		4.8	99.6	729
5		27.1	98.3	856	3		635.0	99.6	818
6		15.5	98.2	955	4		150.0	98.2	833
7		12.0	98.2	1,003	5		27.1	97.9	836
8		51.6	98.2	1,032	6		15.5	97.8	955
9		3.0	98.1	1,032	7		12.0	97.8	996
10		210.0	98.0	1,046	9		3.0	97.8	1,022
11		281.0	97.0	1,059	10		210.0	97.7	1,046
12		164.2	97.0	1,110	23		128.9	97.3	1,047
13									
14		281.8	96.5	1,179	11		281.6	97.0	1,059
15		20.5	95.9	1,189	51		22.5	96.4	1,075
16									
17		40.4	95.8	1,216	12		154.2	96.4	1,110
18		37.4	95.7	1,226	13		78.8	96.0	1,136
19		29.0	95.6	1,248	14		281.8	95.9	1,179
20	9	58.7	95.6	1,316	16		40.4	95.3	1,188
		3,466.2	95.5	1,337	15		20.5	95.2	1,189
21		659.1	88.1	1,342	17		37.4	95.1	1,226
22		70.8	86.7	1,345	21		659.1	95.0	1,228
23		123.4	86.5	1,364	18		29.6	93.6	1,240
24		1,225.8	86.2	1,357	41		369.8	93.5	1,248
25		218.8	83.0	1,378	31		691.7	92.8	1,304
26									
27		124.8	83.2	1,380	19		58.7	91.3	1,307
28		470.6	82.9	1,383	22		79.8	91.2	1,314
29		128.9	81.9	1,391	43	9	1,805.8	91.0	1,326
30		326.3	81.6	1,400	20	8	3,456.2	87.1	1,333
		263.2	80.9	1,417	23		123.4	79.7	1,336
31	8	691.7	80.3	1,425	24		1,225.8	70.5	1,353
32		14.0	78.9	1,425	27		470.6	76.9	1,360
33		140.3	78.8	1,438	25		218.8	75.8	1,378
34					26		124.8	75.4	1,380
35	7	7,033.7	78.4	1,457	30		263.2	75.1	1,385
36									
37		75.8	62.1	1,468	29		326.3	74.5	1,395
38		174.2	61.9	1,493	32		14.0	73.8	1,420
39		30.5	61.5	1,496	35	6-7	7,033.7	73.8	1,424
40	(m) 5-6	0,111.8	61.5	1,499	57		256.2	57.5	1,434
		938.6	48.4	1,523	36		75.8	57.0	1,440
41		360.8	46.4	1,526	52		315.1	56.8	1,453
42		43.8	45.6	1,532	84		60.8	56.1	1,454
43		1,806.8	45.5	1,599	47	(m) 5	5,304.3	56.0	1,456
44	3-4	5,033.2	41.7	1,599	45		7.0	44.7	1,484
		7.0	20.0	1,571	37		174.2	44.7	1,493
46		1,008.1	20.6	1,573	38		20.5	44.3	1,496
47	2	5,304.3	27.5	1,597	42		43.8	44.2	1,497
48		356.3	10.2	1,606	39	4	0,111.8	44.1	1,499
49		1,115.7	15.4	1,622	40	3	938.6	31.1	1,523
50	1	4,735.8	13.0	1,633	44	2	5,033.2	29.1	1,525
51		22.5	2.0	1,650	46		1,008.1	17.0	1,547
52		315.1	2.8	1,690	48		356.3	14.9	1,554
53		34.5	2.2	1,739	56		5.1	14.1	1,573
54		256.5	1.6	1,754	50	1	4,735.8	14.1	1,590
55		147.0	1.2	1,770	49		1,115.7	4.0	1,601
56									
57		5	1.2	1,704	53		34.5	1.6	1,699
58		256.2	1.2	1,827	54		256.5	1.5	1,714
59		198.2	.7	1,947	55		147.0	1.0	1,779
60		98.5	.3	2,030	58		198.2	.7	1,947
		22.1	(1)	2,262	59		98.5	.3	2,023
					60		22.1	(1)	2,240
Total number of wage earners		40,825.8					40,825.8		

1 Less than one-tenth of 1 per cent.

average earnings item and proceeding up the sheet to the smallest earnings item in the group involved. Each cumulative percentage shows the proportion of the total number of persons in the industry or city involved who received earnings as great as or greater than the amount of earnings listed to the right of the cumulative percentage column. More precisely, the cumulative percentages show the proportions of the total number of employees in the industry group or groups or in the specified city or cities who were employed in establishments where the average full-time or average actual earnings were as great as or greater than the amount shown.

