Chapter Title: Appendix A: Note on the Measurement of Factory Employm

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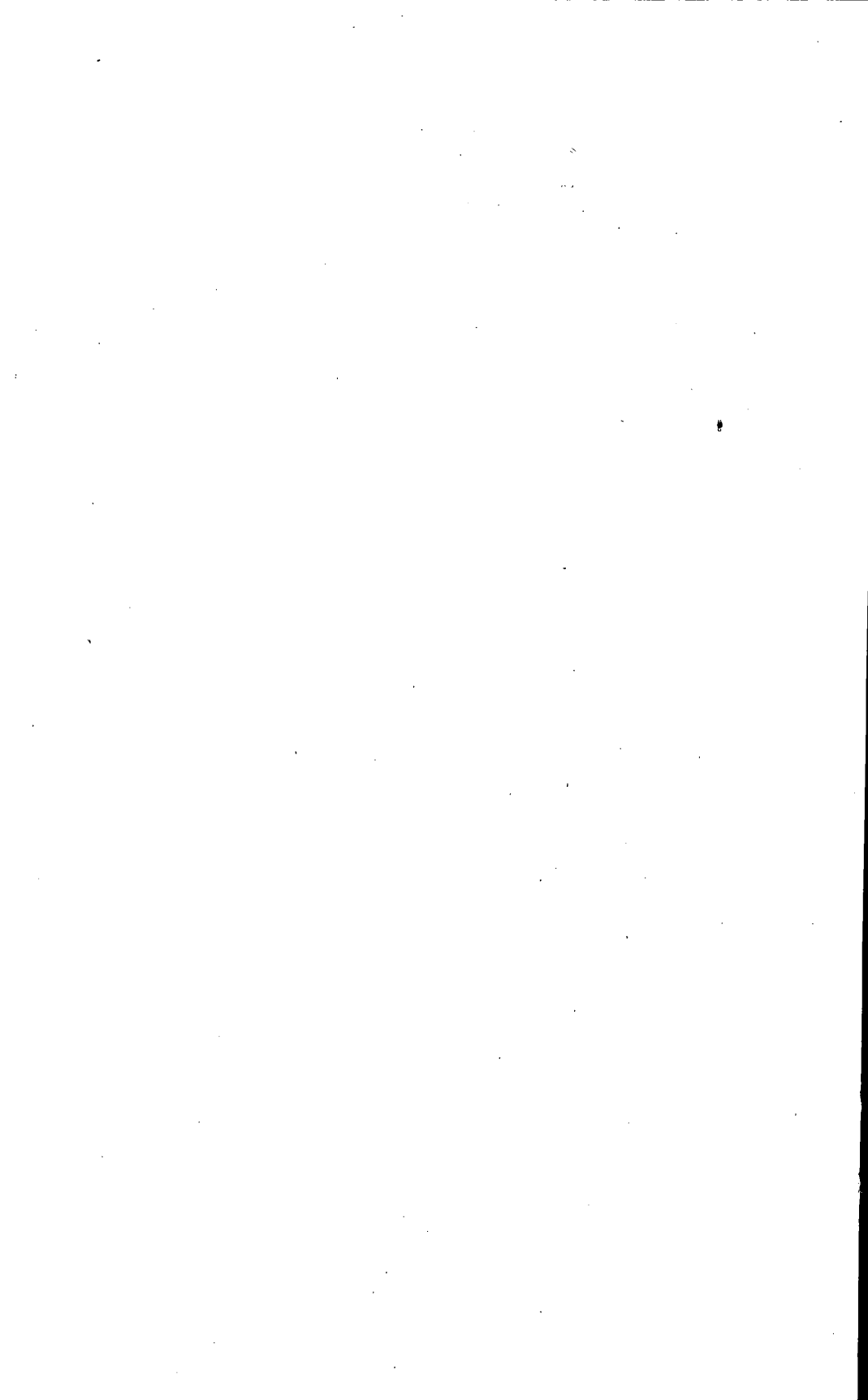
Appendix A

Note on the Measurement of
Factory Employment

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

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

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

[1] National Bureau of Economic Research, 1940.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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