The next step is to compress the arrays which show each establishment separately into frequency distribution tables which show by earnings classes the number of establishments and the corresponding number of wage earners employed therein; that is to say, the number of wage earners employed in establishments where the average full-time, or average actual, earnings were between \$1,000 and \$1,099, and the number of establishments in which the average earnings amounts fell between these sums, and so on for other frequency classes shown in the tables in Chapters X and XI.⁵

The array of the 59 automobile establishments shown in Table 169 has been put in graphic form in Figure 2 (p. 37). The graph indicates that most of the very small establishments made average wages which were either extremely high or extremely low. The great bulk of the 47,000 employees of the 59 concerns evidently were employed in a handful of plants in which average wages paid were quite close to the average wage in the median plant.

DEFLATION FOR HISTORICAL COMPARISONS OF VARIABILITY

In reporting the 1919 situation it was not necessary, of course, to deflate earnings on account of changes in the cost of living. It was necessary, however, to do this in order to make any comparison with the results of other inquiries made in 1899 and 1904. This deflation was accomplished by dividing the full-time earnings items, this being the type of earnings used for the purposes of this comparison, by the cost of living coefficient on the 1899 and 1904 bases, respectively. Thus, for the 1899 comparison, the full-time earnings item for each establishment was divided by 2.63; the resulting deflated arrays of earnings amounts were then treated in the same way as the original items—the medians and decils of the new series being spotted and transferred to a comparative table of decils and medians. Also, the number of wage earners within designated limits in the new deflated array were ascertained and put into frequency tables constructed with class limits corresponding to the class limits used in the 1899 and 1904 investigations.⁶

⁵ See also Table 118 and Tables H and I, on pp. 399 to 404.

⁶ See Table 126, p. 249.

The procedure just outlined was actually used only in connection with one of the separate industry groups. For most of the work a short-cut method of accomplishing the same results was followed in the construction of frequency tables for comparison with 1899 and 1904 frequency tables. Each lower class limit (expressed in dollars) was multiplied by the deflation factor proper for the comparison to be made (namely, 2.63 for comparison with 1899 and 2.35 for comparison with 1904). The amount most nearly approximating the product obtained by multiplying the deflated coefficient by each lower class limit was then spotted on the tally sheet and the indicated cumulative percentage opposite that amount on the tally sheet taken off and entered opposite the lower class limit, originally expanded as just described, and so proceeding with each class at the lower limit—taking off the cumulative percentage appearing on the tally sheet opposite the products so obtained and forming in this fashion a series of cumulative percentages of wage earners receiving real wages in terms of the purchasing power of the earlier census years in each of the frequency classes. The class intervals used were obtained by an adjustment of published frequency tables of the census years 1899 and 1904 in such a way as exactly to match in class intervals the arrays used in this present 1919 analysis.

For the purpose of computing the coefficients of variation in the different industry groups, deflation does not need to be resorted to. The coefficient of variation is the percentage of variation, or the ratio of the standard deviation to the average, multiplied by 100. This coefficient was calculated from the frequency tables constructed from the undeflated full-time earnings data of the tally sheet.

CALCULATION OF COEFFICIENTS OF VARIATIONS

The method of calculating the standard deviation (σ) and coefficient of variation (V) is indicated for all of the 20 industries combined in Table 170. The data in the first two columns are taken from Table 118. The formula for the standard deviation (given on page 240 above) is—

$$\sigma = \sqrt{\frac{\sum fd^2}{n} - c^2}$$

The correction for error in assumed average is—

$$c = \frac{\sum fd}{n}$$

So that

$$\sigma = \sqrt{\frac{\sum fd^2}{n} - \left(\frac{\sum fd}{n}\right)^2}$$

Substituting from Table 170

$$\begin{aligned}\sigma &= \sqrt{\frac{9,127,703}{426,989} - \left(\frac{-763,203}{426,989}\right)^2} \\ &= \sqrt{21.3769 - 3.1949} \\ &= 4.264 \text{ (in class interval units).} \\ &= \$426 \text{ in original units.}\end{aligned}$$

Since the coefficient of variation (V) equals

$$\frac{\sigma}{M} \times 100.$$

In this example

$$\begin{aligned}V &= \frac{426}{1272} \times 100 \\ &= 33.52 \text{ per cent.}\end{aligned}$$

TABLE 170.—ILLUSTRATION OF METHOD OF COMPUTATION OF STANDARD DEVIATION FROM DISTRIBUTION OF "ACTUAL" EARNINGS (7 CITIES AND 20 INDUSTRIES COMBINED): 1919

ASSUMED EARNINGS (MIDPOINT OF CLASS INTERVAL)	Number of wage earners ¹	Devia- tion from arbi- trary origin	$fd.$	$f(d.)^2$
	(f)	($d.$)		
\$150.....	3,297	-12	-39,564	474,768
\$350.....	1,616	-11	-17,776	195,536
\$450.....	4,614	-10	-46,140	461,400
\$550.....	12,272	-9	-110,448	994,032
\$650.....	13,690	-8	-109,520	876,160
\$750.....	28,913	-7	-202,391	1,416,737
\$850.....	27,349	-6	-164,094	984,564
\$950.....	26,157	-5	-130,785	653,025
\$1,050.....	30,283	-4	-121,132	484,528
\$1,150.....	25,356	-3	-76,068	228,204
\$1,250.....	34,842	-2	-69,684	139,368
\$1,350.....	46,288	-1	-46,288	46,288
\$1,450.....	59,592	0	0	0
\$1,550.....	41,613	1	41,613	41,613
\$1,650.....	17,983	2	35,966	71,932
\$1,750.....	14,081	3	42,243	126,729
\$1,850.....	10,265	4	41,060	164,240
\$1,950.....	7,015	5	35,075	175,575
\$2,050.....	11,197	6	67,182	403,092
\$2,150.....	2,571	7	17,997	125,979
\$2,250.....	1,852	8	10,816	86,528
\$2,350.....	1,677	9	15,093	135,837
\$2,450.....	1,134	10	11,340	113,400
\$2,550.....	554	11	6,094	67,034
\$2,650.....	876	12	10,512	126,144
\$2,750.....	553	13	7,189	93,457
\$2,850.....	438	14	6,132	85,848
\$2,950.....	201	15	3,015	45,225
\$3,000.....	1,210	16	19,360	309,760
Total.....	426,989	-763,203	9,127,703

¹ From the figures of this and the preceding column is derived a weighted, mean amount of earnings of \$1,272.

Returning again to the tally sheet reproduced in Table 169, it will be seen that after computation of cumulative percentages, it is quite easy to pick out real or full-time earnings in the median concern in the array. Similarly, quartiles and decils can be picked out, and these percentile scales of earnings show not only an average of earnings (namely, the median) but indicate in addition the range of variation of earnings from this average. It is from tally sheets like that of Table 169 that the decil and median items are drawn for the different city and industry groups to form such percentile distributions as are shown in Tables 116 and 117.

LIMITATIONS OF THE STATISTICAL UNIT EMPLOYED

The foregoing explanation of the procedure followed will, perhaps, make somewhat clearer the nature and shortcomings of the statistical unit in the resulting frequency tables and percentile arrays. Certainly there would be no misgivings whatever if the unit in our arrays were the amount of earnings, full-time or actual, received by the individual employees. The unit, however, is actually something very different. The unit which underlies all of the tables which present the result of this analysis of variability is that ubiquitous average which we have called "census average wage."¹ It is very hard to say just how serious a matter this is; the seriousness of it evidently must depend in part upon the range of individual variation represented by each *establishment* average. Whatever validity there may be in the method which we have used would seem to depend upon the truth of the assumption that in a plant where the average earnings are low, the general run of earnings received by its employees must also be proportionately low. Of course, it is not likely to be true that all of the wage earners in an establishment where the average wage payment is \$1,000 received lower earnings than any of the employees in another establishment where that average is \$1,500. Obviously, the ranges covered by the two wage amounts overlap, the lower ranges of individual variation in the establishment having a higher average wage payment overlapping upon the higher individual variations of the establishment having a lower average wage payment. All of this means, of course, that the median item in our arrays are establishment items; and there is perhaps scarcely more than a sporting chance that the median wage earner, if the truth were known, is actually employed in the median establishment. But the notion does not seem entirely grotesque that the probabilities are that the median employee in any group would be found in the establishment making the median wage. The employees receiving the median earnings amount would certainly be much more likely to be employed

¹ See initial paragraph, Ch. XIII, p. 269.

in an establishment in or near the median establishment than they would be likely to be employed in a plant at one or the other of the extremes of the earnings scale. It would be very improbable that the median employee (if he existed) would be employed in an establishment the average of whose wage payments is extraordinarily high. It would seem a fair statement then to say that the distribution of the individual earnings can be roughly shown by the distribution of establishments arrayed according to the size of their average wage payments. How widely different the result would be if it were possible to make the unit in our frequency table or percentile arrays the amount earned by each individual employee it is impossible to say.